# UHN Division of Nephrology

DIVISION OF NEPHROLOGY

## Housestaff/NP Guidebook

July 2012

# INTRODUCTION

Welcome to Nephrology at the University Health Network. The Division of Nephrology is one of the largest Nephrology programs in Canada, encompassing treatment of Chronic Kidney Disease (CKD) with dialysis and transplantation, general nephrology, subspecialty clinics, teaching and research. There are a large number of active staff nephrologists at the Toronto General, Toronto Western and affiliated hospitals.

Dr. Judith Miller, Division Medical Director
Dr. Joanne Bargman, Medical Director, Peritoneal Dialysis; Education Chair
Dr. Chris Chan, Medical Director, Home Hemodialysis
Dr. Vanita Jassal, Medical Director, TR Hemodialysis, O'Neill Centre Peritoneal Dialysis
Dr. Charmaine Lok, Medical Director, RMC and Hemodialysis Vascular Access Program
Dr. Robert Richardson, Medical Director, Hemodialysis Program

In-patient clinical services consist of a 9 bed In-patient Nephrology Ward, and the Multiorgan Transplant Unit. General Nephrology is carried out through our Consulting Teams. The service is always very busy, therefore requires much organization and co-ordination. This guidebook focuses on your rotation in General Nephrology and is a guide to management of nephrology patients utilizing accepted protocols and useful suggestions.

Outpatient clinical services consist of Home Peritoneal Dialysis (PD), Outpatient Hemodialysis (HD), Home HD, Self-Care HD and Out-patient clinics including an active Renal Management Clinic. Additionally, we have a HD unit at Toronto Rehab (TR) on University Ave., which provides HD for patients in rehab at TR and in chronic care at TR's Bickle Centre facility at Dunn Ave, and we provide PD at O'Neill Centre nursing home. Our Nephrology service covers all UHN sites as well as consultation for Mount Sinai and Women's College Hospitals. The philosophy of care is toward that of Living Well at Home, Self Management, and Home/self-care modalities of dialysis - PD, HD and Nocturnal HD.

During this rotation, you will have exposure to, and learn how to manage many of the following conditions: Acute renal failure; chronic kidney disease and its management; end-stage renal disease; an understanding of dialysis - both HD and PD; hypertensive disorders; renal disorders of pregnancy; tubulointerstitial renal diseases, cystic diseases and other congenital disorders; glomerular and vascular diseases (including the glomerulonephritides, diabetic nephropathy, and atheroembolic disease); disorders of mineral metabolism, including nephrolithiasis and renal osteodystrophy; disorders of fluid, electrolyte, and acid-base regulation; disorders of drug metabolism and renal drug toxicity.

It is hoped that this Guidebook will assist you in the management of your patients and in your learning experience. In an effort continually improve our service; we welcome feedback on this document.

**Guidebook Editor**:
Diane Watson, Nurse Practitioner
diane.watson@uhn.ca
(416) 340-4800 ext 8238

**Contributors:**
Betty Kelman, Nurse Practitioner
UHN Division of Nephrology
UHN Renal Pharmacists
UHN Nephrology Allied Health
Dr. Stephen Vas
Dr. David Mendelssohn

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## In-Patient Nephrology Ward

7CB 340-5330, 14-5330 Fax 340-4102

- Nine Nephrology beds - No in-patient Nephrology at TWH so all Nephrology admissions to TGH
- Off service PD – 7CB pgr (416) 715-9232 or ph 5330. Fax orders to 340-4102

## Medical Coverage

### Red and Blue Teams "Acute Care Teams":

- Acute Care Teams - acute renal related problems, undiagnosed renal failure, or renal pts for various other procedures e.g. biopsy, angioplasty.
- Attending Staffperson - responsible for the team, patients and ITER forms.
- Renal resident/fellow as team leader, co-ordinates the work of the team, assists in teaching, and aware of all pts on team.
- Diane Watson, Nurse Practitioner (NP) ph 8238, pgr 790-7775 to consult on all new dialysis pts and assist with dialysis options, focussing on Home dialysis, out pt HD spots, palliative mgmt.
- On call does consults at TGH, MSH, PMH and Women's College Hospital Covers ward issues in evenings & weekends
- Women's College Hospital has no in-pt medicine beds, thus if necessary, admit to TG under Yellow Team and follow as a consult for Nephro issues.

### Yellow Team "In Patient Ward Team" and TWH Nephrology:

Attending Staffperson, Nurse Practitioner (NP), and 2 Renal Fellows

- Betty Kelman NP. ph 8501, pgr 790-7758 (PD specialist)
- 1 Fellow acts as team leader and is responsible for pts with acute/complex medical issues, and is a medical resource to NP (see Responsibilites p 25).
- NP is responsible for dialysis pts with uncomplicated illness, awaiting placement, rehab, dialysis, vascular access/PD catheter issues, palliative management.
- Individuals in Acute Kidney Injury (AKI) do NOT go to Yellow Team, but are admitted under Medicine with Acute team consult
- May admit from ER between 08:00 to 16:00 for non-life threatening admissions after triaged by On Call MD.
- Transfers from other services or teams must be Staff to Staff, NOT thru NP.
- Staff and second Fellow cover Nephrology consults at TWH.

## Rounds

Refer to Calendar of Weekly Rounds at end of Guidebook

## Sign-In Rounds

- Mon - Fri 08:00 **sharp** 8N-828. To co-ordinate patient care for each day
- Review prev days admissions, consults, dialysis, elective admissions, vascular access issues
- Very short (1 or 2 sentence) summary of admissions, consults and ward problems - focus on major issues and dialysis needs
- Weekends and holidays, meet team in am to plan the day.
- Red and Blue teams to notify Yellow Team of patients potentially needing transfer to In-Patient Nephrology unit. Staff to consult Yellow Team Staff.
- All teams to notify Diane of patients starting dialysis in order to facilitate education re dialysis modality and finding dialysis spots.

## Sign-out Sheets

Very important but succinct communication tool. Assign your name to your patients, document code status, and update sign-outs daily. Avoid using "today, tomorrow" etc. Very short history and update of issues in point form – not necessary to include ALL information and your thoughts, just important data. Document date of pts first HD, PD or CRRT. Identify issues for on-call to follow up on for that night or weekend, then erase once done.

## Patient Centred Care Rounds

Held for Yellow Team each Wednesday 11:00 in 7C Conference Room. To discuss pts medical/social issues and discharge plan.

## Teaching Rounds

Mornings:
**Mon to Thurs 08:30-09:00**, teaching rounds in the 8N-828 conference room following Sign-In. Nephrology Curriculum.
**Fri 08:30-09:30**, Renal Rounds 12NU 1276. In summer, each team presents a topic on a rotating basis. During year, staff and fellows prepare renal rounds.

Afternoons:
**Tues 12:30** Dialysis Journal Club, 8N-828. Critical review of dialysis journal article.

**Wednesday - Astellas Conf Rm 11C 15:00-16:00** Education Rounds.
**16:00-17:00** City Wide Neph Rounds.

**Thursday 16:00-17:00** Renal Biopsy rounds 10 ES-316. It is the responsibility of the team who admitted the patient for biopsy to present the cases and lead discussion. Dr Rohan John, the pathologist will notify Dr. Reich's (3439) office as to which patient to be presented and she will contact the team as early as possible.

## Sign Out Rounds

- In-pts needing follow up and consults to be signed out to the On-Call nightly.
- Weekend signout Friday at 15:00 in the 8N-828 conference room.
- Prepare written sign-out sheets ~6 per team. Be brief on sign-out sheets.
- HD for the weekend and Monday morning should be arranged and HD and PD orders written for your own patients before you leave on Friday.

## Ambulatory Care Clinics

- Housestaff are required to attend an ambulatory care clinic in order to see what is, in fact, the bulk of nephrology care delivery.
- Housestaff will be assigned to a 5 day block for clinic.
- Clinics are held on 12-NU

## On Call

- On-call schedule is posted on the ward and in the residents room.
- There is always Housestaff on first call, renal fellow on back-up, and staff nephrologist on call
- New consult pts remain with the team of junior housestaff on call.
- Person on call is responsible for all in-patients and consults.
- Please date your consults, make your name legible and pager no.
- On-call room 12ES 402 – Don't leave valuables in the room
- On call to ensure that at least 1 HD pt has orders for following a.m. so HD nurse can start before sign-in.

## Confidentiality

Please remember that all patient information is confidential. Shred old sign-out sheets & consult notes (shredder in On Call and Sign-in room). Do NOT discuss patients on elevators or public areas. Do NOT use email for ANY patient info

unless on UHN system or ONE pages (with patients consent). (NEVER utoronto, Hotmail, Yahoo, gmail etc) (UHN email Policy 1.20.010)

## Nephrology Team

## Nursing Staff

- There is a nurse on Nephro assigned to PD each day pgr. 715-9232, ph 5330

## Renal Coordination Office

Evie Porter, RN, MN, C Neph(C) Renal Coordinator - 3588
Maria Mendez, RN, BSc, C Neph (C) Renal Coordinator – 6053
Monica Martin, B.Ed., Clerical – 3056 fax: 4291

- Monitors the flow of renal inpatients and assists NP re: planning and coordination of care, including discharge planning
- Maintains database on patients with AKI
- Assists the Renal Management Clinic.
- Books all urgent and non urgent renal biopsies

## Renal Management Clinic (RMC)

Sharron Izatt, RN, Manager – 2399 pgr 715-4380
Evie Porter, RN, MN, C Neph(C) - 3588
Maria Mendez, RN, BSc, C Neph (C) - 6053
Diane Stoker B.Sc. Secretary - 6389 fax 4291
Clinics Monday, Tuesday ph 2860

- Provides multidisciplinary care for patients diagnosed with CKD Stage 3 - 5. (Including failing kidney transplants and other transplant pts with CKD)
- Educates patients about CKD and treatment options
- Plan for transition to dialysis and/or Live Donor Transplant
- Arranges for dialysis access.
- To refer patient to RMC, fill out RMC referral form and fax along with info to 340-4291
- Patients must be seen as an Outpatient by a Nephrologist for initial workup of CKD before referral to RMC, even if seen as Inpatient consult.
- May not get an appointment for up a month or more, pls ensure they are stable enough to wait, if not, pls have them follow in nephrologists office.

University Health Network

# Renal Management Clinic
# REFERRAL GUIDELINES

## PURPOSE OF THE RENAL MANAGEMENT CLINIC

The Renal Management Clinic is an interdisciplinary clinic dedicated to promoting the health of patients with chronic kidney disease (CKD) and aims to:

- Slow the progression of CKD
- Prevent known related co-morbidities
- Assist patients and their families to adapt to and manage chronic illness through education & psychosocial support
- Plan for & facilitate the smooth transition to dialysis and/or kidney transplantation

**REFERRAL PROCESS**: referral to the clinic must be made by an outpatient nephrologist. Patient's receiving immunosuppressive therapy for GN will be followed in RMC for CKD management along with f/u by referring MD for management of immunosuppressive therapy.

## CRITERIA

1. CKD confirmed by a Nephrologist (i.e. Reversible causes ruled out)
2. Glomerular filtration rate ≤ 30 ml/min*
3. Patient informed of purpose of clinic
4. Patient must reside in UHN catchment area

* When GFR <=30ml/min, referral is mandatory; if GFR between 30-60 ml/min then it is up to the discretion of the referring nephrologist. Referrals will NOT be accepted when GFR < 15 ml/min if known established CKD

## INFORMATION REQUIRED

1. Contact Information Required:
   - ❑ Patient telephone numbers (home, work, mobile, alternate contact)
   - ❑ Home address
   - ❑ Emergency contact (name & telephone)
   - ❑ Family/General Practitioner's name/address/telephone/fax
   - ❑ Referring Specialist's name/address/telephone/fax/billing number
   - ❑ Other name/address/telephone/fax (e.g., transplant, homecare coordinator)
2. Patient Information Required:
   - ❑ Name of patient
   - ❑ OHIP number
   - ❑ Date of birth
   - ❑ Languages spoken
   - ❑ Updated Medical History
3. Current Height (cm) & Weight (kg)
4. Current list of Medications and Allergies
5. 24 hour urine collection for creatinine clearance and proteinuria, completed within 2 months of first appointment.
6. Laboratory results within 1 month of first appointment:
   - ❑ Serum creatinine & urea
   - ❑ Electrolytes
   - ❑ Calcium & phosphorous
   - ❑ PTH
   - ❑ Albumin
   - ❑ CBC
   - ❑ Iron saturation & ferritin
   - ❑ Hemoglobin A1c (if diabetic patient)
7. Other investigations, if done within 1 year of first appointment:
   - ❑ EKG, Chest X-Ray, Echocardiogram

# Renal Management Clinic
# REFERRAL FORM

**Referring Nephrologist:**_____ **Date:**_____

**Patient Name:**_____ **MRN:**_____

## PLEASE CHECK IF COMPLETED:

- ☐ CKD confirmed by a Nephrologist (i.e. Reversible causes ruled out)
- ☐ Glomerular filtration rate ≤ 30 ml/min
- ☐ Patient informed of purpose of clinic
- ☐ Accompanying updated detailed **typed** medical history

**REFERRAL PROCESS**: referral to the clinic must be made by an outpatient nephrologist. Patient's receiving immunosuppressive therapy for GN or transplant will be followed in RMC for CKD management along with f/u by referring MD for management of immunosuppressive therapy.

**Patients will not be accepted into the renal management clinic unless above has been completed**

## INFORMATION REQUIRED

1. **Contact Information**:
   - ☐ Patient telephone numbers (home, work, mobile, alternate contact)
   - ☐ Home address
   - ☐ Emergency contact (name & telephone)
   - ☐ Family/General Practitioner's name/address/telephone/fax
   - ☐ Referring Specialist's name/address/telephone/fax/billing number
   - ☐ Other name/address/telephone/fax (e.g., transplant, homecare coordinator)
2. **Patient Information**:
   - ☐ Name of patient
   - ☐ OHIP number
   - ☐ Date of birth
   - ☐ Languages spoken
   - ☐ Current Height (cm) & Weight (kg)
   - ☐ Current list of Medications and Allergies
   - ☐ 24 hr urine collection for creatinine clearance and proteinuria, completed within 2 months of first appt
3. **Laboratory results** within 1 month of first appointment:
   - ☐ Serum creatinine & urea
   - ☐ Electrolytes
   - ☐ Calcium & phosphorous
   - ☐ PTH
   - ☐ Albumin
   - ☐ CBC
   - ☐ Iron saturation & ferritin
   - ☐ Hemoglobin A1c (if diabetic patient)
4. **Other investigations**, if done within 1 year of first appointment:
   - ☐ EKG, Chest X-Ray, Echocardiogram

Referring Nephrologist's signature: _____

**CONTACT**
**Renal Management Clinic**
Telephone: (416) 340-4800 x6389
Fax: (416) 340-4291

University Health Network
Toronto General Hospital Toronto Western Hospital Princess Margaret Hospital

## Consulting Nurse Practitioner (cNP)

Diane Watson, RN(EC), MSc, C Neph (C) cNP – 8238 pgr 790-7775
Monica Martin, B.Ed., Clerical – 3056 fax: 4291

- cNP provides education/support for pts starting dialysis emergently
- Pls refer ANY new In-pt starting dialysis who will need long term dialysis
- Assists with coordinating out patient HD, PD, NHD, Geriatric rehab.
- Refers patients to outside centres for dialysis near their home
- Assists with and teaches Fellows removal of tunnelled IJ catheters
- Helps with referrals to rehab or placement

## Physiotherapy/Occupational Therapy

Kelly Strong, MSc, PT pgr 719-3903
Tiffany Byndloss PTA/OTA pgr 719-3869
Shiyen Shu, MSc, OT 719-1558

On In-Pt ward, HD, PD units. Physios assist in rehabilitation needs and planning for discharge, or assessing for rehab hospital.

For Out-Patients:

**Outpatient Referrals for Physiotherapy (Exercise Programme in Hemodialysis)**
Order must be written in chart for PT
Coverage for 1st and 2nd shift only, not for 3rd shift (assessment for independent programme on special request)

**Criteria for referral**

- Medically stable, cleared for cardiovascular training
- Cognitively intact – able to follow instructions, capacity for learning & carry over
- Motivated & interested in exercising during dialysis
- On hemodialysis for >3 months

**Contraindications to the exercise program include:**

- Poorly controlled blood pressure – SBP>160, DBP >90, SBP<90, DBP<50
- Uncompensated CHF
- MI within 6 months
- Any other cardiac conditions that contraindicate cardiovascular training
- Recent history of unstable angina
- Cardiac arrythmias, severe valvular disease
- Persistent predialysis hyperkalemia

- Severe renal bone disease
- Fixed musculoskeletal deformities such as paralysis, chronic contractures
- Severe diabetic retinopathy (risk of vitreous bleeding)

.

Requests such as those for low back pain, mobility/safety assessments or return to work should be referred to an out-patient clinic, or CCAC physiotherapy. Requirements for manual therapy & electrotherapy (eg. TENS, Muscle stimulation) cannot be assessed on dialysis. Doctors can write a referral for these, or patients can self-refer for services.

## Renal Pharmacist

Marisa Battistella, Pharm D. In Centre, Home HD: 3207 pgr 790-0793
PD: 6547 pgr 790-7790
Stephanie Ong RMC: 6547 pgr 790-8466

Pt counselling re meds, discharge medication education.
Resource for renal dosing and med issues specific to nephrology.

## Vascular Access Coordinator

Cyndi Bhola RN, MSc C Neph (C) - 3518 790-5320
Sally Franca, Medical Secretary 6993

- Notify Cyndi for vascular access issues – tunnelled central line insertion/removal, permanent vascular access creation or issues.
- Housestaff to enter requests for tunnelled central lines in Electronic Patient Record (EPR): Under Nephrology Order set: Diagnostics → "Abd/Thoracic Angio". Enter comment (reason for insertion/removal/guidewire change).
- Report all insertions/removals/changes/line sepsis to Cyndi at AM rounds.

## PD Catheter Coordinator

Zita Abreu, RN, BScN - 2358

- Notify for PD catheter issues – insertions, removals, manipulations
- She will arrange PD cath insertions - laparascopic, radiologic or surgical

## Hemodialysis Units

Hemo West (HW) - 4072 fax 3084. Hemo East (HE) – 5707 fax 4892.
Home HD 3736 fax 4379
Deloris Bennett, RN, MBA(cand), C Neph (C), HD Manager HW 6049
Denise Williams, RN, MSc, C Neph (C), HD Manager HW 6305
Annellie Cristobal, RN, HD Manager, HE – 6908
Kirsten Lewis, RN, MN(cand) C Neph (C), HD Manager, HE – 8502
Sharron Izatt, RN, Manager, Home HD - 2399
Debra Appleton, RN, MN, C Neph (C), Advanced Practice Nurse Educator – 8726
Vanessa Godfrey, RN, MSc, Advanced Practice Nurse Educator – 2051

- HD Manager or charge nurse to be contacted for all pts requiring HD or any changes for inpatients - attends AM sign-in rounds.
- Use Standing order sheet for HD orders. Orders to be written for the weekend and Mon am, before leaving Friday, and for discharged new HD pts.
- ALL patients starting HD **MUST** have Hgb, Creatinine, Urea, serum bicarbonate, Ca++, phosphate, albumin, PTH bloodwork done PRIOR to first dialysis. (Ontario Renal Reporting System guideline)
- HD schedule for the day reviewed at morning sign-in
- Urgent HD after hours to be discussed with the renal fellow.
- HD requests from other hospitals - call staff Nephrologist on call. Dependant upon status noted in Sign In morning meeting.
- On call HD nurse for emergency dialysis after hours and Sundays through locating (to avoid hemodialysis on Sundays unless urgent.) CVVHD (only at Mount Sinai Hosp) and SLED should only be initiated during the day.

## Toronto Rehab (TR)

Natalie Stanton, RN, MN, HD Charge RN, 597-3422 ext. 3801 fax 977-8719
In-Pt Unit, TR rehab 597-3422 ext 3018. In-Pt Unit, CCC 597-3422 ext 2235
Dr. Vanita Jassal, TR Hemo Nephrologist 3196

TGH runs the HD unit at TR for geriatric patients getting rehab at TR-rehab as well as those who reside at TR-Complex Continuing Care (CCC) on Dunn Ave. Consider rehab for any HD patient >60 yrs if they have had a prolonged hospital stay, are not managing at home, or need to learn energy conserving techniques.

Applications for rehab or CCC are through Social Worker. You would need to do the Dialysis part of the application form for TRI.

There is also a Day Hospital program which patients can attend 2 days per week for those needing some rehab, but not requiring in-hospital rehab.

## Physician Coverage for Hemodialysis

| MWF | Hemo West | Hemo East |
|---|---|---|
| **1** | **Scholey** | **Fenton** |
| **2** | **Pei** | **Reich** |
| **3** | **Richardson** | **Chan** |
| **TTS** | | |
| **1** | **Richardson** | **Lok** |
| **2** | **Lok** | **McQuillan** |
| **3** | **Cherney** | **Bargman** |

## Peritoneal Dialysis Unit

Home Peritoneal Dialysis Unit - HPDU 12ES 5672 fax 4169
Sharron Izatt, Nurse Manager 2399 pgr 715-4380
Zita Abreu, RN BScN, PD access coordinator - 2358

- Peritoneal dialysis (PD) is an excellent choice for chronic dialysis, and all patients should be assessed for ability to carry out PD, even if they require acute dialysis. PD can be started very soon after the PD catheter is inserted, thus can be used acutely.
- PD is available at TW, carried out by staff nurses on 8 Fell (see Peritoneal Dialysis section in this Guidebook).
- All patients on PD need dialysis orders. Pts usual orders may be faxed from the HPDU (or in pm in HPDU chart via Security), but all acute pts need assessment.
- ALL patients starting PD must have Hgb, Creatinine, Urea, serum bicarbonate, Ca++, phosphate, albumin, PTH bloodwork done PRIOR to first dialysis. (Ontario Renal Reporting System guideline)

## Sheppard Centre/Sussex Centre Self Care Dialysis Units

Sheppard Ctr (Sheppard and Yonge)
Ph (416) 223-2013 fax 223-3321

Sussex Centre (Burnamthorpe Rd, Mississauga)
Ph (905) 272-8334 fax (905) 272- 4534
Cathy Fulton, Manager, (416) 223-2013

- Administered from UHN, the Sheppard and Sussex Centre Self Care dialysis units offer self care HD 3x/week or short daily dialysis in a relaxed, quiet, home-like environment.
- Patients come to TGH for clinic follow up, diagnostic tests, medical referrals and for other urgent medical care.

## Nutrition for Renal Patients

**Nephrology Dietitians (RD's)**

Jane Paterson, MSc, RD, Practice Leader & RMC 8591 pgr 719-3600
Karla Dawdy, HBSc, RD (In-Pt, Pre-dialysis & Home HD) 4625 pgr 719-3114
Antonia Drivas, BSc, RD (PD & HD HE) 6530 pgr 790-4519
Christine Nash, MSc(C) RD (PD & HD HE) 6272 pgr 790-4536
Linda Cerullo, RD, (HD HW & Kidney Tx) 4103 pgr 719-3249

The Nephrology Dietitians are available daytime hours Monday – Friday.

When ordering diets: ***Do not order** "Renal Diet" or "Diabetic Renal Diet".
There are 4 Standard Renal diets at UHN to choose from.

Order one of the following Standard Diets:

| Name of Diet | Protein | Phosphorus | Potassium | Salt | Fluid |
|---|---|---|---|---|---|
| *ERI (Early Renal Insufficiency)* | 60g | <40 mmol | Must be added if required | <217mmol | Must be added if required |
| *ESRD Diet (no dialysis)* | 60g | <40 mmol | <60 mmol | <217mmol | Must be added if required |
| *Hemodialysis Diet / IPD Diet* | 80g | <40 mmol | <60 mmol | <217mmol | 700 mL |
| *Peritoneal Dialysis Diet* | 80g | <40 mmol | Must be added if required | <217mmol | Must be added if required |

If a patient requires a **diabetic** diet, order a **No Added Sugar Diet** and write appropriate renal restrictions as listed above.

**For example:** a patient on Hemodialysis with Diabetes, would require the following diet ordered: No added sugar, 80 grams protein, < 40 mmol phosphorus, < 60 mmol potassium, < 217 mmol sodium, < 700 mL fluid

Additional restrictions such as fluid and potassium should be added as required to the standard renal diets. If unsure what diet to order, pls page the inpatient Nephrology RD at 416-719-3114 or leave a message at 4625.

**Inpatient Nephrology RD**
The inpatient Nephro RD will see all pts admitted to TGH who are followed by a UHN Nephrologist. All Nephro Program Inpts are screened and prioritized for care. Please consult the Inpt RD for all new pts to the UHN Nephro Program or for any pertinent nutrition issues, such as dysphagia, prolonged N/V, severe wt loss or gain, wounds, enteral feeding, TPN/IDPN, multiple food allergies or any special nutritional needs for inpatient care.

**Ambulatory Hemodialysis and Peritoneal Dialysis RD**
The Dietitians assess and educate all new HD and PD patients and provide ongoing nutrition intervention/education for abnormal diet-related biochemistry, malnutrition, significant weight loss/gain, high IDWG/fluid overload, GI disturbances, and enteral feeding/IDPN. Please notify the appropriate RD as listed above with any nutrition concerns.

**Pre-dialysis (Non-RMC) RD**
Nutrition counseling appointments are available Tuesday afternoons by referral only for any patient followed by a Nephrologist at UHN or Mt. Sinai. Referrals to be faxed to 416-340-4291.

**Renal Management Clinic (RMC) RD**
All patients are assessed and followed by a Dietitian as part of the Multi-disciplinary team upon referral to the RMC.

## Renal Social Work

Zoe Levitt, MSW, 3618 pgr 719-2876
Melissa Rubin MSW, 6047 pgr 719-3731
Michela Verdirame MSW, 3983 pgr 719-2812
Marla Scipione, MSW, 4768, pgr 719-2668

- Provide pre-dialysis patient and family education, counseling regarding adjustment to illness, treatment decision-making, family concerns, locating and arranging the resources necessary for an appropriate and timely discharge.
- Each Renal SW has a variety of areas of responsibility, please contact appropriate person:

**Michela Verdirame:** Peritoneal Dialysis and Home Hemodialysis. Inpatients belonging to PD and Home Hemo and NEW Nephrology inpatients by last name S – Z.

**Zoe Levitt:** Renal Management clinics. Inpatients belonging to RMC clinics and NEW Nephrology inpatients by last name: A – E

**Marla Scipione** : Hemo West (all days all shifts). Inpatients belonging to Hemo West unit and NEW Nephrology inpatients by last name: F – L

**Melissa Rubin**: Hemo East (all days all shifts). One RMC clinic of Dr. Rory McQuillan. Inpatients belonging to Hemo East unit and McQuillan's RMC clinic. NEW Nephrology inpatients by last name : M- R

## Discharges

- It is imperative that discharges are well planned due to the demand for beds.
- Ensure patients are ready for discharge - Homecare (CCAC) arrangements, particularly if on PD getting assisted PD, transportation for dialysis, discharge orders, and Rx's. New HD pts to have first HD orders written.
- Patients **must be discharged by 11:00 AM**
- Complete on line **Discharge Summary** for all Yellow Team pts. (Found under "Other" tab on Pt care screen). Notify Nephrologist who follows pt.
- Consult teams to prepare paper Discharge Summary to fax to dialysis unit – or bring to morning report, and written HD orders for new patients.
- Discharge summary **MUST** include date of initial dialysis treatment, cause of renal failure, whether or not biopsy proven (where applicable), specify type of diabetes and weight within the 1st month of treatment, also specify any condition that would shorten life expectancy to less than 5 years.
- Communicate with the patient's primary nephrologist/nurse to update about the patient's hospital stay, changes in meds, and discharge plans.

## Renal Education Room

12ES – 401, adjoining the On Call Room. The W.T.W. Clark Renal Education room is named in honor of a former colleague who was the first Nephrologist at TGH and is supported by his friends and Miles Canada. There are reference books and computer programs - “Up to Date”. Computer and Printer for your use – please do NOT try to fix if not working, let Diane know and use other printer.

- Laptop computer and data projector may be booked through Dr. J. Miller's office (4966) for presentations.
- Digital camera may be booked through Diane, 8238.

## Microscope Rooms

- 12 NU clinic. Microscope, centrifuge, slides, sulphasalycilic acid etc to prepare and view urine. Please DISPOSE of urine, slides and pipettes etc., when finished, and keep this room clean for the next person.

- Contact Security for access after hours.

## Bloodwork

- Because Nephrology patients are anemic, order only necessary bloodwork, and remember to cancel orders for repeated BW
- All pts, before starting dialysis or CRRT, must have Hgb, Cr, Urea, CBC, PTH, Ca, $PO_4$, Bicarb, Alb (Ontario Renal Reporting System Guideline)
- Check amount of BW ordered on consult pts and suggest less frequent BW unless clinical decisions rely on it, e.g. INR’s
- Remember, BW such as daily Cr on someone on chronic dialysis is not helpful
- HD pts can have bloodwork drawn in HD unit unless otherwise indicated. This should be specified on the HD Orders. If pt is at Mt Sinai and comes to TGH for dialysis, please order baseline and ongoing BW to be done on EPR in HD.

## Allergies

- Please remember to document allergies on Doctors Orders forms, and check Allergies when ordering medications.

- Renal pts often require alterations in dosing of medications due to renal failure and/or dialysis. Consult renal pharmacist if there are questions re dosing beyond described in this Guidebook
- When admitting a patient, call the appropriate Hemo Unit or HPDU to have them fax medication and dialysis orders.
- Remember to order Aranesp/Eprex and Venofer, HD pts may not include these as meds that they are on, as they are given in HD
- All pts to be vaccinated for Pneumococcus, Influenza, Hepatitis and Tetanus per protocols, documented in HD and PD charts.
- See sections "Common Drugs Used in ESRD" and "Drug Dosing for HD, CAPD and CRRT".

**Ontario Drug Coverage Overview for CKD Patients**

Types of Coverage:
1) Cash
2) 3rd party insurance (through employment, Blue Cross, Liberty Health)
3) Ontario Drug Benefit (ODB)

**Ontario Drug Benefit (ODB) Eligibility**
–65 years old or older
–Receiving services from Home Care (CCAC) program
–Residents of long term care facilities or Homes for Special Care
–Eligible under the Trillium Drug Program
–Receiving benefits from Ont Works, Ont Disability Support Program (ODSB) or social assistance

What is covered?
–Formulary medications - Follow the Ontario Drug Benefit Formulary
–Limited Use Products - Covered when patient meets listed criteria
-Must put Limited Use code on actual prescription
–"Exceptional Access Program" (formerly "Section 8") approved meds (see below)

Exceptional Access Program (formerly "Section 8")
A source of payment that can be applied for when no formulary alternative is available or suitable
–Application requires Individual Clinical Review
–Meds that are not listed in ODB formulary or which fall under limited use criteria
–Physician is making "special request" for coverage
–Guided by DQTC and other expert medical advisers to review individual requests

What do I need to request for Exceptional Access Program review?
–Prescriber's information
–Patient demographics including OHIP number

–Requested drug (generic name, brand name, dosage strength and drug identification number)
–Detailed summary of condition
–If the patient has taken the drug, provide objective evidence of efficacy (lab results, diagnostic tests, culture and sensitivity reports, etc.)
–Additional information regarding previous therapy, contraindications to formulary medications, concomitant drug therapy
–Desired outcome with requested drug

Before I send out a Exceptional Access Program request, Check:
» Is the patient covered by ODB?
» Has the patient tried medications covered by ODB?
» Do I have all the necessary background information to support using this request? (lab results, diagnosis, response to treatment)
- **FAX: (416) 327-8123 or (416) 327-7526**
- **Follow up information** PHONE: 416-327-8109

If in doubt, please page renal pharmacist at 790-7790 or HD pharmacist 790-0793.

## Admissions Policy for Dialysis Patients

### Patient Destination

- These guidelines refer to patients with ESRD who are on some form of chronic renal replacement therapy, or are pre-dialysis, and require in-patient care. ***This does not refer to patients seen on the consult service or those with renal transplantation.***
- The following tables indicate what clinical problems (in the ESRD patient) would be directed toward General Internal Medicine, General Surgery, and Nephrology respectively:
- **N.B. If there is a concern as to which service the patient should be admitted, residents are instructed to contact the STAFF physicians immediately and allow them to make the decision.**

| General Internal Medicine | General Surgery (or appropriate sub-specialty) |
|---|---|
| • Cellulitis | • Abdominal Pain – Surgical Abdomen, peritonitis in non-PD pts |
| • Pneumonia | • Cholecystitis |
| • Pulmonary Embolus | • Gallstone pancreatitis |
| • DVT | • Bowel Obstruction |
| • Unstable Angina | • Unstable GI bleed |
| • Non-Q MI | • Post-operative complications |
| • Cardiac Dysrhythmias (non CCU) | • Arterial thrombosis (vascular service) |

| | |
|---|---|
| • PVD & complications | • Gangrene requiring amputation (vascular service) |
| • TIA/CVA | • Fractures (orthopedic service) |
| • Seizures | |
| • GI Bleed | |
| • Acute Renal Failure | |
| **Nephrology** | |
| Dialysis Access Issues<br>• Creation of access (PD or HD)<br>• Infection<br>• Thrombosis<br>• Radiologic/Surgical Revision<br>• Sepsis related to Access<br>Peritonitis (in PD patients) | |
| Inadequacy of Dialysis | |
| Urgent Dialysis in a Dialysis or pre-dialysis Patient<br>• Volume Overload<br>• Electrolyte Emergency i.e ↑ Potassium | |
| Awaiting out-patient Dialysis spot | |
| Dialysis patients admitted to other services who are palliative, rehabilitating, or awaiting placement to long-term care facility. | |

## Management of HD Patients Referred to Emergency Department (ED) with Dialysis related Issues

This protocol was arrived at between the Depts of Nephrology and of Emergency Medicine to expedite the care of patients who suffer complications **while undergoing hemodialysis (HD)** and are deemed to be in need of assessment. If such a patient is identified in a hemodialysis unit the following should occur:

1. If the patient's condition warrants admission (eg: line sepsis, deterioration in cardiovascular status, decreased LOC, etc), then the Staff Nephrologist or Nephrology Fellow will contact the resident on-call for the appropriate service, depending on the patient's presenting problem (refer to the attached protocol), who will then arrange direct admission to hospital. This may be a Nephrology bed, in the case of dialysis-related issues, or a GIM or Surgical bed, in the case of non-renal issues. In the absence of beds in the appropriate service the patient will then be transported to the ED to be admitted to the appropriate service and consulted on by the Renal Team as needed.

2. If the patient's condition or deterioration in the hemodialysis unit does not immediately demonstrate the need for admission, then it will be the expectation that the Staff or the Fellow will verbally directly communicate with the physician in the ED on-call for that time period, and that individual will communicate the reason for referral to the ED, any pertinent past medical history, as well as the goal of the referral. The name and MRN of the patient will be communicated to the ED physician or the nurse in charge in verbal or written form.

3. Patients referred from the HD Unit are quite complex with respect to their pathology. When they are referred to the ED they often present complex and time consuming diagnostic and therapeutic dilemmas. It will be the expectation that the physicians in the ED can call the resident on-call for the Renal Service and use the Resident's advice in the management of this patient.

4. If a patient is accepted by the Renal service from another institution then the Resident who has accepted the case will communicate this and any other pertinent information to the Charge Nurse verbally. If the department is in a bed crisis, attempts will be made to admit the patient straight to the floor.

Edward Cole, MD, FRCP(C)
Former Director, Division of Nephrology

Greg A. Jakubowski, BSc, MD, CCFP(EM)
Director, Department of Emergency

## Admissions from Toronto Western

There are no in-patient Nephro beds at TW, thus patients coming to TW Emerg must be assessed, and a note written by the Nephro resident on call at TW. If the pt requires a Nephro admission, the TG staff/fellow is to be notified and accept the patient in transfer. If the patient has medical issues, as outlined in the previous table, they would be admitted to the appropriate service at TW and followed in consult by the TW Nephrology resident. HD and CAPD are available at TW.

## New Nephrology Patients

Any patient "new" to Nephrology coming through Emergency should be stabilized and upon discharge, referred to a Nephrologist in their area.

ALL patients starting dialysis (HD or PD) **MUST** have Hgb, Creatinine, Urea, bicarbonate, $Ca^{++}$, phosphate, albumin, PTH bloodwork done PRIOR to first dialysis. (Ontario Renal Reporting System guideline). Specify and document any condition that would shorten life expectancy to less than 5 years.

Notify Diane Watson, NP (14-8238) of patients new to dialysis, likely needing long term dialysis, who require education, dialysis modality options, or an out pt HD spot.

## Responsibilities of the Yellow Team Nephrology Fellows

The Yellow Team consists of Nephrology Fellows and a Nurse Practitioner (NP). One fellow covers Toronto Western (TW) for consults, and another covers Toronto General (TG) in patient nephrology with the NP. Generally, each fellow spends 1 month at each site, for continuity of care. The focus of the TG rotation is to manage chronic dialysis patients with dialysis-related medical issues, such as peritonitis and vascular access problems, and to learn about managing issues such as palliative care in Nephrology. The focus at TW is to provide consultation for ARF, CKD, electrolyte disorders, and care of patients on dialysis requiring other services such as orthopedics and neurology, housed at TW.

**Inpatient (TG) Responsibilities**

- Yellow Team fellow is the Inpatient Nephrology team leader, and the physician ultimately responsible to know about day to day care of <u>all</u> Yellow Team patients including those assigned to the NP.
- Yellow Team fellow reports to Staff Nephrologist.
- Patients are divided between the Fellow and NP according to medical acuity and division of labour. Assign yourself to your patients' names on the White board. Assign yourself to your patients on the Sign-Out sheet in EPR.
- Attend Sign In rounds each morning TG 8NU-828 @ 0800. Be aware of when your patients need dialysis, and ensure that they are scheduled, and orders are written.
- Assess each assigned patient and determine needs – medical, psych/social, physio, nutrition. For dialysis pts, Target weight, dialysis treatment, lab results and meds should be reviewed.
- New admissions assigned to Fellow are to be seen and assessed; and medications, bloodwork etc ordered in EPR by the Fellow.
- For a new admission, call the HD or PD unit for the dialysis orders and medication record, including immunization if needed. Remember that patients may not have Aranesp, Eprex or IV iron written in their own list of medications.
- Advise the patient's usual nephrologist so that they are aware of pts admission.
- A full clinical note should be written for each patient to include history, physical assessment, medication changes, dialysis, plan, consults required and diagnostic tests planned. A short note with updates should be written daily and include assessment and plans.
- Discussions with patients and their families are very important, and if required, you can set up a family meeting for major issues such as code status, disposition etc. As appropriate, family meetings include the staff MD, SW, physios, dietitian and RN's as needed.
- Generally, after Sign in rounds, see all of your assigned patients then meet with NP to review other patients with her, and assist with medical issues.

- Lead rounds with staff nephrologist to review issues and plans for each patient. Be prepared to have evidence-based rationale for treatment plans.
- Update Sign out sheet on EPR each day with plans and salient issues for patient. Be brief. Outline for On Call person any issues that need follow up by them.

**Consults**

When making an elective referral to a consult, call 3155 Locating, to page service and document in the chart the issues to be dealt with.

**Admitting/Transferring Patients**

For bed flow and advice on admitting directly to the floor, speak with Colleen Shelton (Nurse Manager) or Susan Kiernan (PCC) or charge nurse for the day, who will get approval from the appropriate administrative personnel. Please check on the isolation status of the patient before asking for bed in case isolation is required. If a bed is available, you will also have to call Admitting TGH (3921) with pts name, MRN, diagnosis, admitting doctor and bed allocation. Otherwise direct referring team to send patient to ER.

For transfers from other hospitals, centres without dialysis take immediate priority. If a UHN patient is at another hospital with dialysis, can try to arrange transfer as above, only if bed is available. Ensure patient is medically stable for transfer directly to a ward bed.

**Discharging Patients**

It is essential that discharges are well planned and comprehensive so that patients are able to manage and do not require early re-admission. Identify a discharge date well ahead of time, in consultation with patient and family.

Assess patient for issues required for discharge, such as transportation, prescriptions, rehabilitation, dialysis requirements, ambulation. Assess if the patient might need rehab, (and refer to TRI-rehab), or an Alternate level of Care (nursing home or chronic care placement).

When pt is ready for discharge, ensure that the following are in place:
- Prescriptions
- Discharge Summary – helpful to start writing it in EPR on admission and update throughout patients stay. Be sure to review all medications prior to discharge with the assistance of pharmacist, and note any changes or new medications in the Discharge Summary.
- Notification to Dialysis Unit and patients nephrologist (verbal or UHN email) of patient's discharge, and issues to follow up on. New patients to have initial dialysis orders sent to dialysis unit.
- Follow up appointments. Referral letters written and faxed as required.
- Include issues for GP or specific MD to follow up on, in D/C Summary

- Homecare (CCAC) referral if needed, particularly if they need home assistance for PD – at least 24 hrs before planned discharge
- Wheeltrans/transportation to dialysis (if not in place, discuss with family and SW)

**Home Care (CCAC)**

If an individual needs assistance at home, complete CCAC referral on line – at least 24 hrs prior to discharge. Colleen Lee, or other discharge coordinator can assist. Clearly state what assistance is needed, e.g. dressing changes, insulin injections, physiotherapy, personal support worker (PSW) etc. Complete all sections of the form. If an individual needs HomePlus, ie assistance with PD at home, please make sure there is at least 72 hrs lead time, and contact HPDU as well.

**Rehab**

If a patient is unable to ambulate or mobilize with an assistive device, consider rehabilitation at TR-rehab if they are >60, or alternate rehab facility if <60. To arrange rehab, contact physio for an assessment and contact Social worker (SW) to initiate rehab papers. If the patient is on HD, you must fill out the TR Dialysis Service Application paper form, and give to SW.

**ALC Status**

If a patient is declared ALC (alternate level of care), ie. appropriate to transfer to another facility, but awaiting a bed, the MD will have to enter an 'ALC' order in EPR. If an ALC patient becomes acute and cannot be transferred due to medical reasons, put an 'ALC removal order' in EPR.

**Code Status**

It is very important to establish code (CPR, no-CPR) status of our patients. This conversation should be handled with great empathy but present a realistic view and likelihood of survival. Document code status on the Doctors Orders and Sign-out sheet, and document discussion in the Clinical notes.

**CCOT (Critical Care Outreach Team)**

The team is available to review patients who are taking a turn for the worse, e.g. with refractory decreased BP or $O_2$ sats, decreased LOC. They will provide assessment and advice and if pt needs ICU transfer, will recommend and assist with the process. Call through Locating 3155.

**Weekly Interprofessional Patient Centred Care Rounds**

Wednesday at 10:00, 7C-746. Be prepared to give short (1 line) presentation of each patient and current plans. Discuss plans with team members – Physio, Pharmacist, Nutritionist, Social Worker, OT, RN's, Kidney Foundation team member, etc. Focus on what patient needs to have in place for treatment and discharge.

## Friday Sign-out

Bring 6 edited and updated signover forms, to assist staff in knowing status and whom to contact. Review only patients whom you want the weekend team to see or follow up.

## Consult (TW) Fellow Responsibilities

- Present consults at Sign-In at TG 8NU-828 @ 0800. If unable to attend, advise Inpatient Fellow of consults for previous day.
- Review all patients on Signout sheet, updating as required. Meet with Staff at their convenience, to review patients' issues and plans.
- Remember to review meds and bloodwork for each patient and ensure that they are appropriate for renal patients (ie avoid frequent bloodwork and ensure medications are renally dosed and appropriate e.g. Fleet Mineral oil enema instead of Fleet PO4 enema).
- If already a dialysis patient, call their dialysis unit - HD or PD for most recent dialysis orders, medications and history. Remember that patients may not have Aranesp, Eprex or IV iron written in their own list of medications.
- Document renal issues, progress and plans on Clinical notes in patients chart, write Nephrology suggestions on Doctors Order sheets in chart.
- Upon discharge, fill out Nephrology Discharge Summary, and new HD orders and fax to the dialysis unit or bring to Sign-In the following morning and give to appropriate Nurse Manager.
- Communicate with patients' Nephrologist to update about the patient's hospital stay and discharge plans.
- Only CAPD is available at TWH: for ER or In Patients, discuss with the Nurse Manager / Charge Nurse on 8BF 13-5167

# HEMODIALYSIS

Hemo West (HW) Hemo Unit: 4072. Fax 3084
Hemo East (HE) Hemo Unit: 5707 Fax 4892

- Hours 07:30-23:00 Mon-Sat, 3 "shifts" of pts each day.
- On-call nurses cover emergency HD at TG, TW, MSH and PMH after hours and Sundays - reached through locating. Initiation of a new hemo patient, whether acute or chronic must be in consultation with a staff Nephrologist, with a catheter in place and verified radiographically.

## Indications for Hemodialysis:

a) Acute Kidney Injury (AKI)
   - Refractory fluid overload
   - Refractory hyperkalemia or rapidly rising $K^+$
   - Severe metabolic acidosis (pH<7.1)
   - Severe uremia – pericarditis, neuropathy, unexplained decreased LOC
   - Overdose with a dialyzable drug/toxin

b) Chronic Kidney Disease (CKD)
   - Pericarditis or pleuritis (urgent)
   - Progressive uremic encephalopathy or neuropathy with s/s such as confusion, asterixis, myoclonus, wrist or foot drop or seizures (urgent)
   - Clinically significant bleeding diathesis attributable to uremia (urgent)
   - Fluid overload refractory to diuretics
   - Hypertension poorly responsive to antihypertensive medications
   - Persistent metabolic disturbances refractory to medical therapy – hyperkalemia, metabolic acidosis, hypercalcemia, hypocalcemia, hyperphosphatemia.
   - Persistent nausea/vomiting
   - Weight loss or signs of malnutrition.

c) Relative Indications
   - GFR< 15 (CKD Stage 5), esp in elderly and diabetics
   - Anemia refractory to ESA's
   - Persistent pruritis, restless leg syndrome

Up to Date, 2010

ALL patients starting HD must have Hgb, Creatinine, Urea, serum bicarbonate, Ca++, phosphate, albumin, PTH bloodwork done PRIOR to first dialysis. (Ontario Renal Reporting System guideline)

## Ordering Hemodialysis:

- Use "Hemodialysis Orders" Sheet. Write the orders a day ahead if possible. Call the HD unit as soon as you know that an inpatient will require dialysis.
- When ordering medications which need to be given at dialysis, remember to specify "with dialysis" when ordering on computer, or on MD orders.

**Filling out Hemodialysis orders sheet:**

1. "Daily" - all acute or unstable pts, evaluate pt prior to each Rx.
   "Chronic" - stable chronic pts.

2. Dialyzer
   For acutes-order Xenium 210. The standard for chronic HD pts is F80 which is reused using heat reprocessing.

3. Method
   "Conventional" refers to intermittent HD. HD time includes solute removal + ultrafiltration (UF). Can also have isolated UF if pt very volume overloaded - may permit a greater rate of fluid removal with less hemodynamic compromise. Increase dialysis hours until PRU (Percent Reduction of Urea) (adequacy) is >65%

$$PRU = \frac{\text{Pre Urea - Post Urea}}{\text{Pre Urea}} \times 100$$

4. Dialysate
Sodium: standard is 140 mM. May order $Na^+$ "Ramping" for pts with a lot of fluid to remove, - e.g. Na 145 1st hr, 140 2nd hr, 137 3rd hr, 135 4th hr, ordered in consultation with fellow or staff.

Potassium: 1.0, 2.0, 3.0 mmol/L available. Goal is predialysis $K^+$ 4.0-5.5, post dialysis $K^+$ 3-3.5. (to guesstimate: 7 – pt's $K^+$ = dialysate K+). Standard is 2.0.

Calcium: "regular" is 1.5 mM. Also 1.25 and 1.00 mM available for hypercalcemia and 1.75 mM available for hypocalcemia.

Bicarbonate is the standard buffer, generally use 40.

Phosphate: Patients on HD or SLED may develop hypophosphatemia. One way of correcting this is to add Fleet $PO_4$ Enema (concentrated sodium phosphate) to the acid concentrate. 100 mL of Fleet enema contains approximately 175 mmol of phosphate – which gets diluted 1:45 by the dialysis machine.
There are 2 sizes of acid jugs, 5.0 and 4.5 L - determine from the nurse which size is being used:

For 5.0 L acid jugs:

| Amount of Fleet enema | Final Dialysate Concentration |
|---|---|
| 125 mL | 1.0 mmol/L |
| 100 mL | 0.8 mmol/L |
| 50 mL | 0.4 mmol/L |

For 4.5 L acid jugs:

| Amount of Fleet enema | Final Dialysate Concentration |
|---|---|
| 120 mL | 1.0 mmol/L |
| 95 mL | 0.8 mmol/L |
| 47 mL | 0.4 mmol/L |

5. Target weight (TW) and fluid removal.
TW = pt's euvolemic weight at the end of dialysis - ie. no peripheral or pulmonary edema, normal JVP, normal BP, and no s/s ECFV depletion - cramps, dizziness, orthostatic hypotension
Stable patients: establish TW by physical exam with reference to patient's current weight; hemo nurses determine amount of fluid to remove using the predialysis and target weight.
Acute In patients: Inpatients are ill and are often losing flesh weight and require frequent assessment and TW adjustment or they may become hypertensive and volume overloaded. In pts who cannot be weighed, you may prescribe "fluid removal goal" in liters. Pts to be assessed pre and post dialysis to ascertain appropriate fluid removal.

6. Heparinization
Regular heparinization = 1000u bolus and 1000u/hr.
Tight = 0 bolus, 500 u/hr
No heparin = 0 bolus, 0 infusion, N/S flushes or Bioflow - use for patients with bleeding, coagulopathy, pre/post surgery, and HIT+. The risk of tight or no heparinization is dialyser clotting (blood loss). Need to balance risk of bleeding to risk of clotting system.

7. Blood Flow (Qb)

Standard is “Maximize at RN discretion”, up to 400 mL/min Generally slower Qb's for first few runs to avoid dialysis disequilibrium (e.g. 250 mL/min).

8. BP maintenance

Standard is saline; occasionally Albumin 25%. In some ICU pts already on inotropes, dopamine may occasionally be used.

9. Bloodwork

“Monthly Routine” - only for chronic outpts; "other" includes any blood tests to be done before or after dialysis. Blood is taken from the dialysis access, saving a venipuncture. **Only order NECESSARY bloodwork**, as dialysis pts are anemic.

## Other Hemodialysis orders

### Antibiotics

- Some IV antibiotics are to be given post dialysis, and may be given through the dialysis machine, the HD doses are noted in the UHN Guidelines for Antimicrobial use.

### Blood Transfusions

- Blood Transfusions – C&T prior to, and give during HD to allow removal of fluid volume and $K^+$.
- Pts must sign a consent for blood transfusion, explained by and signed by MD, try to get consent for 1 year.

### IV Iron

Either Iron Saccharate or Iron Dextran may be given on HD.

- Dose - IV Iron Sucrose (Venofer) - 100 mg IV with HD x 10 consecutive HD's. Maintenance dose 100 mg IV q1-2 weeks.
- Dose - IV Iron Dextran - Test dose 25 mg IV with HD, with MD present. If no problems, 75 mg IV then 100 mg x next 9 HD's (rarely used).
- Have Benadryl 50 mg, Solumedrol 100 mg & Adrenalin 1:1000 .3-.5 mL on hand.

University Health Network
Toronto General Hospital Toronto Western Hospital Princess Margaret Hospital

# Doctor's Order Sheet

Hemodialysis Unit

## Hemodialysis Orders

Addressograph

PLEASE USE BLACK OR BLUE BALLPOINT PEN, PRESS FIRMLY

**ALLERGIES:**
NO KNOWN ALLERGIES ☐
KNOWN ALLERGIES (Specify) ☐

| PHYSICIAN'S ORDER AND SIGNATURE | SIGNATURE(S) AND POSITION | AC-TION | PHARMACY |
|---|---|---|---|

**(Check ☑ appropriate box(es) and complete orders as required)**

### 1. TREATMENT:

❑ Daily dialysis (acute/unstable in-patients) for_____/_____/_____ (dd / mm / yy)

❑ Chronic dialysis orders _____times per week (Started:_____/_____/_____) (dd / mm / yy)

**Dialyzer:** ❑ Fresenius F80 reuse (Standard) **OR** Other:_____

**Method:** ❑ Conventional dialysis for_____hours **OR**

❑ Ultrafiltration for_____hours, dialysis for_____hours

**Dialysate:**
❑ Na+: 138 mmol/L (Standard) **OR**_____mmol/L

**Na+ Ramping (Mean based on predialysis serum sodium)**
❑ Linear 145 mmol/L to 135 mmol/L (Bellco™ User Profile 1-4 mean 140)
❑ Linear 143 mmol/L to 133 mmol/L (Bellco™ User Profile 1-4 mean 138)
❑ Linear 140mmol/L to 130 mmol/L (Bellco™ User Profile 1-4 mean 135)
❑ Other:_____ (based on average pre-dialysis sodium)

**UF Ramping (Use only with Na Ramping):**
Percentages for hourly fluid removal (modified for variable treatment times)
❑ 40% - 30% - 20% - 10% (Bellco™ User Profile # 3) (standard)
❑ 50% - rest - 30% - rest - 10% - 10% (Bellco™ User Profile # 1)
❑ 50% - 30% - 10% - 10% (Bellco™ User Profile # 2)
❑ Initial 15 minute rest then straight UF (Bellco™ User Profile # 4)
❑ Other:_____

**K+:** ❑ 2.0 mmol/L (Standard) ❑ 1.0 mmol/L ❑ 3.0 mmol/L Other:_____
**Ca++:** ❑ 1.5 mmol/L (Standard) ❑ 1.0 mmol/L ❑ 1.25 mmol/L ❑ 1.75 mmol/L
**Bicarbonate:** ❑ 40 mmol/L (Standard) ❑ 35 mmol/L **OR** ❑ Other:_____mmol/L

**Additives:**_____

**Target weight:**_____kg **OR Fluid Removal Goal:**_____litres.

**Heparinization of Dialysis Circuit:** (1,000 units/ml)
❑ Regular: 1000 units bolus then 1000 units per hour (Standard)
❑ Tight: 500 units bolus then 500 units per hour
❑ No Heparin with normal saline flushes as per RN discretion

**Blood Flow:** ❑ Maximize at R.N. discretion **OR** ❑_____mL/min.
**Blood Pressure maintenance:** ❑ Normal Saline as needed **OR** _____

### 2. LABORATORY TESTS:

**Out-patient Blood Work:** ❑ Monthly Routine **OR** ❑_____
**(DO NOT USE THIS FORM FOR MEDICATIONS OR INPATIENT BLOODWORK)**

Physician's Signature: _____ Date ____/____/____ (dd / mm / yy) Time: _____

D2116

## Dialysis in the ICU and "off-unit" - CRRT

- Patients in the ICU, CCU and Off unit reviewed at AM report
- ICU pts often hemodynamically unstable, with large obligate fluid input, on inotropes, with co-morbid conditions, which complicate their dialysis.
- Conventional HD can worsen hemodynamic instability. CRRT - Continuous Renal Replacement Therapies are slower and gentler than conventional HD.
- ALL patients starting HD must have Hgb, Creat, Urea, bicarbonate, Ca++, $PO_4$, albumin, PTH done PRIOR to first dialysis. (Ontario Renal Reporting System guideline)

## Peritoneal Dialysis

- In pts with intact peritoneal cavities, PD can be excellent in ICU setting.
- Contact General surgery to implant the PD catheter. Dr. Robinette 3855 – fax referral to 4500. Contact Zita 2358 for PD cath insertions.
- ICU nurses carry out the dialysis - CAPD.
- ICU and ER nurses are also certified to initate PD peritonitis protocol.

## Sustained Low Efficiency Dialysis (SLED)

- SLED is used in the MSICU, CCU and CVICU as the first choice for any patient who is a candidate for CRRT. One Hemo nurse can manage 1 or 2 SLED pts simultaneously, and the supplies are far less costly than CVVHD.
- SLED consists of 6 dialysis treatments per week for 8 hrs (Mon – Sat), using a conventional HD machine with standard concentrates, slow Blood pump speed (200 mL/min), slow Dialysate flow (350 mL/min), using Xenium 150 dialyzer.
- Heparin anticoagulation as standard, may also do flushes or Bioflow.
- 1 liter/hour hemofiltration with saline

### Orders for SLED

(**S**ustained **Low E**fficiency **D**ialysis)

| | STANDARD | Options |
|---|---|---|
| Time | 8 h | x |
| Blood pump speed | 200 mL/min | x |
| Dialysate flow | 300-350 l/min | x |
| Anticoagulation | Heparin | Saline flushes |
| Saline hemofiltration | 1-2 L/h | x |
| Dialyzer | Xenium 150 | x |
| Sodium | 140 | x |
| Potassium | 3 | 1,2,3 |
| Calcium | 1.5 | 1.25,1.5,1.75 |
| Bicarbonate | 35 | 30,35,40 |
| Phosphate | 0 | May add to dialysate if Pi < 1.0 mM* |

* Patients on HD or SLED may develop hypophosphatemia. One way of correcting this is to add Fleet $PO_4$ enema (concentrated sodium phosphate) to the acid concentrate. 100 mL of Fleet enema contains approximately 175 mmol of phosphate – which gets diluted 1:45 by the dialysis machine.
There are 2 sizes of acid jugs, 5.0 and 4.5 L - determine from the nurse which size is being used:

For 5.0 L acid jugs:

| Amount of Fleet enema | Final Dialysate Concentration |
|---|---|
| 125 mL | 1.0 mmol/L |
| 100 mL | 0.8 mmol/L |
| 50 mL | 0.4 mmol/L |

For 4.5 L acid jugs:

| Amount of Fleet enema | Final Dialysate Concentration |
|---|---|
| 120 mL | 1.0 mmol/L |
| 95 mL | 0.8 mmol/L |
| 47 mL | 0.4 mmol/L |

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# Doctor's Order Sheet

## Nephrology SLED orders
## Sustained Low Efficiency Dialysis

*Addressograph*

PLEASE USE BLACK OR BLUE BALLPOINT PEN, PRESS FIRMLY

**ALLERGIES:**
NO KNOWN ALLERGIES ☐
KNOWN ALLERGIES (Specify) ☐

| PHYSICIAN'S ORDER AND SIGNATURE | SIGNATURE(S) AND POSITION | ACTION TAKEN | PHARMACY |
|---|---|---|---|

**(Check ☑ appropriate box(es) and complete orders as required)**

### 1. ON ADMISSION:

Start date _____/_____/_____ (dd/mm/yy)
❑ To be continued daily Monday to Saturday. (standard)
❑ To be continued _____days week (between Mon-Sat)

[Sunday/after hours requires shortened SLED orders]
- a daily review of orders is required by Nephrology,
- a newly written Pre-Printed Order sheet is required for ALL changes

### 2. TREATMENTS:

❑ Dialyzer: Xenium 150 **OR** Other: _____

❑ Duration: 8 hours **OR** Other: _____

**Blood Flow:** ❑ 200 mL/min. (standard) **OR** _____ mL/min.

**Dialysate:**

**Flow:** 300/350 mL/min (standard)

❑ $Na^+$ ❑ 140 mmol/L **OR** Other: _____

❑ $K^+$ ❑ 3.0 mmol/L (standard) (with 0.75 mmol Mg) ❑ 4.0 mmol/L (with 0.75 mmol Mg)
**OR** Other: _____
(note: all other options have 0.375 mmol/L Mg.)

❑ $Ca^{++}$ 1.5 mmol/L (standard) **OR** ❑ 1.0 mmol/L ❑ 1.25mmol/L ❑ 1.75 mmol/L

❑ Bicarbonate: 35 mmol/L **OR** Other: _____

❑ Phosphate 0 mmol/L **OR** Add _____mL sodium phosphate (product provided as Fleet® enema to be used as dialysate additive)
(125 mL = approximately 1 mmol/L phosphate once diluted in dialysate bath)

**Heparinization of Dialysis Circuit:** (1,000 units/ml)
❑ Regular: 1000 units bolus then 1000 units per hour
❑ Tight/Low: 500 units bolus then 500 units per hour
❑ No Heparin with normal saline flushes as per RN discretion

**Saline Hemofiltration (pre-filter):** 1 L normal saline / hour
**OR** Other: _____

**Fluid Removal Goal:** _____ L. **OR** Target Weight: _____kg.

**Blood Pressure maintenance:** ❑ Normal Saline as needed (usual bolus 100-200 mL)
**OR** Other: _____

### 3. LABORATORY TESTS

- Creatinine, Sodium, Potassium, Calcium, Phosphate, Bicarbonate, bloodwork daily to ensure this bloodwork is available for assessment prior to SLED setup.

Physician's Signature: _____ Date: _____/_____/_____ (dd/mm/yy) Time: _____

D2980S

Form D-2980S (28/06/2010) **COPIES:** ORIGINAL - RETAIN IN CHART YELLOW - PHARMACY

## Continuous Veno-venous Hemodialysis (CVVHD) or Hemofiltration (CVVHF)

- To be ordered ONLY at Mt Sinai
- Slow dialysis and UF with a pump - not dependent on BP
- Requires only a dual lumen catheter as access
- Requires close nephrology supervision
- ICU nurses set up and monitor the system
- Anticoagulation with citrate

### CVVHD and CVVHF - Guidelines for Doctors Orders

**For all order changes, a new CRRT Doctors Order Sheet must be completely rewritten**. Use Dr. Order sheet for CRRT

**All CRRT orders must be reviewed and reordered at least once weekly by Nephrology.**

**1**. **Modality** :
CVVHD *(Continuous Veno-Venous Hemodialysis).*
CVVHDF *(Continuous Veno-Venous Hemodiafiltration).*
CVVH *(Continuous Veno-Venous Hemofiltration).*
(The standard is CVVHD or CVVHDF)

**2** . **Anticoagulation:**
**Citrate** (regional anticoagulation)

**3. Dialysate Solution**:
Hemosol BO - Either 0 K+ or 4 mmol/L K+

**NOTE: *NEVER* ADD FLEET ENEMA DIRECTLY TO BAGS USED FOR CVVHD AS THIS WILL CAUSE SEVERE HYPERPHOSPHATEMIA. Correct hypophosphatemia parenterally.**

**4**. **Replacement Solutions:** Normal Saline ***or*** **Hemosol BO** .

**5. Flow Rates:**
Blood Flow Rate: 100 mL/min.(usual), or may order other rate.
Ultrafiltration Rate : ____ mL/h. *(consider **ALL** intake excluding replacement solution).* Dialysate Flow Rate: ____ mL/hour *(Standard- 20 mL/kg/* hour). Replacement Flow Rate: ____ mL/h.

## Citrate Anticoagulation

- Citrate is used to anticoagulate the extracorporeal blood circuit during CRRT by binding with calcium, rendering it unavailable to the clotting cascade.
- When the blood returns to the patient, the pts serum calcium mixes with the blood and neutralizes the anticoagulation effect.
- Calcium is administered to the pt to replete calcium stores lost as a result of citrate binding.
- Citrate Anticoagulant Citrate Dextrose Solution USP (ACD) Formula A is supplied in 500 and 1000 mL IV bags by Stores and is ward stock on the Hemo Unit.
- The citrate infusion is administered via infusion pump.

Use "CRRT with Citrate Anticoagulaton ICU" - Doctors Order Sheet

### Indications for Use:

- Citrate is the standard anticoagulant for CRRT at Mt Sinai Hospital.

### Citrate Protocol

Citrate Dextrose Solution USP ACD Formula A in access port @starting rate of 200 mL/h. Titrate per Post-filter Ionized Ca

Calcium Gluconate 24.3g in 1L D5W @ starting rate of 50 mL/h using separate central line. Titrate per Systemic Ionized Ca

Required Bloodwork:

Upon start of treatment: baseline Ionized $Ca^{++}$ post filter and systemic; lytes, bicarb, urea, creat, PO4, Lactate, Mg, alb

During Treatment: Post filter Ionized Ca, Systemic Ionized Ca

- At 1 hour
- Q4h x12 hr then q 12h and prn (if no changes to infusion rates)
- Repeat bloodwork 4 hours after each rate change.

Write order to initiate citrate infusion and the calcium gluconate infusion at specified rates of infusion. Daily evaluation of coagulation status

Nurses have been educated to notify MD for the following circumstances:

- systemic ionized $Ca^{++}$ < 0.75 or as specified with MD's orders
- when citrate rate is >250 mL / hour
- if patient has gross metabolic alkalosis ($HC0_3$ > 35)

**note: Replacement fluid and dialysate fluid are both automatically removed by the machine.**

## Problems with Continual Renal Replacement Therapies

- Requires anticoagulation with heparin. Citrate anticoagulation available (see protocol).
- Nephrology (not the ICU staff) responsible for changing dialysis prescriptions as required.

If you have questions or problems, please contact Dr. Richardson (340-3889 pgr.790-9663) for advice.

# Sliding Scales for Citrate Anticoagulation Infusion Rates

**Citrate Infusion**: Adjust rates as soon as bloodwork results are available,based on normalized Ionized Ca results (corrected to pH 7.4). *(suggested starting rate at 200 mL/h)*

Anticoagulation Citrate Infusion based on post-filter ionized Calcium results:

| **Post –filter Ionized Ca++ (mmol/L)** | **Change Citrate Infusion Rate :** |
|---|---|
| *Use PRISMA Venous Port* | |
| < 0.25 | ↓ present rate by 10 mL/h |
| **0.25-0.35 (target)** | **no change** |
| 0.36-0.45 | ↑ present rate by 10 mL/h |
| > 0.46 | ↑ present rate by 20 mL/h |

→ notify Nephrologist when citrate rate is > 250mL/h

**Central Line Infusion:** Calcium Gluconate 24.3g in 1L D5W *(suggested starting rate at 50 mL/h)*

| **Systemic Ionized Calcium** | **Change Calcium Gluconate Infusion Rate :** |
|---|---|
| *(Use Patient Arterial line)* | |
| < 0.75 mmol/L | ↑present rate by 20 mL/h and notify Nephrologist |
| .75 - .94 | ↑ present rate by 20 mL/h |
| .95-1.10 | ↑ present rate by 10 mL/h |
| **1.11 – 1.20 (target)** | **no change to present rate** |
| >1.20 | ↓ present rate by 10 mL/h |

**Replacement Fluid Infusion:** (0.9% Sodium Chloride usual solution for replacement)

- Start at 0 mL/h at the beginning of treatment and change based on scale below.
- if blood gas **bicarbonate** is **greater that 30 mmol/L**
  - → start replacement at 250 mL/h
  - → after 12 hr, if bicarb still > 30 mmol/L, increase replacement ot 500 mL/h
  - →No further increases without Nephrology order.
- If blood gas bicarbonate is less than 24 mmol/L, stop replacement fluid.
- if serum **sodium** is **greater than 145 mmol/L** with replacement, using a Y connector, hang 1 bag of 0.9% sodium chloride and one bag of 0.45% sodium chloride to run together at equal rates for reinfusion.

**Dialysate solution**: Prism0cal (= Na 140 mmol/L, bicarb 32 mmol/L, K 0 mmol/L, Ca 0 mmol/L). Prism0cal must **always** be used with both calcium and citrate infusions. It must never be used alone.

**Additive**: Add __ mEq/L KCl to a 5 L bag for a final concentration of __ mEq/L

## Vascular Access (VA) For Hemodialysis

### Internal:

AV graft

- Connects artery to a vein using synthetic material (e.g. PTFE - "Impra®"), implanted by surgeon usually in forearm, upper arm or thigh (rarely, chest).
- Can be used ~ 2-4 weeks after surgery; newer grafts using new materials will be able to be used within 24 hours, contact Cyndi to find out what type of graft material it is.
- Should auscultate a bruit and feel a thrill.

AV fistula

- Anastamosis of patients own artery to vein, created by surgeon.
- Requires up to 6 months to mature (average 3 months).
- Should auscultate a bruit and feel a thrill.

Both of these are accessed at HD via large bore needles. The access extremity should be protected and not be used for venipuncture or BP measurements.

- All patients for chronic HD should have permanent vascular access, preferably an AV-fistula or AV graft. Refer directly to VA coordinator (Cyndi Bhola x 3518).
- Will be seen in Vascular Access Clinic and booked for OR
- For OR, complete standing Vascular Access Orders sheet
- Surgeon is responsible for assessing pt and obtaining consent
- Assess diabetic patients for need of orders for IV in non-access arm

### Central Venous Catheters (CVCs):

**Percutaneous**:

- May be placed at the bedside, and is short-term temporary. Used for days (if necessary, weeks).
- Placed using sterile technique in Internal Jugular (IJ) opposite to the side that the surgically created VA will go, or femoral vein
- Tip of IJ catheter sits at the junction of the superior vena cava and the right atrium.
- Use 13-15 cm for IJ CVC (preferably with curved tips for IJ), 20-24 cm for femoral CVC (preferably straight tips for femoral)
- If available, use portable U/S (in Hemo East 5707) to assist insertion
- Instill 4% Citrate to catheter lumen volume (indicated on lumens) post

insertion. If not available from Pharmacy or in Pyxis, use heparin 10,000 units per mL: draw up 5,000 units (0.5 mL) mixed with enough saline to fill the volume indicated on the catheter lumen.

- Temporary IJ catheters must be sutured, with position verified by CXR and documented before use
- Removed by housestaff, fellows and certified hemodialysis nurses or NP's – the date of removal must be reported to Cyndi Bhola during morning report.
- If catheter is slipping out, never push back in. Change over a guide wire.

**Tunnelled:**

We use primarily "CardioMed" and "Hemostar" brands.

Advise patients that these tunnelled catheters, are ONLY TEMPORARY and should be replaced by AV fistula or graft ASAP.

The patient should be informed that a simultaneous surgical consult will be made for creation of an AV-fistula or AV-graft

**In order to request a tunneled CVC insertion, the following are required:**

**1) Referral form**

**2) Call Cyndi Bhola (x3518)**

Cuffed Tunnelled catheter inserted in Angio under fluoroscopy

- Used only until fistula/graft is ready or the patient has exhausted other accesses.

- Change or removal for poor flows and/or infection may require removal by radiology for concurrent fibrin sheath evaluation +/- disruption.
- Entering requests for permanent line insertions and removals in Electronic Patient Record (EPR) as follows: Under Nephrology Order set: Diagnostics → "Abd/Thoracic Angio". Enter comment –reason for insertion/removal.
- Does not need to be X-rayed prior to use (inserted under fluoro).
- Should be capped with 4% Citrate at insertion.

## Polysporin Triple

"Polysporin Triple topical antibiotic protocol" should be ordered for all patients with tunnelled catheters.

## Infection Guidelines for Vascular Access

### Hemodialysis Catheter Infection

- Diagnose type of catheter infection – exit site, tunnel, bacteremia. See Table 1, Definitions of catheter related infections.
- Look for redness, pain, discharge at the exit site or over catheter tunnel, fever (remember not all renal pts will mount a fever), other s/s of sepsis (nausea, vomiting, malaise, hemodynamic instability etc).
- Obtain exit site and/or blood cultures and sensitivities as appropriate to type of infection (Table 1).
- If the patient is inpatient: When obtaining blood cultures, one culture should be obtained from the catheter lumen. A second should be from a peripheral vein, unless not feasible, then, from the extracorporeal circuit. When ordering blood cultures in EPR, indicate "from lumen" or "from circuit" respectively.
- If the patient is in the outpatient dialysis unit, the nurse should obtain blood cultures "as per HDLI protocol" (HDLI=hemodialysis line infection)

If a patient with a catheter develops signs and symptoms of sepsis, do not assume the catheter is the source, RULE OUT other sources of infection.

*Inform Cyndi (x3518), if infection suspected, who will review with Hemodialysis Infection Control Subcommittee (HICS)*.*

See Flowchart: Algorithm for Central Venous Catheter Related Infection

Start empiric antibiotic treatment Protocol:

- Ancef 2 gm IV post each HD, & Tobramycin 2 mg/kg loading then 1mg/kg post each HD until C&S known. If allergic to Ancef, Vancomycin 1 gm loading (or if >80 kg, give 15mg/kg), then 500 mg with each HD

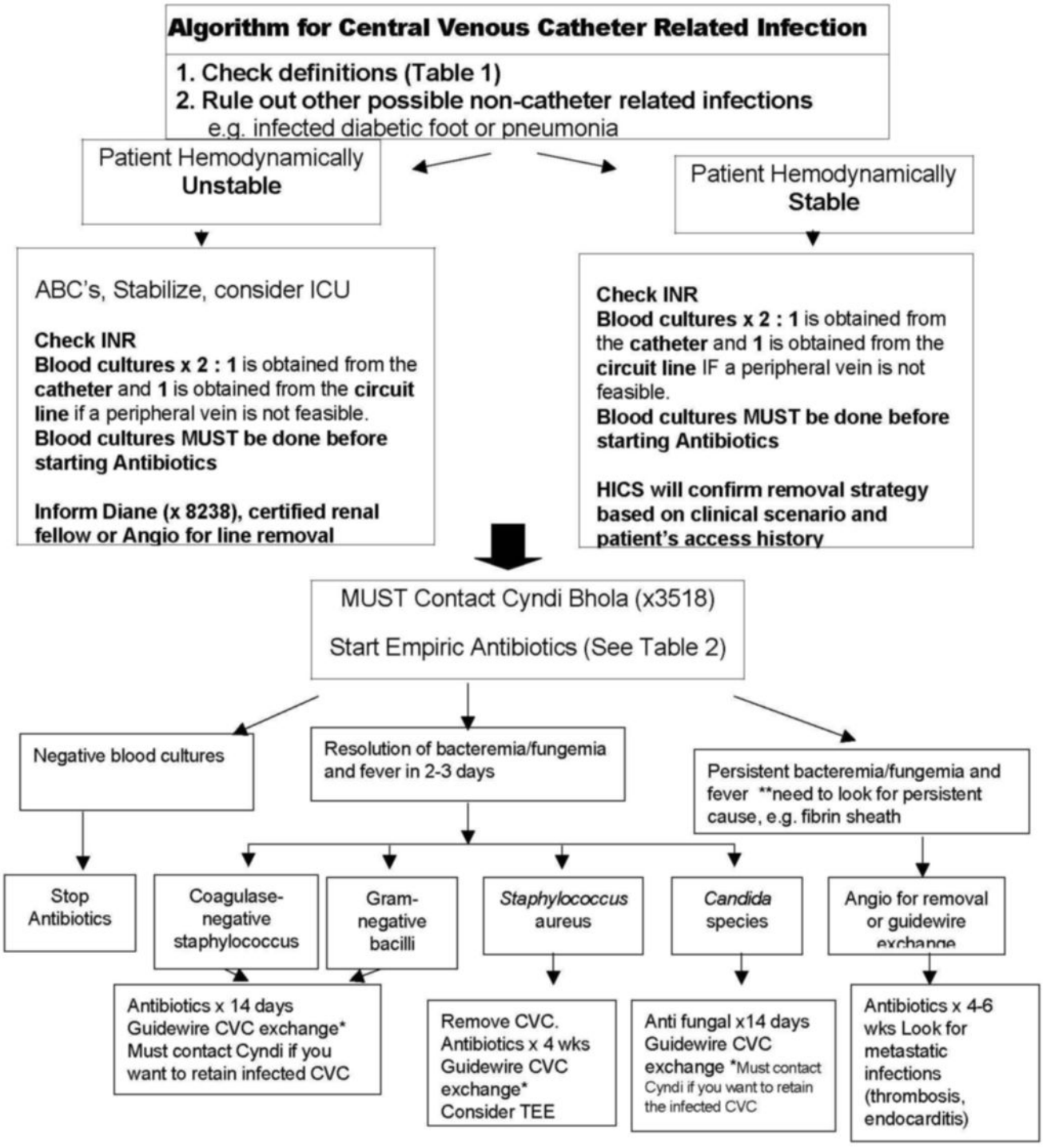
  •For Nocturnal dialysis patients, Ancef 1.5 gm loading dose, then 1gm daily, and Tobramycin 1 mg/kg q $2^{nd}$ HD. If allergic to Ancef, Vancomycin 1 gm IV to start (or if >80 kg, give 15mg/kg), then call Pharmacy (Marisa) x 3207 for dosing

  •Cyndi will arrange CVC removal or guidewire catheter exchange if needed. On weekends and evenings, interventional radiology will perform CVC removal after assessing for and disrupting a fibrin sheath (if present) only if they are already in-house for another reason. Otherwise, Nephro Fellow to do line removal or change of non-tunnelled CVC over wire. If removal, leave catheter out for 48-72 hr before new insertion and inform HICS (x3518)

  •Arrange re-insertion by Angio, put order in computer. Under Nephrology Order set: Diagnostics → "Abd/Thoracic Angio". Enter comment to indicate reason for removal.

***HICS** = **Hemodialysis Infection Control Subcommittee.**

Dr. C. Lok, Nephrologist x 4140
Cyndi Bhola, Dialysis Vascular Access coordinator x 3518 pgr 790-5320
Marisa Battistella, Pharm 3207 pgr 790-0793
Infection Control Practitioner x 4634




*Note: If there is purulence at the ext site or tunnel, you MUST contact **Cyndi (x3518),** guidewire exchange is not allowed

## Table 1. Definitions of Catheter-Related Infections

| Definition | Definite | Probable |
|---|---|---|
| **Exit site infection** | Purulent discharge at exit site<br>or<br>Erythema, tenderness, induration (2 of 3) at exit site with a positive culture of serous discharge | Erythema, tenderness, induration (2 of 3) at exit site without a positive culture of serous discharge<br>or<br>Above without discharge but lack of alternative explanation |
| **Tunnel infection** | Purulent discharge or aspirate from a tunnel or pocket site not contiguous with exit site<br>or<br>Erythema, tenderness, induration (2 of 3) at a tunnel or pocket site not contiguous with exit site with a positive culture of serous discharge or aspirate from that site | Erythema, tenderness, induration (2 of 3) at a tunnel or pocket site not contiguous with exit site and serous discharge or aspirate from that site without a positive culture<br>or<br>Above without discharge but lack of alternative explanation |
| **Catheter-related bacteremia** | Confirmation of septic thrombophlebitis with a single positive blood culture<br>or<br>Single positive blood culture and positive culture of catheter segment with identical organism<br>or<br>≥10 fold colony count difference in blood cultures drawn from device and peripheral blood<br>or<br>Single positive blood culture and positive culture from discharge or aspirate from exit site, tunnel or pocket, with identical organism | 2 or more positive blood cultures with no evidence for source other than the device<br>or<br>Single positive blood culture for *S. aureus* or *Candida* with no evidence for source other than device<br>or<br>Single positive blood culture for coagulase negative *staphylococci, Bacillus, Corynebacterium jeikeium, Enterococcus, Trichophyton* or *Malassezia* in immunocompromised or neutropenic host or in patient receiving total parenteral nutrition with no evidence for source other than a centrally placed device |

Reproduced from Preventing Infections Associated with Indwelling Intravascular Access Devices Health Canada, 1997. Minister of Public Works and Government Services Canada,2002.

## Table 2. Culture and Sensitivity Follow-up

**HICS will provide recommendations if specific concerns. Cyndi x 3518 (or any HICS member) MUST be notified of any suspected access related infections.**

| *Culture results* | *Continue or add, based on sensitivity* | *Discontinue* |
|---|---|---|
| **Coagulase negative staphylococci** | Ancef 2 gm IV q HD x 2 wks. If resistant to Ancef, use Vancomycin 1 g loading (or if >80 kg, give 15mg/kg), then 500 mg q HD for 2 weeks. No Vanco levels are required.<br>For NHD pts, Ancef 1-2 gm IV q HD x 2 wks. If allergic, Vancomycin* 1 gm IV, and call Pharm | Tobramycin |
| **Gram negative** | Tobramycin 2 mg/kg loading then 1mg/kg post HD x 2 wks.<br>For NHD*, Tobramycin 1 mg/kg q 2nd HD x 2 wk | Ancef |
| **S. aureus** | Ancef 2 gm IV with every HD x 4 weeks<br>For NHD, Ancef 1-2 gm IV q HD x 4 wks. If allergic, Vancomycin* 1 gm IV (or if >80 kg, give 15mg/kg),and call Pharm.<br>Note: for all SA, if SBE, treat for 6 weeks. | Tobramycin |
| **MRSA** | Vancomycin* 1 g loading (or if >80 kg, give 15mg/kg), then 500 mg q HD x 4 wks*.<br>For NHD*, Vancomycin* 1 gm IV, call Pharm<br>Note: for all SA, if SBE, treat for 6 weeks. | Ancef<br>Tobramycin |
| **Enterococci** | Vancomycin* 1 g loading (or if >80 kg, give 15mg/kg), then 500 mg with every HD for 2 wks. OR Ampicillin 2 gm q 12 h x 2 wks, and Tobramycin 2 mg/kg loading then 1mg/kg post q HD x 2 wks. | Ancef |
| **Fungus (yeast, candida)** | Fluconazole 400 mg po loading dose, then 200 mg po daily (give post HD on HD days) x 2 wks. Note: po is ~ 100% bioavailable, thus is preferred route. ANY prescription for oral antibiotics given to patient must also be ordered in patient's dialysis order sheet in their chart. Inform Pharm if IV desired (d/t vomiting, inability to swallow) | Ancef<br>Tobramycin |

***Vancomycin/Tobramycin – Consult Marisa x 3207 re: need for drug levels**

| Exit Site Infections | | |
|---|---|---|
| Organism | Treatment based on sensitivities, examples: | Duration |
| Coag neg staph | Septra 1 DS po daily | 7 days |
| Gram Negative | Ciprofloxacin 500 mg po daily | 7 days |
| Staph Aureus | Cloxacillin 500 mg po q 6 hr<br>Or Ancef 2 gm IV q HD | 7 days |
| Fungus | Fluconazole 200 mg po daily | 7 days |

- If not completely resolved in 7 days, call Cyndi (x3518) for further evaluation.

- ANY prescription for oral antibiotics given to patient must also be ordered in patient's dialysis order sheet in their chart.

## AV Graft Infection

*Infection in an AV graft is a **medical emergency**.*

- More common in a graft than in a native AV fistula. AV fistula buttonhole cannulation may be more susceptible to infection.
- Pts with St aureus may become septic within several hours.
- Vancomycin 1 gm IV loading (or if >80 kg, give 15mg/kg), ASAP, then 500 mg IV post HD.
- Stat vascular surgery consult for assessment and possible removal
- Can rarely be treated with prolonged course of antibiotics, but more likely the graft will need to be removed.
- Assess for septic emboli/ metastasis e.g. bacterial endocarditis.

### Suspected HD Vascular Access Infection Report

Patient's name: _____ MRN: _____ Date: _____

□ **NO OTHER SOURCE OF INFECTION FOUND**

□ **Cyndi Bhola 3518** or other member of HICS notified

**Exit site infection**: □ Purulent discharge □ Serous discharge □ Redness □ Tenderness

**Tunnel infection**: □ Purulent discharge □ Serous discharge □ Redness of tunnel

□Tenderness of tunnel

**Bacteremia**: □ Fever >37.7 C □ Rigors during hemodialysis

□ Ensure Cultures sent from : □ Peripheral blood □ Retrograde catheter □ Exit site

**AV Fistula or Graft:** □ Fever >37.7 C □ Rigors □ Purulent or serosanguinous discharge

□ Redness or streaking □ Any discrete suspicious pustule or lesion

Please return this form to Cyndi at morning rounds

This form is kept in the hemodialysis nursing stations

## Thrombosis Guidelines for Vascular Access

### Non-tunnelled Catheters:

- If catheter functions poorly during HD, assess fully, including CXR for proper placement
- Try rotating catheter within the hub. If no improvement, change over guide wire.
- Try pulling back a fraction of a cm, and re-suture – Never push a catheter back in once pulled back.
- May use tPA, w
- May need to insert new CVC in new site – be careful to avoid opposite site to preserve vessels for future fistula/graft creation

### Tunnelled Catheters:

- If poorly functioning, check placement on CXR, if good placement, trial of tPA is reasonable
- Write tPA order (although nursing medical directive)

## Accessing HD Catheters

Catheters should ONLY be accessed for IV or blood sampling under emergency circumstances, as this is the patient's lifeline. Refer to Hemodialysis Manual, under "Departments" in UHN Intranet. (Policy numbers: 18.70.001 Accessing Central Line for Hemodialysis / 18.60.010 Central Venous Line - to Attach an IV / 18.60.011).
To Disconnect a Central Catheter with Heparin/Citrate Policy 18.60.013 Clearing a Thrombus - Hemodialysis rtPA Protocol

To access the catheter, use aseptic technique and have patient supine. Remove gauze, tapes and ensure the clamps are closed. Cleanse with chlorhexidine and place on sterile field. Remove cap, attach sterile 5 mL syringe. Open clamp and withdraw 3-5 mL blood (to remove citrate/heparin). Clamp and remove syringe. Attach 10cc syringe with 5 mL. normal saline, unclamp, and aspirate small amount of blood (to remove any air at catheter tip) then flush in saline. Clamp and remove syringe - attach to IV line.

If drawing blood sample, attach 20 mL syringe, draw out 20 mL blood, set aside with tip on sterile field, attach another syringe, draw appropriate amt of blood, then re-attach 20 mL syringe and return 20 mL of blood. (This serves to ensure

that blood sample does not contain saline, citrate or heparin). Remember to clamp before and after each step.

Catheter should be re-flushed and anticoagulated after use, using citrate/heparin.

### Alteplase (Cathflow®) (tPA)

- tPA may be instilled using aseptic technique per Protocol "To clear an indwelling intravascular catheter with fibrinolytic agent – Cathflow® (rtPA)", Hemodialysis Policy & Procedure Manual.
- tPA provided as alteplase (Cathflow®), reconstituted in pharmacy, provided in syringes
- Clean CVC and ports with chlorhexidine swabs, ensure clamps are closed, and with patient flat, attach empty 5 mL syringe, open clamp and aspirate heparin and/or clots. Clamp CVC and remove syringe.
- Use 1 syringe tPA for each blocked lumen. Attach syringe, open clamp and instill slowly and gently, using push-pull motion until total volume instilled.
- If unable to instill entire contents, leave syringe attached, wait several minutes and try again. This attempt can be repeated several times
- Leave tPA in for at least 1 hour. If still clotted, leave for 2nd hour, if still clotted repeat with another syringe of tPA -leave longer (max overnight) If still no results, arrange CVC change.
- If patency restored, aspirate 3-6 mL blood to assure removal of all drug and clot residue. Flush with 10 mL NS, anticoagulate with citrate 4%.

### Native AV Fistulae:

Usually last for several years and are by far the preferred method of chronic vascular access if mature to function.

- One drawback is that when they thrombose, there is usually no effective treatment unless declotting can occur early (within 24-72 hours).
- Do not usually require admission for thrombosis. Instead, instruct pt to come early for next HD so that a non-tunnelled catheter can be inserted.
- Vascular Access Coordinator, Cyndi – 3518, to be informed so pt is put on the list for creation of a new permanent vascular access.

*The key is prevention of thrombus by adequate blood flow and avoidance of hypotension. Therefore, careful monitoring of target weight and avoidance of hypovolemia is essential*.

## AV Grafts:

- All patients with synthetic AV-grafts should be instructed to take 4 capsules of fish oil/day (1 capsule should contain EPA 400mg and DHA 200 mg) as it has been proven to reduce the rate of thrombosis and interventions
- Thrombosis is not uncommon; patency can usually be resumed by declotting procedure (ideal within 24-72 hours; may still be effective within 5 days)
- Not necessary to admit, but need to contact VA Coordinator Cyndi, 3518 or VA secretary Sally (x6993) to arrange procedure.
- Radiologist will insert catheters and infuse thrombolytic agents to declot graft.
- If radiology back-up is not available, unsuccessful or contra-indicated, contact vascular surgery to perform a thrombectomy. This still needs to be followed by an angiogram and angioplasty. Contact Cyndi will arrange this unless urgently required in evenings or weekends.
- In order to obtain flow studies and Dopplers for AV grafts, call Vascular Lab 3589 to book study and leave a message with Cyndi Bhola to follow up.
- Cyndi must be notified of all access related problems and procedures
- If a patient is an inpatient and needs declotting, order NPO for 4 hr pre-procedure, and IV saline lock on other arm

## Removal of tunnelled cuffed hemodialysis catheter

To be carried out only by Staff, certified Renal Fellow or certified nurse practitioner (Diane Watson). Feel free to call Diane at x 8238, pager 790-7775, for any assistance.

### Supplies:

Minor tray (NOT multi purpose)
# 15 scalpel blade
2% Xylocaine – 10 mL
25 g needle
2 - 10 cc syringes with 18G (red) needles
Dressing for after (Mepore, mefix, tegaderm)
5-8 4x4's (10cm x 10cm gauze sponges)
Suture (3-0) – if not using exit site approach
Chlorhexidine 2% swabs or other appropriate skin cleaner
Gloves – 1 pair non-sterile procedure gloves, 1 pair sterile
Alcohol prep
Steri-strips
Mask

## Procedure:

P.

- Ensure INR is <1.50, no ASA, warfarin x 5 days. Patient to be supine during procedure.
- Explain to pt it takes ~ 45 min, and they will have to stay lying down for ~30 min afterward.
- Put a mask on you and the patient (if the patient cannot lie still or is coughing).
- Prepare tray with scalpel blade, needle, syringes, dressing, 4x4's, suture, steri-strips
- If dressing is in sterile package, open on to tray, if not sterile e.g., Medipore, cut 15cm piece and put on side of table.
- With procedure gloves, remove old dressing and tape from caps.
- Landmark for cuff (NB to landmark as may not feel cuff after Xylocaine). Be aware that Cardiomed catheters once had a double cuff (2 cuffs side by side), palpate to see if you can feel an "extra wide" cuff, and prepare to remove if necessary. Single cuff feels ~1cm, double feels ~2cm wide.
- Scrub hands. Gown and glove.
- Clean skin area from cuff site outwards. Clean external catheter, exit site, catheter clamps and caps. Drape -1 under catheter, 1 covering neck, face – have pt turn head away – they may remove mask at this point.
- Ensure catheter lumens are clamped.
- Insert needle with empty 10 cc syringe into rubber port on cap. Open clamp on that lumen and draw back ~5 mL of citrate (heparin) and blood. (This removes the citrate/heparin and allows lumen to fill with blood in case of accidental puncture of catheter during freezing).
- Clamp lumen and withdraw needle.
- Repeat with other lumen. Set blood filled syringe aside for disposal.
- Fill other 10cc syringe with 10mL Xylocaine then change to small 25g needle for freezing.
- Re-landmark cuff. Freeze skin superficially over cuff, aspirating each time before injecting xylocaine. Freeze superficially either side of cuff. Change angle on needle to $90^{o}$ and enter to the side of the cuff and inject deeper and under the cuff, aspirating each time. Repeat on other side of cuff. Should use adequate freezing, about 8 mL total.
- Prepare tray while allowing freezing to "take".
- Prepare scalpel blade on handle. Prepare suture. Set aside for use 2 curved forceps/hemostats, 2 probes (L shaped hooks), 1 pair scissors, scalpel, thumb forceps.
- Check that area is well anaesthetized.

<u>If cuff is close to exit site (<2.5 cm):</u>

- Approach via exit site with curved forceps/hemostats and blunt dissect cuff from the exit site. It is often helpful to use the L-shaped hooks to work around the cuff. After the cuff is visible, look proximal (to the pt), to identify fibrin-covered catheter beyond the cuff; Remove this fibrin/tissue from the catheter. Try using the gauze as an "abrasive" to remove the fibrous tissue. May have to carefully pinch and tear with the thumb forceps. Do NOT use scalpel when this close to the catheter. Remember that the other end of the catheter is in the person's right atrium, and a small nick could cause a huge bleed, or an air embolus. Use Diane's "crochet hook" technique with the L shaped hook to expedite removal.
- Once the fibrin/tissue is removed around full radius of the catheter, check that catheter slides out easily, by pulling about 2 cm. If it slides easily, have pt take a deep breath hold it. At the same time, apply pressure at IJ site at the neck as well as the catheter exit site

with one hand and steadily remove catheter with the other. Check catheter for clots, fractures.

- Have patient breathe normally. Apply pressure for full 5+ minutes. Apply steri-strips to exit site, or sutures if necessary. Apply modified pressure dressing (roll up gauze and cover tightly with Medipore or Mefix dressing.)
- Have pt remain supine x 20-30 min. Advise re shower technique to keep dressing dry and to remove dressing and steri-strips in 1 week. Tylenol plain or ES is usually sufficient for pain after anaesthesia wears off.
- Document procedure, blood loss, instructions to pt.

<u>If cuff is >2.5 cm from exit site, must make an incision:</u>

- Stretch skin and make fairly shallow incision over (or just to the side of) length of cuff plus ~ ½ cm distal and proximal to cuff. Incision is usually ~ 2-2 ½ cm long. Be sure not to cut catheter.
- With curved forceps/hemostats , blunt dissect tissue to the sides and below cuff, freeing up the cuff. (Usually takes ~ 20+ min).
- If you can, clamp on the cuff full thickness of the catheter to help lift it away. Remove fibrin/tissue from the actual catheter, distal and proximal to the cuff. Try using the gauze as an "abrasive" to remove the fibrous tissue. May have to carefully pinch and tear with the thumb forceps. Do NOT use scalpel when this close to the catheter. Remember that the other end of the catheter is in the person's right atrium, and a small nick could cause a huge bleed, or an air embolus. Use Diane's "crochet hook" technique with the L shaped hook to expedite removal.
- When cuff and distal and proximal catheter is clear, clamp catheter above cuff (proximal to pt). Cut catheter distal to cuff and pull distal portion thru the tunnel. Discard.
- Have pt take a deep breath and hold it. At the same time, apply pressure at IJ site in the neck, as well as incision site with one hand and steadily remove catheter with the other. Check catheter for clots, fractures.
- Apply pressure for full 5+ minutes.
- Suture incision line. Steri strips over exit site. Modified pressure dressing (roll up gauze and cover tightly with Mepore or Mefix dressing.)
- If suspicious of infection, send catheter tip for C&S.
- Have pt wait ~ 30 min before getting up. Advise re. shower technique. Suture removal in 10-14 days. Tylenol plain or ES is usually sufficient for pain after anaesthesia wears off.
- Document procedure, blood loss, instructions to pt.

## Management of Bleeding from HD catheter

Occasionally, a catheter may bleed from the exit site following insertion or trauma. Attempt to effect hemostasis through continued pressure (resisting the urge to "peek") for at least 15 min. It is useful to see if the source of the bleeding can be identified, or whether it is pulsatile. Check INR and stop antiplatelet and anticoagulant agents.

A hemostatic agent may be used around the exit site, or into the tunnel if possible. We do NOT use Thrombostat® due to very high incidence of

anaphylaxis in our unit. Surgicel ®or Kaltostat® may be applied to the exit site, and continued pressure applied. If severe and bleeding does not stop within 30 minutes, consider FFP's. If bleeding cannot be controlled, refer the patient back to Angiography if it was a new catheter, or to vascular surgery, if it was due to trauma.

## Antibiotic Prophylaxis for Hemodialysis Patients

Any HD patient with a central line or PTFE (Impra®) graft **must** have antibiotic prophylaxis prior to any invasive procedure and **any** dental procedure as follows.

### Cystoscopy /GI

Not generally used for upper GI procedures unless suspected liver or gallbladder infection
Amoxicillin 2.0 gm po 1 hour pre procedure
Or
Ampicillin 2.0 gm IM or IV 30 mins pre procedure

If Allergic to Penicillin**:** Clindamycin 600 mg po 1 hr pre procedure or 600 mg IV 30 min pre procedure

### Dental Procedures

- For <u>all</u> dental procedures, including cleaning.

Amoxicillin 2.0 grams po 1 hour pre procedure.
Or Ampicillin 2.0 gm IM or IV 30 mins pre procedure
If allergic to Penicillin: Clindamycin 600 mg po 1 hr pre procedure or 600 mg IV 30 min pre procedure
Or Cephalexin or cefadroxil 2.0 gm po 1 hour pre procedure
Or Azithromycin or clarithromycin 500 mg po 1 hour pre procedure

## Prophylaxis for Contrast (Dye) Allergy

For individuals who have had previous allergy to dye or iodine:

- Prednisone 50 mg 13 hours pre procedure
- Prednisone 50 mg & Benadryl 50 mg 1 hour pre procedure.

## Management of Intoxication

*All poisonings should be managed with the supervision of renal fellow and staff Nephrologist*.

**Hemodialysis**

- For solutes that have low MW, not protein bound, water soluble
- Concurrent: renal failure, acid-base disturbance, electrolyte or volume abnormality correctable by dialysis
- Requires vascular access (ideally 2) and anticoagulation

## Methanol

- Industrial solvent/ windshield washer fluid, antifreeze
- $T_{1/2}$ variable: 12-20 hrs, minmum lethal dose 50-100 mL
- Metabolism – oxidation to 1) formaldehyde and 2) formic acid

Clinical manifestations:
*Early Stage* (< 6 hrs): non-specific, mild or transient: inebriation, drowsiness
*Delayed Stage* (6-30 hrs): Vertigo/N/V abdo pain

- Restless, dyspneic (Kussmaul breathing)
- Blurred vision (papilledema, disc hyperemia)→ blindness
- Seizures, opisthotonus, coma → death
- Lab findings: AGMA, osmolar gap, ↑ formate level, ↑ lactate level, ↑ amylase (pancreatitis)
- Toxic levels: >10mmol/L (50 mg% or 500 mg/L)
  ANY level with anion gap metabolic acidosis
- 4 mL methanol has caused blindness - 15 mL of methanol can be lethal !!!!
- Metabolized by alcohol dehydrogenase - has lower affinity for methanol than ethanol.
- Metabolized into formic acid - causes the large anion gap metabolic acidosis.

- Prognosis dependant on amt of methanol metabolized and determined by the time between ingestion and treatment, the amount of ethanol on board, the degree of acidosis and the extent of the visual disturbance.
- Diagnosis is usually made by history and biochemical landmarks. An anion gap metabolic acidosis with an osmolar gap between measured and calculated osmolality is classic (calculated osmolality = Na x 2 + urea + glucose). The difference represents the mosmoles of methanol and can be used to guess the level until levels are available.

**Management**

- Hemodialysis and Ethanol
- Ethanol is given as an antidote - orally or by IV. Aim for a blood level of 100 mg% (20-25 mmol/L). The alcohols are distributed across total body water.
- Oral Ethanol
- Loading dose of 40 gm ethanol. (Absolute (95%) ethanol has SG of 0.8 gm/mL.) This works out to 50 mL of absolute ethanol or 120 mL of 40% ethanol e.g. scotch. Maintenance dose -12 mL of absolute or 30 mL (1 oz) of whisky per hour with frequent measurements to ensure levels as above.

IV Ethanol

- Begin with IV bolus of 0.5 gm ethanol/ Kg
- Aim for plasma ethanol concentration of 20-25 mmol/L
- **NOTE**: Must be diluted to a 15% solution or less to be non toxic. Mix 72 mL absolute ethanol in 500 mL D5W or NS to give a solution of 10 gm/100 mL i.e. 100 gm/L. A 70 Kg man gets 350 mL of this solution or 35 gm. This is followed by a maintenance of 10 gm (100 mL) per hour. Continue infusion even if dialysis is in progress to make up for metabolized ethanol.

Fomepizole

- For acute management of methanol or ethylene glycol intoxication at peripheral hospital until pt is stable for transport (very costly)
- Not for routine use at UHN, extremely costly (available from Sick Kids Hosp)
- Used at Mt Sinai Hosp.
- Used instead of Ethanol to inhibit alcohol dehydrogenase, thus NO Ethanol to be added to the dialysate or given IV if Fomepizole used.

Hemodialysis

- Hemodialysis indicated for serum methanol levels > 10 mmol/L, or even at lower levels if anion gap metabolic acidosis is present.
- Insert 2 catheters – in separate venous sites, order Xenium 210 dialyzer and dialyze at Qb of 300 or more
- Dialysis nurse to add ethanol to dialysate 320 mL of absolute ethanol (95%) to 5L of acid concentrate (this is to avoid blood ethanol from being dialyzed out).
- DO **NOT** use Heparin for Methanol Intoxication (reports of brain hemorrhages from methanol), order “Bioflow”.
- Order appropriate K dialysate (usually 3K if patient not in renal failure)
- Dialysis often needed for > 10 hours. Change dialyzer q 6 hr.
- Continue to dialyze to methanol level < 5 mmol/L. By the time this result is back, actual level will be lower. D/C dialysis and send final methanol level.
- PD is less effective but may be of some use in those who cannot be hemodialyzed. Add ethanol to the PD fluid.

- Follow ethanol and methanol blood levels q 3-4 hourly with the aid of a chart.

## Ethylene Glycol

- Component of antifreeze and solvents. Dialysis indicated for level > 6 mmol/L or lower levels with anion gap met acidosis
- $T_{1/2}$ is 3 hours
- Lethal dose ~ 100 mL.
- S/S - neurological– drunkenness to coma, tachypnea, pulmonary edema, flank pain and RF
- Classically, but not always, crystalluria (needle shaped or envelope shaped crystals)
- Management is same as methanol intoxication, i.e. ethanol + dialysis.

## Lithium

- Therapeutic range: 0.4-1.3 mEq/L
- Toxic manifestations may appear >1.5 mEq/L
- Clinical manifestations:
- *Acute intoxication*: N/V, neuromuscular irritability, coarse tremor, ataxia, slurred speech, confusion, fever, stupor, coma, CV collapse
- *Chronic intoxication:* polyuria & NDI, renal acidification defects, CIN, thyromegaly
- Lab manifestations: leukocytosis; ECG: flattened T's, AV blocks, QT prolongation

**Management**

- Well hemodialyzable
- Hemodialysis for 8-12 hours
  Indications: Li level > 3.5 mEq/L
  Li level >2.5 mEq/L if symptomatic or renal insufficiency
  Goal: sustained level 1 meq/L 8 hrs post HD
- Dialyze 8-12 hours and monitor post plasma Li levels q4h for 36 hours
- Monitor for post HD rebound as slow equilibration between extra and intracellular lithium May require repeated HD treatments

## Salicylates

- ASA, Aspirin, oil of wintergreen (topically or ingested. 5 mL oil of wintergreen = 7000 mg salicylate or 21.5 adult aspirins)

- Minimum lethal dose 10 g ASA; levels useful 6 hrs post ingestion
- Acute ingestion: 1 tab/kg = severe (1 tab = 325 mg)
- Metabolism – ASA hydrolyzed to salicylic acid → glycinated to salicyluric acid in liver→ excreted via kidneys; urine pH > 7.0 enhances excretion

Clinical manifestations

- *Chronic ingesters:* HA, tinnitus, ↓hearing, dizziness, weakness, N/V, ↑RR, confusion
- *Acute/severe intoxications*: above + fever, seizures, coma, ARDS

Acid base disturbances:

- Respiratory alkalosis → resp alk + AG metabolic acidosis → metabolic acidosis

**Management**

- Systemic and urine alkalinzation urine: goal urine PH >7.5
- Hemodialysis

  Indications: Salicylate level > 7 mmol/L
  Seizures/coma
  Severe metabolic acidosis, esp. with RF
  Non-cardiogenic pulmonary edema
  Esp if elderly, smoker, acute on chronic ingestion

**Poison Control** Telephone Number: (416) 813-5900

References:

AKF Nephrology Letter 10:1-20, 1993
Brady & Wilcox. Therapy in Nephrology & Hypertension, 2003. Chapter 89, pg 675-680
Washington Manual

# PERITONEAL DIALYSIS

## Home Peritoneal Dialysis Unit

Home Peritoneal Dialysis Unit (HPDU) 12ES ph. 5672
For PD training, clinics and out pt PD issues. Open Mon-Sat except Dec. 25 & Jan. 1. After hours On Call RN pgr 715-1326 or through locating 340-3155.

## Ordering Peritoneal Dialysis

- Use orders as appropriate to the type of PD (see Peritoneal Dialysis Prescriptions section)
- TGH, PMH, MSH: For ER or In Patients, call 5330 or pgr 715-9232 to notify PD nurse that the patient will need PD
    - Acute cycler dialysis may be done at TG Emerg for fluid volume overload, hyperkalemia or any situation requiring frequent PD exchanges. Cycler and CAPD available.
- TWH: for ER or In Patients, discuss with the Nurse Manager/Charge Nurse on 8BF 13-5167 NOTE: **** Only CAPD is available at TW****

ALL patients starting PD must have Hgb, Creat, Urea, bicarbonate, Ca++, $PO_4$, albumin, PTH done PRIOR to first dialysis. (Ontario Renal Reporting System guideline)

## Medical Coverage

Mon -Fri Daytime
The Home Dialysis resident is expected to see IPD patients by noon each day to assess pts, address concerns, and write orders. An admission note and PD orders are to be written for all new PD patients in HPDU to include TW, med, and diet, and weekly progress note.
The nephro trainee should determine a morning and afternoon check-in time with HPDU and allow at least one hour each visit to discuss with the HPDU charge nurse the training patients' concerns, drop-in pts and peritonitis review. Outside of the designated visit times, the nurses will page the renal nephrology trainee for urgent or unexpected needs.
After hours and Saturdays

The nephrology trainee assigned to TWH consults to be available for the HPDU nurse on call and to see drop-in patients on Saturday. He/she should come at the beginning of the shift before going to TWH.

## Responsibilities of the Nephrology trainee

### HPDU

- **IPD patients** Assess each patient on IPD by noon. Target weight, dialysis treatment, lab results and meds should be reviewed. Check patient schedule at HPDU reception desk. On the patients' first IPD session, out patient admission orders should be written. These orders should include target weight, frequency and volume of exchanges, medications, investigations, insulin orders for diabetics, etc.
- A clinical note should be written **once weekly** for each patient.
- **Phone calls:** During the day the nurse receives and triages all phone problems and calls the nephro trainee as needed for advice. As much as possible, she will wait for the designated time for the nephro trainee to visit the unit to assess the issues. After hours, the on call nurse is required to call the nephro trainee on call when medical advice and/or a doctor's order is needed.
- **Peritonitis:** The office nurse monitors each case of peritonitis and assesses the patients' symptoms and medications. Cases are reviewed daily with MD.
- **Lab-Data Review:** The PD nephrology trainee should review all lab data and reports as advised by the charge nurse.
- **Drop-Ins:** Some drop-ins are expected and patients are advised to arrive at the time the nephrology trainee is expected to come to HPDU. For urgent drop-ins, the nurse may call the nephrology trainee to assess the patient.
- **Training Patients:** Each diabetic requires assessment and orders written during the first training day. Non-diabetic patients can wait until the second training day unless the training nurse has concerns. Training patients should be assessed every few days by the PD nephrology trainee while in training or more often as assessed by the triaging nurse. Patients scheduled for training require orders.

### Unit Routines

Baseline "admission" bloodwork is automatically done when a new PD patient enters the program. This is usually done during the IPD period, or on the first training day in HPDU. Other "routine" blood work is performed at each clinic visit (every 4-8 weeks), while some blood tests are performed every 3 or 6 months. Other baseline investigations include:

- Abdominal ultrasound
- Chest X-Ray
- 2D Echo
- ECG

These tests are typically carried out prior to the first clinic appointment post Home PD training. Patients who request transplant referral are seen by the HPDU ward clerk, to begin the baseline workup tests and make an appointment at the Transplant Assessment Office.

### Writing Orders

All changes in therapy including the dialysis prescription, new medications and diagnostic tests should be written in the order section to inform everyone what has been done for the patient (i.e. even when a verbal order has been carried out). Diagnostic tests and bloodwork should be entered in Electronic Patient Record (EPR). A progress note should be written whenever there is any new prescription or significant intercurrent illness. New medications or changes in meds are recorded in the medication sheet by the primary nurse or nurse transcribing the order. Leave the yellow copy of all prescriptions with the chart for filing.

**Patients Requiring Referral to Another Service**

When you make an elective referral to a consult you must send a written referral letter (this is a legal requirement) detailing the problem to be assessed.

## Peritoneal Dialysis Prescriptions

For all PD prescriptions, volume & frequency of exchanges, additives and Target Weight (TW) need to be ordered. Specify the TW as "full" or "drained" weight. "Target weight (full)" includes the instilled volume of fluid. An "exchange" includes the fill, dwell and drain time of a specified volume. Individual patient prescriptions and documentation are available from HPDU 12 ES (5672) daily from 0800 to 1545.

### CAPD (Continuous Ambulatory Peritoneal Dialysis)

**AM I___I___I___I_____ PM**

- 4 – 5 exchanges/ day with long dwell overnight.
- Dwell times average 4 – 6 hours during day and 8 – 10 hours overnight.
- TW includes the volume of the exchange.
- Patients with diabetes have the option of intraperitoneal (IP) insulin or s.c. insulin. (see section Insulin therapy in CAPD)
- Patients with diabetes require an order for the frequency of blood glucose monitoring. This usually coincides with PD exchanges but may be less frequent in stable patients.

**Sample Prescription of CAPD:**
CAPD : 2 litre volume QID, Target weight 68.0 kg (full)

### CCPD (Continuous Cyclic Peritoneal Dialysis) and E-CCPD* (Enhanced CCPD)

**AM I____(I)*____I_I_I_I_I_I_ PM**

- 3 – 5 exchanges/ night with long day dwell. Exchanges are delivered overnight utilizing a machine with last fill exchange of >500 mLs. The last fill is left indwelling during the day for 12 – 16 hours. Patient reconnects to machine at night to drain and resume overnight exchanges.
- *Enhanced CCPD (E-CCPD) is similar to CCPD except the patient does a day time exchange(s) to interrupt the long day dwell (i.e. fluid exchanged manually at 1400 or at most convenient time)
- Overnight exchange volume and day volume may differ. If patient has back pain/herniae, he/she may tolerate larger exchange volume at night with smaller volume during day.
- TW includes the volume of day exchange.
- Patients with diabetes require an order for the frequency of blood glucose monitoring. Patients new to CCPD should check BG's 5 x daily (recommended at 0800,1200,1800,2200 and 0200).
- Patients with diabetes are generally managed with 2 doses of s.c. Insulin, one prior to dialysis on the night cycler and one in the morning post dialysis. The patient may require the larger dose at night.

**Sample Prescription CCPD**
Total Volume: 10 litres (4 exchanges of 2 litre volume overnight plus last fill of 2 litres)
Therapy Time: 9 hours
Exchange volume: 2 litres
Target weight: 70 kg (full)

**Sample Prescription E-CCPD ***
Total Volume: 12 litres (4 exchanges of 2 litre volume overnight plus last fill of 2 litres + midday exchange of 2 litres)
Therapy Time: 9 hours
Exchange volume: 2 litres
Target weight: 70 kg (full)

## NIPD (Nocturnal Intermittent Peritoneal Dialysis)


- Frequent exchanges/ night with <500mL day dwell.
- While it is preferable to have a day dwell, the dry day may be used for patients who do not tolerate day exchanges (i.e. back pain/herniae, recent abd surgery or increased fluid absorption)

- Target weight is generally an empty weight unless patient has a small day dwell.
- Patients with diabetes require an order for the frequency of blood glucose monitoring. Patients new to NIPD should check BG's 5 x daily (recommended at 0800,1200,1800,2200 and 0200).
- Patients with diabetes are generally managed with 2 doses of s.c. Insulin, one prior to dialysis on the night cycler and one in the morning post dialysis. The patient may require the larger dose at night.

**Sample Prescription NIPD**
Total Volume: 8 litres (4 exchanges of 2 litre volume overnight no last fill)
Therapy Time: 9 hours
Exchange volume: 2 litres
Target weight: 70 kg (empty)

## IPD (Intermittent Peritoneal Dialysis)

**AM I_I_I_I_I_I_I_I_I_I_I_I_ PM**

- Rapid exchanges delivered over 12 - 20 hours 2 – 3x per week.
- Used post-op PD catheter implantation, post hernia repair and for rapid fluid removal.
- New catheters use low volume and gradually increase over 1-2 weeks.
- Established catheters use volume tolerated by patient.
- Provides dialysis in supine position and reduces risk of leak.
- Generally weighed empty as off dialysis between treatments
- Patients with diabetes should continue oral hypoglycemic or s.c. insulin, and if in hospital, sliding scale insulin should be ordered.
- Capillary blood glucose monitoring q bag set change (usually every 4-5 hr)

**Sample Prescription IPD**
Total volume: 40 liters
Therapy Time: 20 hours
Exchange volume: 2.0 litres (may range from 750mL to 2.5 litres) *don't use hypertonic dialysate**
Target weight: 45 kg (empty)

*Hypertonic solution can remove more water than sodium, leaving patient hypernatremic at end of session; however, if patients require fluid removal, clinical judgement should be used in determining appropriate bag selection.

University Health Network
Toronto General Hospital | Toronto Western Hospital | Princess Margaret Hospital

# Doctor's Order Sheet

## Nephrology Program

## Peritoneal Dialysis (PD) Orders

Addressograph

PLEASE USE BLACK OR BLUE BALLPOINT PEN, PRESS FIRMLY

**ALLERGIES:**
NO KNOWN ALLERGIES ☐
KNOWN ALLERGIES (Specify) ☐

| PHYSICIAN'S ORDER AND SIGNATURE | SIGNATURE(S) AND POSITION | ACTION TAKEN | PHARMACY |
|---|---|---|---|

**(Please check ☑ appropriate box(es) and complete as required)**

### 1. MONITORING:

Target Weight:_____ kg ❒ Full ❒ Empty
Weights: _____(specify frequency)
Notify MD if patient has abdominal pain or cloudy effluent or exit site has new redness, swelling, pain or exudate

### 2. TREATMENTS:

❒ **Automated Peritoneal Dialysis (APD) – using Home Choice Cycler**
- ❒ Continuous Cyclic Peritoneal Dialysis (CCPD) (night cycler treatment includes a day dwell)
- ❒ Enhanced automated cycler (eCCPD) (night cycler treatment includes a day dwell AND an additional midday twin bag™ exchange)
- ❒ Night Intermittent Peritoneal Dialysis (NIPD) (night cycler but no day dwell)
- ❒ Tidal (order on routine MD orders sheet indicating tidal % and daily ultra-filtration (UF) requirements)
- ❒ Intermittent Peritoneal Dialysis (IPD) (acute cycler management during the day only)

Cycler Programmed Total Volume _____litres (overnight + last fill)
Overnight exchanges _____(number) X _____ (fluid volume) L
Therapy time: provide _____ hours overnight
- ❒ % Strengths:_____

Cycler Last Fill Volume:_____ L (day dwell) (included in cycler programming)
Cycler Last Fill
- ❒ % Strength:_____

**OR**
- ❒ Icodextrin (7.5%)

**OR**
- ❒ Nutrineal (Amino Acid)
- ❒ **Twin Bag™ Day Exchange with APD** (if clinically indicated) at 1400 hrs or _____ (time)
- ❒ % Strength:_____ Volume:_____

**OR**
- ❒ Icodextrin (7.5%)

**OR**
- ❒ Nutrineal (Amino Acid)

❒ **Twin Bag™ Day Exchanges: Continuous Ambulatory Peritoneal Dialysis (CAPD)**
Number of Exchanges:_____per 24 hours
Volume: _____ L (day bags)
Volume:_____ L (night bag- if different)
- ❒ % Strength:_____
- ❒ Icodextrin (7.5%) as night-time bag
- ❒ Nutrineal (Amino Acid) one exchange per day (same time as large meal)

**Note: this may change as required – order changes on routine Dr's Order Sheets**

D6616

PLEASE USE BLACK OR BLUE BALLPOINT PEN, PRESS FIRMLY

**ALLERGIES:**
NO KNOWN ALLERGIES ☐
KNOWN ALLERGIES (Specify) ☐

| PHYSICIAN'S ORDER AND SIGNATURE | SIGNATURE(S) AND POSITION | ACTION TAKEN | PHARMACY |
|---|---|---|---|

**(Please check ☑ appropriate box(es) and complete as required**

**Peritoneal Dialysis On HOLD**

❒ Hold PD and provide peritoneal flush q _____ week(s) with _____ L of dialysate then lock with 5 mL Heparin (5000 units). PD catheter exit site care with each flush and prn.

**For Diagnostic Tests and Procedures:**
Drain prn and then refill with last dwell or provide next exchange as clinically indicated

**PD Catheter Exit Site Care**

❒ Twice weekly and as needed
**OR**
❒ _____(specify frequency)

Start PD Catheter Exit Site Care as per Infected Exit Site Protocol as required

**Infected Exit Site Care Protocol**
Level 1 – new redness, swelling, pain, or crust: increase to daily dressing change
Level 2 – minimal exudate: use mesalt gauze instead of gauze daily
Level 3 – moderate exudate: after soap wash cleanse with 3% Hydrogen Peroxide then wrap 3% Hydrogen Peroxide soaked gauze around catheter for 5 minutes. Use Mesalt gauze instead of gauze daily
Level 4 – large amount exudate: follow level 3 procedure BID
Level 5 – copious amount exudate: follow level 3 procedure TID

## 3. LABORATORY TESTS: (Ordered in EPR)

a) Exit Site Swab for C&S prn if exudate is present
b) Cell count & C&S of effluent prn if hazy or cloudy; or to assess peritonitis (effluent must dwell at least 2 hours - ideally 4 hours)
c) **Peritonitis:**
- ❒ Daily Cell Count of effluent x 5 days and then reassess
- ❒ Daily C&S of effluent x 5 days and then reassess

## 4. MEDICATIONS:

❒ Mupirocin Ointment 2% apply to peritoneal dialysis catheter exit site with each dressing change
**OR**
❒ Other:_____

For fibrin: Heparin 500 units per litre of peritoneal dialysate for all exchanges as needed
**For peritonitis:** Heparin 1000 units per litre of peritoneal dialysate for all exchanges until effluent clear
❒ KCL _____ mEq per litre of peritoneal dialysate for all exchanges (max 10 mEq/L)
❒ _____
❒ _____

Physician's Signature:_____ Date: _____/_____/_____ Time:_____
dd mm yy

## Tidal Volume

Tidal volume PD refers to a method originally developed to increase dialysis efficiency, but in exceptional circumstances, may also be helpful to relieve "dry pain" between exchanges on a cycler. A certain percent of fluid (residual volume) is left in the abdomen between exchanges, thus the remaining amount to be exchanged is ordered as "% Tidal volume". Need to order the Tidal percentage, the UF volume and complete ("full") drain frequency.

To program "Tidal" the following parameters must be ordered:

- The **Tidal percentage** of the total exchange volume to be left dwelling (i.e. an 80% tidal leaves 20% of the fill volume dwelling)
- The **UF/ultrafiltration** = the total volume of fluid you wish to remove from the patient (the cycler will divide this by the number of exchanges and attempt to remove that volume with each exchange) (i.e. UF 1 litre over 4 exchanges = 250 mL each exchange)
- **Full Drains**: because UF volumes are programmed but dependant on patient physiology it is an estimated volume only and patients risk retaining fluid in their peritoneal cavities. The cycler will provide a "full" drain for the last exchange to remove any accumulated excess, however an extra "full" drain can also be ordered mid-treatment by ordering "*full drains every X exchanges"* (remembering that the Initial Drain counts as the first drain volume.)

Sample Orders

**Tidal 80%, 2L fill volume x 5 exchanges plus 2L Icodextrin as a Last Fill.**
**UF 1 litre. Full drain every 3 exchanges.**

## Peritoneal Catheter Insertion

The PD catheter access coordinator, Zita, ph 2358 to be contacted whenever a PD catheter needs to be inserted or removed, or if a PD patient requires an urgent or elective transfer to Hemodialysis.

**Dr. Todd Penner** 416-603-5800 x 6220
Performs laparoscopic PD catheter (Swan Neck) insertions, removals, re-insertions, adhesion lysis and hernia repairs for PD patients in OR at TW. Referral required, contact Zita 2358.

- For Out-patients, Zita will provide a Pre-Admission package - the pre-op history, physical examination form and the doctor's standing order sheet must be completed and returned to her.
- For In-patients, please write pre-op & post-op orders (see next page), NPO and orders for transportation to TWH POCU 2 hours pre-op. POCU is located on the 2nd floor of the Main Pavilion, Room 116 (ext 13-2111)

**Dr Michael Robinette** 416-340-3855
Performs surgical PD catheter (Swan Neck) insertions and removals for inpatients at Toronto General. Fax referral to office fax 340-4500.

**Dr. Martin Simons** 416-603-5537
Dr. Simons, at TW, performs radiological (IR) PD catheter insertions and performs PD catheter manipulations for migration with having inflow/ outflow problems.

**If Zita is not available, referral for IR insertion to be made by notifying Sherry Clement, Nurse Coordinator 13-6301, pgr (416) 715-0235. Put order in computer by Nephrology, under Interventional Radiology. Under "Procedure Search" tab, type "Interventional". Select "Interventional Tube check/change/insertion" →Abdomen →now →"specify in Comment Field" type under Comment, "PD catheter insertion". On top line, "To be performed at", be sure to put TW instead of TG. Include referral information (ie diagnosis, brief PMHx, urgency, location of catheter). Anaesthesia consult not required. Endocrine consult not required if patient stable with respect to DM. Notify Zita (PD access coordinator) 2358.**

**Out patients**
**Patients go directly to Medical Imaging 3rd floor Main Pavillion (East Elevator). If overnight stay is needed, send to Same Day Admit, 6A Fell under Dr. Simons. Have BW done about 1 week prior to procedure: lytes, CBC PT/ INR BS if diabetic. Give patients prescription and info re bowel prep and PD catheter insertion info booklet and advise to arrive 1 hr pre procedure time to get IV etc.**
**Patients must be accompanied by someone to escort them home, with translator if applicable.**

**In Patients**
**If outside TW (ie at TG, PMH or MSH), book transport to and from TW by ambulance/ambutrans (without nurse unless meet transportation criteria for needing a nurse). Call Paul Tuscherer Ext 13-5533 to find out time to book return transport. Ensure pt has a saline lock, Bowel prep, BW results in computer – lytes, CBC, PT/INR, BS. (within 1 week). PD insertion stamped orders filled out and signed. Chart. Notify Zita Abreu and Sharron Izatt by email of all PD catheter insertions.**

## For all PD catheter Insertions:

**Pre-Op**: Hold calcium and iron for 1 week preop, as well as ASA and anticoagulants; **a vigorous bowel preparation pre-catheter insertion is extremely important** 1-litre Colyte x 2 days, clear fluids 24 hours before O.R. NPO after midnight. The surgeon gives IV cefazolin or vancomycin (if penicillin allergic) perioperatively.

**Post-Op**: Colyte 250 mL every day post-op until we know the catheter works well. If the patient objects to taking Colyte, order Senokot 1 bid; if ineffective, 2 bid; if still ineffective, 3 bid.

In-patients: PD catheters are flushed (a volume instilled and immediately drained, no dwell time) post-op at the clinical judgement of the MD or NP, with 3 exch of 1 L Dianeal 1.5% with 500 u heparin/ L. Flushes are done with patient on left side, right side and supine. If effluent remains bloody after initial flushes, do additional flushes until the effluent clears.

Out patients: PD catheters are not normally flushed post-op, but are flushed weekly for 3 weeks and prior to first IPD, and assessed in HPDU until PD training is commenced. Flushes are arranged by the Renal Co-ordinator.

In a well functioning catheter, a 1 L inflow should take ~ 5 minutes and outflow should take ~10 minutes regardless of pt's position. It is essential that the pt planning for APD should have good outflow when lying down.

If a pt urgently requires dialysis, IPD may be started with small volume exch 750 – 1000 mL, then volume gradually increased over a 2-week period to 2 L.

Inpatients generally receive IPD 20 hours 2 x/week. Outpatient IPD is 6 hours 3-4 x/week depending on available spots. Pts need a minimum of 2 weeks before PD training starts, and should be instructed to refrain from strenuous activity/lifting and from getting the catheter site wet until training.

Note: UHN uses the Swan Neck curled 2-cuff catheter. Prior to Aug 2005, UHN used the TWH peritoneal catheter with double cuffs. We use a presternal catheter in some cases, with specific indications - contact Zita 2358 if any questions.

**For PD catheter removals:**

- For in-patients who need "urgent" catheter removals, call general surgery on call (if called on Friday will most likely be removed on Saturday). Advise Zita 2358
- Non-urgent catheter removals may be booked through Zita 2358

**University Health Network**
Toronto General Toronto Western PMH

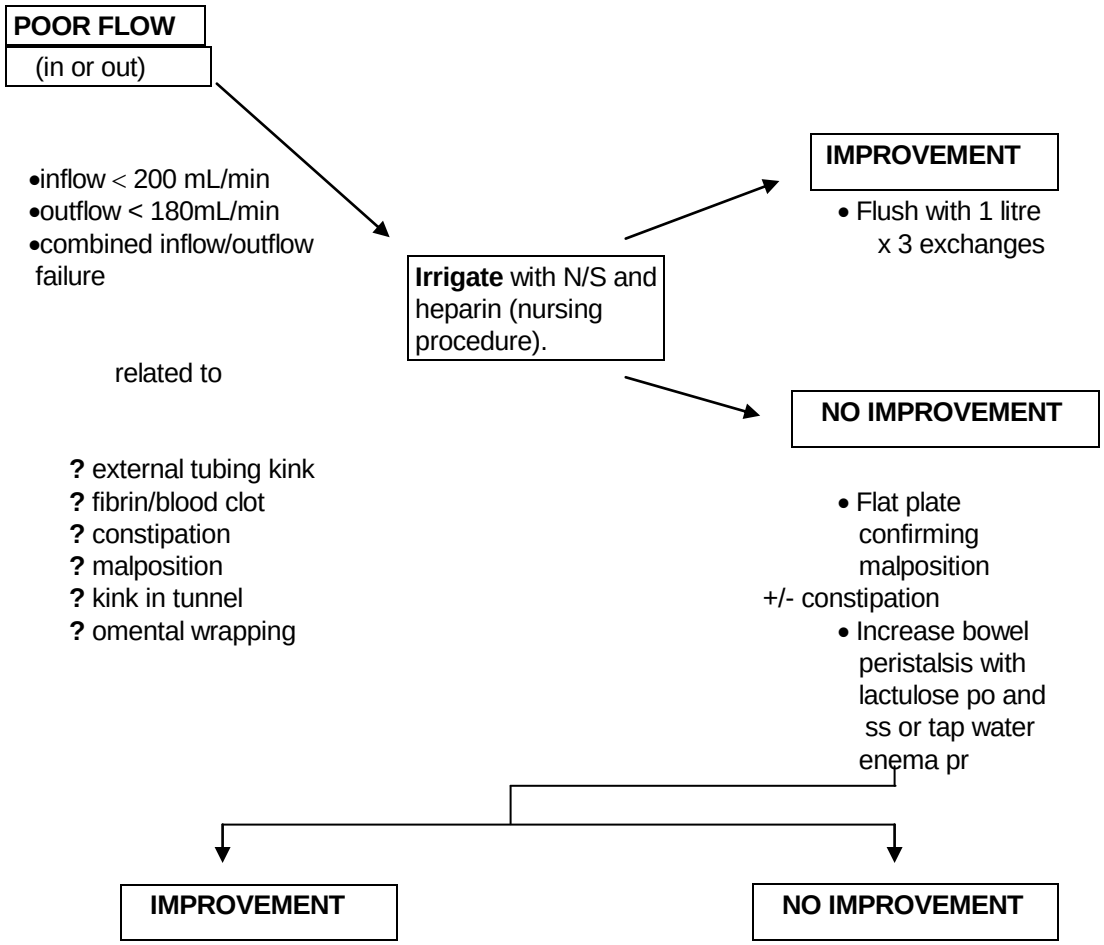
**Doctor's Order Sheet**
**Implantation of Peritoneal Dialysis Catheter**

Addressograph

**ALLERGIES**
NO KNOWN ALLERGIES ☐

| DATE AND TIME ORDERED | PHYSICIAN'S ORDER | | SIGNATURE AND POSITION |
|---|---|---|---|
| | **PRE IMPLANT PHASE**<br>1. NPO after MN except for oral meds.<br>2. M.D. to assess insulin requirements for diabetic patient ☐Yes ☐No ☐ N/A<br>3. Hold oral hypoglycemics ☐ Yes ☐ No ☐ N/A<br>4. Chest X-Ray ☐ Yes ☐ No<br>5. ECG ☐ Yes ☐ No<br>6. CBC, urea, creatinine, lytes; PT,PTT; crossmatch for 2 units packed cells<br>7. Chlorhexidine scrub to abdomen x 3 ☐ Yes ☐ No<br>8. Bowel prep. a)<br>Colyte _____ b)<br>Other, specify _____<br>9. Start I.V. _____<br>10. Give _____gm. Cefazolin immediately pre-op (to be given by anaesthetist) 11. If patient is allergic to Cefazolin, give _____gm. Vancomycin 2 hrs preop over 1 hour.<br>**POST IMPLANT PHASE**<br>1. Flush with 1L volumes of 1.5% dialysis solution in and out x 3 exchanges or until effluent clears.<br>2. Infuse _____ units heparin and cap catheter.<br>3. Flat plate of abdomen.<br>4. Ensure immobilizing dressing is in place.<br>Do not change dressing for _____ days unless heavy bleeding occurs.<br>5. If Cefazolin or Vancomycin not given pre-implant, M.D. to assess antibiotic requirements post-implant.<br>_____ _____<br>Physicians Signature Date | | |

# Post- Op Catheter Complications



## Management of PD Leaks

### Exit Site Leak

These may occur during the first weeks following catheter implantation. For patients at risk for exit site leak post op (i.e. immunosuppressed, diabetic, frail, obese or very thin), PD should be avoided. If the patient requires dialysis, small volume IPD (750 mL) should be administered cautiously. Staff should ensure the patient is completely empty at the conclusion of the flushes or IPD session. If leak does occur, Home PD should be delayed a further 2-3 weeks, and the patient may need to be supported with HD temporarily.

Late exit site leak is less common and may be related to accidental pulling on the catheter. Home PD may have to be interrupted and the patient scheduled for 2 - 3 weeks IPD until the problem resolves.

### Intra-Abdominal Leak/Hernia

Occasionally PD fluid may leak internally and present with swelling in the genitalia or abdominal tissues. Patients may present with evidence of hernia. In these cases, it may be necessary to do a CT Scan (see section on Antibiotic Prophylaxis and Procedure Prep for PD Patients), and possibly have a Surgical consult and temporarily hold Home PD.

When surgical repair is indicated, or until the leak resolves on its own, the patient is usually maintained on IPD because intra-abdominal pressure is lower on IPD, which decreases risk of further leak. When Home PD is resumed, dialysis volumes are usually decreased, then very gradually increased. Some patients on cyclers may be able to continue dialysis at home by reducing volumes and remaining dry during the day. If patients on CAPD undergo more than one hernia repair and develop a subsequent hernia, it is usually recommended that the patient change to an APD regimen with lower abdominal pressure.

### Hydrothorax / Pleuroperitoneal Leak

This is a rare complication which involves leakage of PD fluid into the pleural space, caused by a communication between the peritoneal and pleural spaces. The patient may present with shortness of breath and diminishing PD drain volumes. Immediate treatment is drainage of PD fluid if there is respiratory embarassment. Diagnosis includes CXR seen as a unilateral accumulation of fluid in the lung (more often the right lung). Thoracentesis may alleviate

symptoms, and confirm the diagnosis by analysis of the pleural fluid. The pleural fluid may be higher in glucose and lower in protein than serum, however if the fluid has been in the pleural space for a length of time, there may not be a significant difference. CT scan with contrast in the PD fluid (see section on Antibiotic Prophylaxis and Procedure Prep for PD Patients) will help to identify the location of the leak. Patients may require IPD or HD to allow for healing of the defect, but if not successful, sealing the defect with pleurodesis may be effective.

## Peritoneal Dialysis Systems and Connectology

A PD transfer set/catheter adapter remains connected to the end of the PD catheter to allow the connection of dialysate bags and Cycler tubing. A PD nurse changes this transfer set/catheter adaptor approximately every six months.

The training nurse will determine the best connectology for each patient during training – considering the patient's abilities/disabilities, comfort/discomfort with pulsatile inflow, and individual needs.

## Automated Peritoneal Dialysis (APD) Systems

Systems that utilize a cycler machine to do IPD, CCPD, E-CCPD, and NIPD.

The Home Choice® is the Baxter cycler that delivers Dianeal® solution. This cycler has a pump with a speed of 200 mL per minute.

The FreedomCycler/Newton Cycler® is the Fresenius cycler that delivers Delflex® solution. These cyclers work by gravity.

At UHN, the majority of our patients use the Baxter system.

## Continuous Ambulatory Peritoneal Dialysis Systems

Systems that use a manual bag and gravity to do CAPD exchanges. Manual bags are composed of a fill bag with dialysate and a drain bag incorporated in a sterile system. At the end of the exchange the catheter is capped. For home CAPD, our patients generally use either the Twinbag® system by Baxter or the Premier Plus/Stay Safe® system by Fresenius, although there are a variety of others on the market.

## Manual System

A Manual system is used for inpatients to do flushes to assess inflow and outflow times and for PD in the ICU. Comes with a “Y” tubing and a drip chamber.

## Peritoneal Dialysis Solutions

### Standard Solutions

- **Glucose** concentrations: 0.5%, 1.5%, 2.5% and 4.25%. Osmolality increases with the increases in glucose concentration. Dianeal® and Delflex® are glucose-based solutions.

- **Calcium** concentration: standard ("PD101" 1.75 mmol/L) and low calcium ("PD4" 1.25 mmol/L). **Note:** Most patients use low $Ca^{+}$ concentration bags with the Luer-lock connections. The exception is post parathyroidectomy in which patients use standard $Ca^{+}$ bags with the spike connections. PD101 solutions can be ordered, but may take 1-2 days to be delivered to the unit. During the interim, consider dialysing with PD4 solutions and increasing the patient's oral Ca intake.

- **Volume:** 1.5L, 2L, 2.5L, 3L, 5L. Not all solutions are available in all volumes.

### Specialty Solutions

- **Nutrineal®** : An amino acid based solution used for patients with malnutrition secondary to poor oral intake. Recommend for one 6-hour exchange during the day coinciding with a meal. Consider Nutrineal® equivalent to 1.5% dextrose solution for insulin dosing, although there is no glucose in this solution, thus monitor insulin requirements carefully.

- **Extraneal® (Icodextrin):** A glucose polymer (7.5% solution) based solution that metabolizes to maltose, for patients with ultrafiltration problems. Recommended for one 8 to 12-hour dwell per day. Consider Extraneal® equivalent to 2.5% dextrose solution for insulin dosing, although there is no glucose in this solution, therefore monitor insulin requirements carefully***.

***NOTE:** Patients with diabetes using Extraneal® should check their capillary blood glucose using **ONLY** specific brands, ie Precision®,One-Touch®, Fast Take® (contact HPDU for complete list) as there is a risk of hypoglycemia if the

blood glucose is measured using a device that does not differentiate maltose from glucose. Patients should continue to use these monitors for 2 weeks after stopping Extraneal®. There is also a risk of allergic skin reactions with Extraneal® **so patients should be advised. Additionally,** it should be avoided in those **allergic to corn or cornstarch**.

> ***ALERT**
> If using **Extraneal** only use specific brands of glucose monitoring machines as others will give false high readings. Continue to use for 2 weeks after stopping Extraneal® as the maltose continues to be present for 10-14 days.

- Physioneal®: A pH - neutral solution for patients with intractible abdominal pain after all other options have failed (i.e. trying tidal volume, analgesics, or adding xylocaine). For these individuals, it is used in lieu of other solutions for all PD exchanges.

- Extraneal®, Nutrineal® and Physioneal® are only available from Baxter. If patients using another system require these solutions, they should convert to Baxter or use a universal adaptor.

## Intraperitoneal (IP) Medications

### Heparin

- Indicated if fibrin is present in bags, for slow drainage and for hemoperitoneum. Used in each exchange for 24 hours and reassessed.
- Used routinely for outpatients coming for IPD treatment
- Use in inpatients by clinical judgement, Indicated for peritonitis management
  Dose (Non-peritonitis): 500 units/L
  Dose (Peritonitis): 1000 units/L until effluent clears

### Erythromycin

- Indicated for gastroparesis - 200 mg IP in one bag daily

### Sodium Bicarbonate

For abdominal pain or cramps felt to be related to pH of dialysate
*Note: Bicarb should be added immediately before infused
CAPD Dose: $NaHCO_3$ 8.4% (1 mEq/mL) add 5 mL per L of dialysate
IPD Dose: $NaHCO_3$ 8.4% (1 mEq/mL) add 10 mL per L of dialysate

## Maxeran (metoclopramide hydrochloride)

5 mg/L IP for control of nausea or gastroparesis if oral route not beneficial.

## Potassium Chloride

- 2 - 4 mmol/L for hypokalemic patients in-hospital (this level will limit removal of serum K, but will not supplement potassium)
- for severe hypokalemia, can use maximum dose of 10 mmol/L
- oral supplementation preferred for patients on home dialysis
- For inpatients, if predialysis K< 3.0 mmol/L or if dialysis is to be prolonged (>12 hours), KCL should be added to supplement.
- IP KCl not usually added for CAPD unless in hospital and oral supplements and diet not sufficient.
- Please note, KCl must be ordered each day to be dispensed from the Pharmacy. It comes in minibags 20mmol/50mL.

## Xylocaine without Epinephrine

- Indicated for abdominal cramps or pain only after investigations support that the pain is related to dialysate solution. (i.e. avoid risk of masking pain related to other causes). Not indicated if source of pain is unknown.
  Dose: 1.25 - 5.0 mL/L of 1% or 2% Xylocaine.

## tPA (Tissue Plasminogen Activator – Alteplase® Cathflow)

- tPA is a fibrinolytic agent that is used for one-way or two-way obstruction (poor or no inflow/outflow) when it is suspected that a thrombus is attached to or occludes the PD catheter.
- It is also used as a treatment for recurrent peritonitis. (Refer to Policy #17.130.007 in the UHN Policy and Procedure Manual). tPA is dispensed from Pharmacy in powdered form.
- After reconstitution, instill 4.6 mL, dwell for 2 hours.
- Although experience is somewhat limited, results achieved for both obstruction and peritonitis have been fair.

## Insulin Therapy in IPD

- Generally, if pt on s/c insulin, continue the s.c. dose for both dialysis and non-dialysis days.
- If in hospital, Sliding Scale s.c. insulin should be ordered, and glucose monitored throughout IPD, every 4 hours.

## Insulin Therapy in CAPD

- **Rarely, some patients utilize IP Insulin. It is preferable for them to be maintained on S.C. insulin. Please check with HPDU nephrologist before starting anyone on IP insulin.**

## Insulin Therapy in CCPD

- Pts on CCPD generally receive subcutaneous insulin twice daily.
- If CCPD is D/C'd, adjust dose as glucose load from dialysate no longer received.

## Peritonitis Guidelines

Peritonitis generally managed as outpatients unless severe or patients unable to manage at home. Diagnosis requires 2 of the following 3:

- abdominal pain
- cloudy dialysate fluid
- positive culture of dialysate fluid

A PD effluent cell count with WBC >100 cells/μL or >50% neutrophils with or without positive cultures in addition to the above symptoms is diagnostic for PD peritonitis.
Patients are instructed to bring in the first cloudy bag. If not possible, drained dialysate from patient is sent for C&S, Gram stain, and cell count with differential.

Consider other causes of abdominal pain, i.e. constipation, pancreatitis, ischemic bowel, cholecystitis, hernia etc. Even if there is true peritonitis, consider "surgical causes" such as appendicitis (abdo pain is localized rather than diffuse).

## Initial Assessment

Clinical examination of abdomen for s/s of peritonitis and PD catheter exit site/tunnel; send exit site swab for C&S if drainage present.

Send first dialysate effluent for C&S and gram stain and cell count with differential. If pt does not have indwelling effluent (IPD or NIPD) fill with min 1L and allow to dwell for minimum 2 hrs before sending sample.
Gram stain can be helpful, eg. if yeast, but continue empiric antibiotics until culture results available.
Blood for CBC, diff, lytes, Cr, urea, Ca, $PO_4$, alb, total protein for In-pts or ER pts.

## Management

**Empiric antibiotic therapy – start immediately, do not wait for next scheduled PD exchange:**

**IF PATIENT HAS < 100 mL/day URINE**
IF wt < 50 Kg, Cefazolin 1g in 1 exch/day plus Tobramycin 40 mg in 1 exch/day plus Heparin 1000 units/L in EACH exchange. Use heparin until effluent clear.

IF wt > 50 Kg, Cefazolin 1.5 g in 1 exch/day plus Tobramycin 60 mg in 1 exch/day plus Heparin 1000 units/L in EACH exchange. Use heparin until effluent clear.

**IF PATIENT HAS > 100 mL/day URINE**
IF wt < 50 Kg, Cefazolin 1g in 1 exch/day plus Ceftazidime 1 g in 1 exch/day plus Heparin 1000 units/L in EACH exchange. Use heparin until effluent clear.

IF wt > 50 Kg, Cefazolin 1.5 g in 1 exch/day plus Ceftazidime 1.5 g in 1 exch/day plus Heparin 1000 units/L in EACH exchange. Use heparin until effluent clear.

***Note:*** For patients who are ***allergic to cefazolin,*** give vancomycin
If wt > 50 kg, Vancomycin 2 grams in 1 exch q 5 days if residual renal function, q 7 days if no residual renal function.
If wt < 50 kg, Vancomycin 1 gram in 1 exch q 5 days if residual renal function, q7days if no residual renal function.

If ***allergic to ceftazidime,*** give Tobramycin according to above.

Vancomycin is also to be used as initial therapy for those with known MRSA exit site infections, previous MRSA peritonitis, or those who have recently come from a unit with high incidence of MRSA.

Antibiotics must dwell intraperitoneally for at least 6 hours to allow adequate absorption of the antibiotic into systemic circulation. Generally, IP antibiotics can be given into one exchange per day, often in an overnight exchange, as it tends to dwell for a longer period of time. **The exception is Vancomycin, which must NEVER be given daily, but is ordered q 5 or q 7 days according to residual renal function (see above).

If a patient is in hospital, it is often easier to switch them to CAPD during treatment for peritonitis, to allow ease of specimen collection and antibiotic dosing. If the patient must remain on CCPD, antibiotics should be instilled into the last fill and allowed to dwell during the day.

- If fungal/yeast peritonitis, catheter to be removed ASAP, start pt on antifungal treatment and switched to HD for at least 8 weeks.
- Order additional intraperitoneal additives:
  -heparin 1000 u/L until effluent clears
  -individual requirements for KCl, insulin, maxeran etc.
- Order effluent for daily cell count until cell count $\leq$100 (q 2 days if out-patient). C&S daily until first "no growth"; then q 4 days until total of 3 "no growths". Note, in Electronic Patient Record (EPR), Go to "All Order Screens $\rightarrow$ Nephrology$\rightarrow$ Other Common Tests $\rightarrow$ Dialysis $\rightarrow$choose PD Effluent C&S or PD Effluent, cell count.
- Hold CaCO3 and iron supplements if peritonitis is severe (due to constipation).
  - For urgent catheter removal, call General Surg on call. Notify Zita 2358
  - All treatment should be guided by antibiotic sensitivity of the causative organism (see Tables 2,3,4).

Nystatin 100,000 u/mL, give 5 mL po qid for duration of peritonitis treatment, as prophylaxis against fungal peritonitis. Continue for 1-week post antibiotics.

PD peritonitis can be very painful, order appropriate analgesia.

**Table 2. Culture and Sensitivity Follow-up**

| ***Culture results*** | ***Continue or add*** | ***Discontinue*** | ***Frequency (F) and duration (D)*** |
|---|---|---|---|
| **No growth** in 2-3 days | Cefazolin 1.5 g (1 g if <50 kg) | Discontinue Tobramycin/ ceftazidime | **F**: 1 exchange/DAY<br>**D:** Continue for 2 weeks. Note: If no improvement in 5 days, consider cath removal, continue Cefazolin 2 gm IV qHD when cath is out. Ask lab re. TB or yeast. |
| **Gram Positive** Coag Negative Staphylococcus (CoNS) | Cefazolin 1.5 g (1g if <50 kg) | Discontinue Tobramycin/ ceftazidime | **F**: 1 exchange/DAY<br>**D**: Continue for 2 weeks |
| **Gram Positive** Methicillin Resistant Coag Negative Staphylococcus (MRSE) | Vancomycin 2g IP (1g if <50 kg) | Discontinue cefazolin and tobramycin/ceftazidime | **F:** 1 exchange/WEEK<br>**D:** Continue for 3 weeks**.** NOTE: If residual renal function **(RRF),(i.e. urine >100 mL/24hr)** give: 1 exchange/ 5 days cont. for 3 weeks |
| **Gram Positive** Staphylococcus aureus | Cefazolin 1.5 g (1g if <50 kg) and consider rifampin 300 mg po BID *for the first week of therapy* | Discontinue tobramycin/ ceftazidime | **F:** 1 exchange/DAY<br>**D:** Continue for 3 weeks |
| **Gram Positive** Methicillin resistant Staphylococcus aureus (MRSA) | Vancomycin 2g IP (1 g if < 50kg) PLUS rifampin 300 mg po BID *for the first 2 weeks of therapy*. | Discontinue cefazolin and tobramycin/ ceftazidime | **F:** 1 exchange/WEEK *<br>**D:** Continue for 3 weeks<br>*****NOTE: If RRF (urine >100 mL/24hr) give Vancomycin in 1 exchange q 5 days and continue for 3 weeks. |

| | | | |
|---|---|---|---|
| **Enterococci** | Ampicillin 125 mg/L q exchange (If ampicillin resistant, may change to Vancomycin 2 g one exch q 7 days (1g if <50 kg) (q 5 days if RRF)<br><br>Consider gentamicin 20 mg/L IP in one exchange for synergy. | Discontinue cephalosporins | **F:** Ampicillin EACH exchange, Tobramycin 1 exchange/DAY. Vancomycin 1 exch/WEEK. For VRE, consider quinupristin/ dalfopristin (Synercid) – Consult ID.<br>**D**: Continue for 4 weeks |
| **Streptococci (Gram +)** | Cefazolin 1.5 g.<br>OR Penicillin G 50,000 u /L loading dose then 25,000 u/L | | **F:** Cefazolin 1 exch/day. OR Penicillin In each exchange<br>**D**: Continue for 2 weeks |
| **Gram Negative (e coli, Klebsiella, proteus, serratia)** | Tobramycin 60 mg (40 mg if <50 kg) if no RRF, OR<br>Ceftazidime 1.5 g (1g if <50 kg) if RRF | Discontinue cefazolin | **F**: 1 exchange/DAY<br>**D**: Continue for 3 weeks |
| **Polymicrobial** | Tobramycin 60 mg (40 mg if <50 kg ) if no RRF<br>OR<br>Ceftazidime 1.5 g (1g if <50 kg) AND Ampicillin 125 mg/L if RRF,<br><br>AND metronidazole 500 mg IV/po q8h<br>*Get surgical consult* | Discontinue cefazolin | **F**: Ampicillin in each exchange Tobramycin in 1 exchange/day<br>**D:** Continue for 4 weeks. Continue 1 week post catheter removal, minimum treatment 4 weeks<br>If any organism is gram neg, consider bowel perforation. |
| **Pseudomonas/ Stenotrophomonas** | Tobramycin 60 mg (40 mg if < 50 kg) if no RRF, OR<br>Ceftazidime 1.5 g (1.g if <50 kg) if RRF AND Anti-pseudomonas or anti-stenotrophomonas (see Table 2 or 3). Recommended to use 2 antibiotics – may | Discontinue cefazolin | **F**: 1 exchange/day<br>**D:** Continue for 4 weeks if cath is in, or for 2 weeks following cath removal.<br><br>Catheter removal if exit site or |

| | | | |
|---|---|---|---|
| | use oral quinolone plus alternate. | | tunnel infection |
| **Fungal / Yeast** | While catheter is STILL IN: fluconazole 200 mg in 1 bag **IP** (dwell x 8 hr) q48h <u>OR</u> amphotericin B 0.5-1.0 mg/kg mg **IV** q24h. If >1 mg/kg needed, contact ID. OR itraconazole 100 mg po q12h. *Arrange for urgent PD catheter removal*. | Discontinue cefazolin and tobramycin/ ceftazidime | When catheter is OUT and patient is on HD: fluconazole 200 mg po daily for additional 2 weeks OR itraconazole 100 mg po q12h for 2 weeks. |
| **Mycobacteria** | Rifampin (RIF) 600 mg po daily,<br>Isoniazid (INH) 300 mg po daily.<br>Pyrazinamide (PZA) 1.5 g po daily.<br>Pyridoxine 100 mg po/day to avoid INH induced neurotoxicity. Monitor LFT's.<br>(NOTE: Do not use ethambutol except under unusual circumstances because of the risk of ocular toxicity)<br>Consult ID re sensitivities | | **D:** Rifampicin and isoniazid 12 mo.<br>Pyrazinamide 3 mo.<br><br>Arrange for Catheter removal |
| **All organisms** | Nystatin 500,000 u 5 mL swish and swallow qid for duration of peritonitis treatment plus one week, as prophylaxis against fungal peritonitis. | | **F:** qid<br>**D:** Continue for one week after cessation of antibiotics. |

**Table 3. Antibiotics with anti-pseudomonas activity**

| *Antibiotic* | *Dosage/administration* |
|---|---|
| Ceftazidime | 125 mg/L IP IN EACH exchange |
| Piperacillin-Tazobactam | 3.375 g IV q12h |
| Ciprofloxacin | 500 mg po BID |
| Cefepime | 1gm IP in 1 exchange per day |

**Table 4. Antibiotic with anti-stenotrophomonas activity**

| *Antibiotic* | *Dosage/administration* |
|---|---|
| Trimethoprim / sulfamethoxazole | Loading dose: 320 mg/ 1600 mg (20 mL) IP<br>Maintenance dose: 40 mg/ 200 mg (2.5 mL) IP in one exchange per day |

**Oral Therapy for PD Peritonitis: *Based on culture and sensitivity***

When oral antibiotics are given, consider holding all phosphate binders (e.g. calcium carbonate, aluminum hydroxide) and iron supplements.
**NOTE: Oral therapy should NOT be considered for initial therapy**

Ciprofloxacin 500 mg po BID OR Co-trimoxazole 1 DS tab po daily
OR
Cephalexin 250 mg po TID AND Rifampin 600 mg po daily

Refractory Peritonitis

- If no decrease in cell counts in 3 days or if count fell initially and then increased, repeat culture and consider possibility of secondary peritonitis due to ischemic bowel, cholecystitis diverticulitis or appendicitis
- Refractory peritonitis is defined as failure to respond to appropriate antibiotics within 5 days.
- Consider temporary discontinuation of PD - arrange for temp HD
- Consider conversion to IPD, if suspected microperforation of bowel. IPD allows bowel to rest between treatments.

Catheter removal - required for virtually all fungal peritonitis, and for serious refractory bacterial peritonitis. For in-patients who need "urgent" catheter removals, call general surgery on call (if called on Friday will most likely be removed on Saturday). Advise Zita 2358

- Notify HD unit, and arrange U/C line for hemodialysis through Vascular Access Co-ordinator or Angio.
- If UF failure with peritonitis (weight gain/ECFV overload), alter regimen (ie. shorten dwells, hypertonic bags, Icodextrin/Extraneal™ more frequent exchanges, IPD ).
- Note that Icodextrin is compatable with antibiotics, so can be put into Icodextrin exchange.
- Stable pts may be discharged and continue therapy at home. Consult HPDU to assess pts ability to administer meds.

**For management of any complicated peritonitis, please contact Dr. J. Bargman, pgr. 790-6317.**

**References:**

Hussein, M., Mooij, J.M., Roujouleh, H. (2003). Tuberculosis and chronic renal disease. Seminars in Dialysis, 16(1). 38-44.

Piraino, B, Bailie, G., Bernardinin, J., Boeschoten, E., Gupta, A., Holmes, C., Kuijper, EJ., Li, P.K, Lye, W., Mujais, S., Paterson, DL., Fontan, MP., Ramos, A., Schaefer, F., Uttley, L. (2005). ISPD Guidelines/Recommendations. Peritoneal dialysis-related infections. Recommendations: 2005 Update. Perit. Dial. Int.25(2). 107-139.

## Toxic Shock Syndrome (TSS) in PD

A rarely occurring phenomenon of TSS has been reported in PD patients with peritonitis, usually caused by toxigenic *staphylococcal aureus*. The criteria for TSS diagnosis includes fever, and hypotension with peripheral vasodilatation. (Indeed, differential diagnosis of severe hypotension in a PD patient with peritonitis includes abdominal catastrophe, such as viscus/ bowel perforation, or *staph aureus*-associated toxic shock syndrome.)
Treatment includes broad spectrum antibiotics delivered intravenously, and peritoneal lavage, carried out by very short dwell (<30 min) CAPD or IPD exchanges. The lavage should be carried out for at least 12 hours. The purpose of the lavage is to remove the toxin that is causing the TSS. Adequate coverage for staph aureus should be ensured, even if cultures are still pending.

## Antibiotic Prophylaxis and Procedure Prep for PD Patients

### Cardiac Catheterization / Angiogram -- Dye Exposure

- N Acetylcysteine (Mucomyst®) 600 mg po bid on day before and day of procedure. Available in liquid form at UHN Pharmacies. Hydration is recommended 12 hr prior to, during, and 12 hr post procedure (0.45% saline 1mL/kg/h).
- Patient should be instructed to arrive drained ("empty") for angiogram, and CAPD exchanges to resume ASAP after procedure.

### Cholangiogram

Patient should be drained ("empty") prior to test.

### Colonoscopy (Sigmoidoscopy/Proctoscopy)

Bowel prep is required for colonoscopy, sigmoidoscopy or proctoscopy. Golytely 4L in the afternoon before the day of procedure (best to be consumed in 3-4 hours). Do not use regular Fleet enema because of risk of increased phosphate (may use Fleet Mineral Oil).

Antibiotic prophylaxis is not necessary for sigmoidoscopy or proctoscopy.
Antibiotic prophylaxis is necessary for colonoscopy:

- Ampicillin 1 gm IP in night bag/long dwell prior to procedure **or** oral amoxicillin 2 grams 1 hour before procedure
  If allergic to Penicillin: Clindamycin 600 mg po 1 hour pre or 600 mg IV 30 min pre procedure
- Tobramycin 120 mg IP in night bag/long dwell prior to procedure,
- Flagyl 500 mg po 1hour pre procedure and 500 mg po 12 hours post procedure.

Patient should be drained ("empty") prior to procedure.

### CT Scan - Abdomen

To assess for PD leak, 100 mL of “Visipaque” (available from Radiology) is added IP to the dialysis solution regardless of the volume of the exchange. It is important to raise the intra-abdominal pressure, thus have the patient hold at least 2 L and walk around (as able) for 2 hours, as this may make the leak more visible on the scan. Drain at end of scan and resume dialysis.

CT Scan for other reasons – if abdominal, thoracic or pelvic, drain prior to procedure.

## Cystoscopy

Bowel prep as per radiology request.

Amoxicillin 2 gm po 1 hour pre procedure or Ampicillin 2 gm IM or IV 30 minutes pre procedure. If allergic to Penicillin: Clindamycin 600 mg po 1 hour pre or 600 mg IV 30 min pre procedure.

Ciprofloxacin 500 mg po daily x 2 days and Septra 1 SS daily x 2 days

Patient should be drained ("empty") prior to procedure.

## Dental Procedures

Amoxicillin 2 gm po 1 hr pre, or Ampicillin 2 gm IM or IV 30 min pre procedure.

If allergic to Penicillin: Clindamycin 600 mg po 1hour pre or 600 mg IV 30 min pre procedure
OR Cephalexin or cefadroxil 2.0 gm po 1 hour pre
OR Azithromycin or clarithromycin 500 mg po 1 hour pre procedure

## Echocardiogram

Patient should be drained ("empty") prior to test.

## ERCP (Endoscopic Retrograde Cholangio Pancreatography)

Amoxicillin 2 gm PO 1 hour pre-procedure
Patient should be drained ("empty") prior to procedure.

## Gastroscopy/Upper GI

No antibiotic prophylaxis. Patient should be drained ("empty") prior to procedure.

## Gynecological procedures

(Invasive procedures i.e. Uterine biopsy and D&C. NOT for routine PAP)
Amoxicillin 2 gm 1 hour pre procedure.
Flagyl 500 mg 1 hour pre procedure and 500 mg 12 hours post procedure.
If allergic to penicillin, clarithromycin 500 mg 1 hour pre-procedure.
Patient should be drained ("empty") prior to procedure.

### Iliac Dopplers

Patient should be drained ("empty") prior to test.

### Liver biopsy

Ancef 1 gm IP or IV pre procedure, patient to be drained, and leave dry for 24 hours following procedure.

### Stress Test

Patient should be drained ("empty") prior to test.

### Ultrasound - Abdominal, Thoracic, Pelvic

Patient should be drained ("empty") prior to test.

### X-Ray – Chest, Abdomen, Pelvic

Patient should be drained ("empty") prior to test.

## Other Peritoneal Dialysis Issues

### Hemoperitoneum

Small amount of red blood cells can results in bloody appearance to effluent. Causes may be benign to significant pathology. Noted post surgical implantation of catheters, post abdominal surgery; associated with ovulation and menstrual bleeding; warfarin use; pancreatitis; metastases; ischemic bowel; encapsulating sclerosing peritonitis.

May clear with flushes as in post catheter implantation. Add heparin 500 u/L to prevent catheter obstruction. Heparin is not absorbed across peritoneal membrane and will not have systemic effect on anticoagulation.

## Wet Contamination

Contamination when the tubing system is open or unclamped, potential for organisms to enter the peritoneal cavity.

For pts < 50 kg: cefazolin (Ancef®) 1 gm IP for 6 hr dwell x 1 dose.
For pts > 50 kg: cefazolin 1.5 gm IP for 6-hour dwell x 1 dose.
If allergic to Cefazolin, use Vancomycin 1 gm IP for 6 hr dwell x 1 dose.

## Assessment of Peritoneal Dialysis Prescription

Membrane characteristics may be assessed by PET (note Adequest® is no longer being done). This study must be arranged in advance with the Charge Nurse. Prior to the study, the patient must be stabilized on PD for 1 month and be peritonitis free for 1 month.

## Peritoneal Equilibration Test (PET)

Determines the rapidity of solutes moving across the peritoneal membrane. Patients with rapid transport characteristics (4 hr D/P Cr* >0.82) are better managed with shorter dwell periods (i.e. CCPD) to minimize dextrose absorption and improve ultrafiltration. Patients with slow transport characteristics (D/P Creat* <0.49) require CAPD with longer dwell periods.

To perform "Fast PET":

- Completely drain any effluent that the patient is dwelling from usual Rx.
- Flush pt with 1.5% dialysate, pts usual volume. Ensure complete drain, weigh the bag and record volume.
- Instill 2 L 4.25% dialysate and record fill time (4.25% 2L is preferable for best UF predictions). Zero hour is defined as the end of fill.
- At 2 hours from zero hour, send blood samples for Cr, Urea and Glucose
- At 4 hours, drain completely and record drain time. Send complete effluent for Cr, Urea, Glucose and Volume.

* Calculate D/P Creatinine (Dialysate Cr / Plasma Cr) by dividing the 4-hour dialysate creatinine by the plasma creatinine.

Ref: Twardowski ZJ, Nolph KD, Khanna R, Prowant BF, Ryan LP, Moore HL, &Nielsen MP (1987). Peritoneal Equilibrium Test. Peritoneal Dialysis Bulletin, 7, 138-147.

## Iron Management in Peritoneal Dialysis

### Inpatient

Iron Saccharate - No test dose, maximum 300 mg IV in 250 to 500 mL normal saline over 2 hours. Have Benadryl 50 mg and Solumedrol 100 mg and Adrenalin 1:1000 0.3-0.5 mL on hand.
Oral iron may also be used for maintenance dose

### Outpatient HPDU

Iron saccharate- No test dose required. DO NOT write "IV iron protocol", rather, specify the dose and # of doses.

It is generally ordered in either 2, 3 or 4 doses as follows:

IV iron saccharate 500 g x 2 doses each given over 6 hours
IV iron saccharate 300 g x 3 doses each given over 4 hours.
IV iron saccharate 250 g x 4 doses each given over 3 hours.

The objective is to receive 1g total with doses scheduled at least one week apart.

Advise patients of the risk of allergic reactions prior to ordering IV iron preparations.
IV iron must be booked in advance with Sharron Izatt (Nurse Manager) in order to ensure adequate staffing.

## PD Exit Site Infection (ESI)

- Characterized by erythema around the exit site ± seropurulent discharge. S aureus ESI's are associated with S aureus nasal carriage. Up to 50% of ESI's are associated with tunnel infections. Oral or IP antibiotics resolve ~ 50% of ESI's.
- Consider catheter removal if patient developes peritonitis with same organism.
- Treatment: Local antiseptic, antibiotics, shave distal cuff if protruding, or revise tunnel. May require catheter removal or replacement.

# KIDNEY BIOPSIES

## Elective Kidney Biopsy:

**Before the procedure**:

- ASA should be held x 10 days, warfarin should be held at least 4 days prior to procedure, preferably 5.
- Elective admission package from Monica at Renal Coordination office (12NU ph 3056) -includes requisition from nephrologist, and pt notes.
- Use Renal Biopsy standing order form for pre & post bx orders.
- Carry out pt admission, note pts BP (BP to be <160/95 or Bx may not proceed), examine pts urine microscopically and identify reasons for biopsy (diagnostic, prognostic or therapeutic)
- Follow instructions on biopsy standing order sheet.
- Pt to be NPO prior to procedure
- Ensure PT/INR are within (N) range (INR<1.5). If elevated, consider administration of FFP's. Platelets >50.
- If pt uremic, Cr > 150 umol/L chronically, order DDAVP 20 ug in 100 mL N/S IV over 20 min.
- Consult hematology for any unexplained coagulopathy
- **The biopsying radiologist will cancel the biopsy if appropriate measures to document and correct a coagulopathy are not undertaken.**
- Make sure the post biopsy standing order sheet is in the chart.
- Consent forms for Blood and Tissue are to be filled out by housestaff and signed by pt.
- Informed consent is obtained by the radiologist just prior to the biopsy.
- If pt does not speak English, arrange for a family member or hospital interpreter to translate. If no one can translate, consent can not be obtained and **the biopsy will be cancelled**
- Enter the procedure into the Electronic Patient Record (EPR) computer system as follows:
- Order entry →Procedure tab, type in "Biopsy" →Select "Abd Biopsy"(goes under Interventional)→ Kidneys (5) →Left (as approp) →Tomorrow (4) →Reason Screen: (2) see Comment Field →(8) Comment: "localization for

kidney biopsy" Provide full patient history→OK→Accept (A). If probs, call biopsy room 8257.

- Sedatives should **not** be ordered routinely before a biopsy as pt cooperation is required and excessive sedation can make the procedure impossible to do.
- If it is necessary to use sedation, discuss with biopsying interventionist so that consent can be obtained well in advance.
- The following information is provided to assist in informing the patient:
- A biopsy is “low risk” if kidney size is normal, BP is well controlled, platelet count, PT, PTT & INR are normal and the serum Creat is < 150.
- In these circumstances, the only tangible risk is that of bleeding.
- At our institution, the following are the risk estimates:
- the incidence of gross hematuria is approximately 5-10%,
- the incidence of significant bleeding sufficient to delay discharge is approx 1:100. This refers to persistent hematuria, or perinephric hematoma, which usually settles with conservative management.
- A transfusion is occasionally necessary.
- Serious bleeding complications sufficient to warrant interventions to stop bleeding are of the order of 1:1000.
- Kidney biopsy can be life threatening in 1:5,000 – 1:10,000.
- Inform Dr Heather Reich 14-3439 of any biopsy being carried out.

## Post Biopsy:

- Pts monitored closely for complications, usually apparent in the first few hours.
- The patient is on bed rest for 12-24 hours if admitted. Usually D/C'd next am.
- Vital signs are done frequently and urine is observed for gross hematuria.
- If a complication occurs, notify the biopsying radiologist.
- Most complications are managed expectantly. For a serious complication, consult urology, and/or interventional radiology if consideration of an ablative procedure is warranted.
- If the patient is stable the next morning, they are discharged and an appointment for follow up should be made with the referring staff nephrologist in ~ 2 weeks time to discuss dx and Rx.
- Advise pt to carry out light activities only for 48 hrs post discharge. No heavy lifting or strenuous exercise for 2 weeks. It takes ~ 6 weeks to heal

completely, after the first 2 weeks, they can carry out routine activity and moderate exercise.

- Prepare pts case for presentation at biopsy rounds, focussing on indications for the biopsy.

## Emergency and Transplant Biopsies:

- Much the same as for electives, except the housestaff is responsible for completion of the requisition. Note that req needs to be the one with barcode.
- Pts BP must be within acceptable limits (<160/95)
- Indicate clearly the tests required - usually "light only" for transplants, "light, IF and EM" for native kidney, and if it is "STAT". If it is STAT, make arrangements with pathologist, Dr Rohan John 14-4560.
- For non-transplant biopsy, the completed requisition should be brought to Monica at Renal Coordination Office (12NU) and she will make arrangements for the biopsy.
- If unable to inform Renal Coordination Office, call EM at 14-3184 and Biopsy room 8257 to inform them of biopsy for In-Patients.
- Inform Dr Heather Reich 14-3439 of any biopsy being carried out.

## Arranging Biopsy at Mount Sinai Hospital

- Page MSH Interventional Radiology Staff to perform biopsy.
- Fill out & fax Mt Sinai Medical Imaging Request Form (Form MS275 05/20078)
- If unable to get done at MSH, call Interventional Radiology at TG to arrange, and follow above procedure.
- In either case, make arrangements with pathologist, Dr Rohan John 14-4560.
- Inform Dr Heather Reich 14-3439 of any biopsy being carried out.

**Any biopsy, elective or emergency, which is not low risk or which has any unusual features at all, should be discussed in detail with the biopsying interventionist.**

# TRANSPLANT

## Transplant Rotation

## Wards, ER and Admissions

- 7C (Multi-Organ Transplant Unit) x 5163 (A side), x 5330 (B side) and 10C (Transplant Acute Care Unit) x 4207
- These wards include kidney, kidney-pancreas, liver, heart and lung transplant patients. Each organ has its own team
- Renal transplant patients are admitted under the Renal Transplant service. Kidney-pancreas patients are admitted under the Pancreas Transplant Service; in special circumstances Renal Transplant may be asked to consult (usually when dialysis is required)
- Renal transplant patients may be admitted for: renal transplant, transplant-related problems, graft failure, or for other reasons
- The service also follows all renal transplant patients admitted to another service, including patients at PMH or Mt. Sinai; patients at the Western are followed by the fellow covering the Western, with advice from us as needed
- Consults from ER are handled by Renal Transplant service between **8 AM and 6 PM**. After that, first call is by fellow covering MOT ward (who is usually not a nephrology fellow), who will contact fellow on call for renal transplant to discuss cases
- Transplant coordinators will call if they know of a patient who is going to the ER or needs admission; patients expected in the Emergency Department who arrive between 8 AM and 6 PM, especially when directed by the Transplant coordinator, are the responsibility of the renal transplant fellow. This includes patients whom the MOT on-call fellow has been contacted for after 6 pm i.e. it is the your responsibility to ensure that these patients are promptly reviewed upon arrival

## Order Entry and Documentation

- Orders are placed in MOE/MAR, except for those entries which still go on paper

- **When patients go to the OR, all orders are cancelled, and must be re-entered into MOE/MAR post-operatively**
- Orders do not need to be re-entered when patients move from the Transplant ACU to 7C
- Bloodwork and other tests should be ordered the day before, since patients need blood drawn at specific times to monitor immunosuppressant levels (cyclosporine, tacrolimus, sirolimus)
- Discharge summaries must be completed within 48 hours of discharge; preferably, they should be ready on the day of discharge
    - If a patient requires returning to dialysis, please contact Diane Watson ph 8238 (790-7775) to discuss modality and arrange an out patient spot.
    - Document patients on Sign-out sheet as a form of communication, this is not a legal document, thus other documentation should be on the chart or in OTTR.

OTTR

- OTTR (Organ Transplant Tracking Record) contains the most complete information on each patient, including medical history, medications, allergies and progress notes.
- It also includes the results of bloodwork done at outside labs as well as labs, radiology, pathology and transcriptions done at UHN. **Most patients have their blood done at outside labs and EPR will be incomplete**.
- There is a "Diagnosis" section in OTTR. **It is your responsibility to update this section as necessary**

Some important diagnoses to include for new transplants as needed:

1) PRA (peak) 0, 1-49, or > 50%
2) Donor-specific antibodies (present or "No DSA")
3) Extended criteria donor (single or double)
4) DCD (donation after cardiac death) donor
5) Delayed graft function (dialysis required in first week post-transplant)
6) CMV mismatch
7) EBV mismatch

Acute rejection should be entered as the grade (borderline, IA, IB etc) for acute cellular rejection; Antibody-mediated rejection is a separate diagnosis and entry.

- There is a very long list of diagnoses available; the list is searchable; if the diagnosis does not initially appear, click the “More” button in the search window and try again
- Access to OTTR requires an ID and password, which you will receive at the beginning of the rotation.

## Rounds, Clinics, and Call Schedules

- Please see the schedule. Fellows are expected to attend a weekly post-transplant clinic, and a pre-transplant clinic if possible
- A folder with a variety of primary research and review articles is available in Dropbox. Email Dr. Schiff for access or ask one of the other fellows to share with you. You will still have access to it after your rotation

### New transplants

- Living donor recipients are admitted the day before transplant to the transplant ward; donors are usually admitted under Urology and are followed by the Nephrology team, not Renal Transplant. Occasionally, a living donor is admitted on 7C, but is still under Urology. However, if there is an emergency with the donor after hours, the Renal Transplant fellow should see the patient if requested.
- Deceased donor recipients are admitted either by the MOT fellow on call (if after hours) or by the Renal Transplant fellow. The Renal Transplant fellow must make a decision about whether the patient requires dialysis pre-operatively.
- Some deceased donor recipients will require a **stat cross-match** (see below) prior to transplant. This will be decided by the attending on-call in discussion with Trillium before the patient is brought into hospital. It is usually done in patients who have a PRA > 0% (see below). In those cases, a “backup” recipient will usually be brought in. They must also be assessed and ready for transplant, in case the first recipient cannot go ahead because of a positive crossmatch

### PRA, DSA and Crossmatching

- Antibodies to HLA antigens are a risk factor for both acute cellular and humoral rejection
- PRA refers to panel-reactive antibodies: this reflects the **variety** of anti-HLA antibodies a patient has. It is separately measured for class I and

class II antigens. In both cases, it is reported as a result from 0 to 100%; it is tested every three months for all patients on the renal transplant waiting list

- **cPRA** refers to calculated PRA, and represents antibodies against the current pool of local donors, e.g. a patient with a cPRA of 45% will have antibodies against 45% of donors in the GTA over the last several years
- If a patient has anti-HLA antibodies against a particular donor, these are called **donor-specific antibodies** (**DSA**)
- The **crossmatch test** assesses the presence of DSA against a particular donor. This is reported as positive or negative. There are two different methods to perform the test, complement-dependent cytotoxicity (CDC) and the more sensitive flow cytometry
- Crossmatch tests are done separately for T and B cells. In the setting of a deceased-donor transplant, a **negative T-cell crossmatch by CDC technique** is required to proceed to transplant.
- In some cases, the crossmatch test will be negative but DSA will be positive. This may be reported as a "**positive virtual crossmatch**." This requires discussion with the attending staff, but these patients should be transplanted using the high immunologic risk protocol (below)

## Immunosuppression for New Renal Transplant Recipients

### Definitions of donors and recipients

**Extended Criteria Donor (ECD) Kidneys**

Age >/= 60 yr or
Age 50-59 with 2 of:

- CVA as cause of death
- History of hypertension
- Donor creatinine $\geq$ 135 $\mu$mol/L

Offered to patients on ECD List with informed consent (consent already done at time of listing, not when recipient brought in for transplant)

- Singles if eGFR $\geq$ 70 ml/min
- Doubles if eGFR 50-69 ml/min
- Decline if eGFR < 50 ml/min

Decision whether to use ECD kidneys as singles or doubles made by attending nephrologist

**Hepatitis Virus Positive Donors**

- HBV core antibody positive but HBsAb negative – give with informed consent to immunized HBsAb positive recipients
- HBsAg positive kidneys not used
- HCV Ab positive kidneys currently not being accepted

**High Immunologic Risk**

Defined as:

- Living donor with positive crossmatch or donor-specific antibody (DSA) – will have undergone "desensitization" prior to transplant
- Deceased Donor with DSA or repeat mismatch from previous transplant
- Use high immunologic risk protocol (see below)

**Deceased Donor with Detectable DSA**

- Current sample sent to lab for stat crossmatch
- Tested next working day with single antigen flow beads
- Provided donor HLA is represented on beads, presence or absence of low-titre DSA can be ascertained (if donor HLA not present on beads, will be classified as "cannot be determined")
- If DSA present, treat according to high immunologic risk protocol
- If no low-titre DSA, consider treating according to high risk for DGF protocol as an alternative to decrease immunosuppression exposure

**High Risk for Delayed Graft Function**

Includes kidneys from:

- Donation after cardiac death donors (DCD)
- Extended criteria donors (ECD)
- Neurologically-deceased donors with longer cold ischemia times

**Patients at High Immunosuppressive Risk and Receiving Standard Criteria Donor (SCD) Kidney**

Defined as:

- Age $\geq$ 60
- EBV mismatch
- CMV mismatch
- History of multiple skin cancers or serious malignancy
- HbsAg or HCV positive
- Portal hypertension

## Immunosuppression protocols

The choice of immunosuppression should always be discussed with the attending staff. The following represents current protocols in the Renal Transplant Program, but variations may occur

### Choice of Calcineurin Inhibitor (CNI)

- Tacrolimus (Prograf) in high immunologic risk and default choice in all other cases
- Cyclosporine (Neoral) in high diabetes risk (age > 60, or >/=2 of positive family history, gestational diabetes, previous glucose intolerance, HCV positive, Hispanic, black, or BMI >/=30) AND low immunologic risk (i.e. PRA 0% for class I and II antibodies, current and peak)

### High Immunologic Risk Protocol

See definition above

- IVIg 1 gm/kg IV pre-transplant; maximum dose 140 g
- Solumedrol 7mg/kg up to 500 mg IV over 30 to 60 min prior to Thymoglobulin; then prednisone 1 mg/kg days 1 and 2, 0.5 mg/kg day 3-4, 0.3 mg/kg day 5-13, 0.2 mg/kg day 14 to 20, 0.15 mg/kg day 21
- Thymoglobulin 1.5 mg/kg/day to **total of 7 mg/kg**; first dose to start ASAP post-op (once patient is in Transplant ACU, not in PACU
- MPA (Myfortic 720 mg po bid is standard; older patients may be on mycophenolate mofetil, aka CellCept) starting post-op day 0
- Tacrolimus target 10-15 ng/ml (always a trough level)

### High Risk for Delayed Graft Function (DGF)

See definition above

- No IVIg pre-op
- Steroid dosing as above
- Thymoglobulin dosed as above to **total of 5 mg/kg**
- MPA dosing as above
- Target tacrolimus to 5-10 ng/ml or target cyclosporine with C2 monitoring to 900-1100 ng/ml (blood drawn 2 hours post-dose)

### Low Immunologic Risk With Early Graft Function

- No IVIg pre-op

- Solumedrol 7mg/kg up to 500 mg IV over 30 to 60 min prior to Thymoglobulin; then prednisone 1 mg/kg days 1 and 2, 0.5 mg/kg day 3-4, 0.3 mg/kg days 5-6, 5 mg/day day 7 and onwards
- Thymoglobulin **3-5 mg/kg** as above
- MPA as above
- Target tacrolimus to 5-10 ng/ml or target cyclosporine with C2 monitoring to 900-1100 ng/ml

**Patients at High Immunosuppressive Risk and Receiving Standard Criteria Donor (SCD) Kidney**

See definition above

- No IVIg pre-op
- Solumedrol 7mg/kg up to 500 mg IV over 30 to 60 min prior to Thymoglobulin; then prednisone 1 mg/kg days 1 and 2, 0.5 mg/kg day 3-4, 0.3 mg/kg days 5-6, 5 mg/day day 7 and onwards
- Basiliximab 20 mg IV day 0 and 4 instead of Thymoglobulin
- Start full-dose MPA as above on day 0 but consider reduced dose or duration if stable
- Target tacrolimus to 5-10 ng/ml or target cyclosporine with C2 monitoring to 900-1100 ng/m

## Prophylaxis post-transplant

- Nystatin 100,000 units swish and swallow qid
- Ranitidine 150 mg po qd; use PPI (pantoprazole) in patients with symptoms on ranitidine
- Septra DS 1 tab qMWF; for patients with intolerance or sulfa allergy, alternatives are dapsone 100 mg qd; pentamidine 300 mg by inhalation q 4weeks
- Valganciclovir for all recipients who are CMV-positive and receive thymoglobulin; CMV-negative recipients who receive a kidney from a CMV-positive donor (“CMV mismatch”), regardless of immunosuppression used; also for EBV-negative recipients who receive a kidney from an EBV-positive donor (“EBV mismatch”), regardless of immunosuppression used; standard dose is 900 mg qd, adjusted for renal function
    - Standard CMV prophylaxis is three months for patients who are CMV-positive pre-transplant, six months for patients who are CMV mismatch; no valganciclovir for patients who are CMV-

positive and receive basiliximab, or CMV donor and recipient negative

- All patients should receive DVT prophylaxis with heparin 5000 units s/c bid from time of admission to time of discharge; this includes readmissions. Do not use low-molecular weight heparin due to problems with drug dosing when renal function is rapidly changing.

## Treatment of acute rejection

Acute rejection should also be confirmed by renal biopsy. Arrange for biopsies by speaking to the biopsy centre in Interventional Radiology. Also, the renal pathologists, Dr. Rohan John (ext. 4560) and Dr. Carmen Avila-Casado (ext. 3283) should be informed by phone or email that this biopsy is an “ultra-rush” to ensure same-day results.

Treatment needs to take into account type of rejection (cellular, humoral or both), grade of rejection (i.e. Banff 1A, 1B, 2A, 2B, 3), baseline renal function, patient comorbidities, and degree of chronic changes or scarring. The following are **suggestions only**, and treatment should always be discussed on a case-by-case basis:

- Mild cellular rejections (Banff 1A) are usually initially treated with pulse Solumedrol 7 mg/kg/qd x 3 days. Maximum dose is 500 mg, followed by an oral steroid taper
- More severe cellular rejections are often treated with Thymoglobulin 1.5 mg/kg/d (maximum single dose 150 mg) x 5-10 days. Pre-medicate with acetaminophen and diphenhydramine as per standard thymoglobulin protocol
- Patients who receive thymoglobulin need to be restarted on the same prophylaxis as a new transplant recipient
- Humoral rejection may be treated with plasma exchange and IVIg 1g/kg. Plasma exchange needs to be discussed with Dr. David Barth, director of the plasmapheresis unit. Usual number of plasma exchange sessions is 5. IVIg is usually only given if there will be a 2-3 day break between sessions, and at the end of the course of plasma exchange
- Some cases of humoral rejection may also receive treatment with steroids, Thymoglobulin or rituximab

- All rejections require a reassessment of baseline immunosuppression. Options include: changing cyclosporine to tacrolimus, increasing target tacrolimus levels, changing azathioprine to MMF or increasing MMF dose, starting or increasing steroid dose

## PD Catheter Care after Renal Transplant

- Prior to renal transplant, have patient drained for surgery, and ensure that PD catheter is secured.
- After transplant, if dialysis is not required, advise the patient to continue PD catheter exit site care at least twice weekly until arrangements are made for PD catheter removal. The catheter should be flushed every two weeks, therefore please call HPDU, 14-5672 to advise patient's primary nurse and to arrange PD flushes if the patient is not able to carry them out independently. Please call Zita, PD access coordinator 14-2358, to arrange PD catheter removal.
- If dialysis may be required in the near future, please arrange weekly PD catheter flushes through HPDU, or advise patient to flush weekly, and inform HPDU of patient's status.

## HD Catheter Care after Renal Transplant

- Tunnelled HD catheters should be removed as soon as it is feasible to avoid catheter related infection, ideally, prior to discharge after transplant
- If there is concern that the catheter may be needed, arrange with patient's HD unit regarding flushing and dressing changes at least weekly.
- Arrange catheter removal by Diane Watson through Cyndi Bhola 3518, or through transplant co-ordinator, Kidney Transplant coordinators

**Renal Transplant Coordinators**

| | | |
|---|---|---|
| Jennifer Ly | Deceased Donor Renal | 8374 |
| Lee-Anne Hyer | Deceased Donor Renal | 6817 |
| Andrea Norgate | Kidney-Pancreas | 8866 |
| Julie Cissell | Living Donor Renal | 4577 |
| Michael Garrels | Living Donor Renal | 5889 |
| Lorna Cotter | Post Tx | 3972 |
| Theresa McKnight | Post Tx | 3599 |
| Carlene Masney | Post Tx | 6657 |
| Carol Wright | Post Tx | 5567 |

**Transplant Clinic 4113 Transplant Day Unit 5773**

## Issues for Nephrology Patients (not under Transplant team)

### Transplant Assessment

- All pts should be screened for transplant eligibility when CrCl <30 ml/min. Include willingness, risk factors, potential living donor.
- Write a Referral letter to transplant nephrologist.
- The following is needed to initiate transplant assessment:
- The patient's blood group.
- Current medication records.
- Bloodwork: CBC, lytes, Ca, PO4, LFT's, HIV, HBsAg & Ab, Hep B core, Hep C, CMV IgG, EBV, Varicella Zoster IgG
- If Kidney-Pancreas Tx, above plus C-Peptide
- Cardiac status: ECG, 2D Echo; Persantine Stress Test if age > 40 (within the last year if available).
- Chest Xray, Abdominal U/S and iliac Doppler
- The type of dialysis, date of initiation, unit, days and shift if HD
- The patient's height and weight.
- The referring staff physician.
- A social work assessment completed within one yr of referral.
- Any significant information e.g. disabilities, language barrier, family/social support, substance abuse, nursing concerns.
- Medical history reports, other consult reports e.g. cardiology, hepatology

## Management of Failed/Failing Transplant

Patients to remain on transplant service during the admission for failed transplant, when initiating dialysis. Communicate immunotherapy and steroid plan clearly in Discharge Summary.

When CrCl <30, pt should be referred to Tx RMC (see RMC Referral form pg 12). If pt has been stable at CrCl <30, should refer if there is a new decrease in CrCl.

**Withdrawal of Immunotherapy, Septra:**
Discuss with Transplant Nephrologist for management.

**Withdrawal of Steroids:**

- Consult Transplant Nephrology fellow or staff
- rapid reduction to 15 mg/day (if no acute problem)
  2 weeks later reduce to 12.5 mg/day
  2 weeks later reduce to 10 mg/day
  further taper over 1/4 total duration of steroid treatment
  eg. 4 years of steroids, taper over 1 year to zero
- patients on steroids > 10 years may not recover adrenal function. Suggest maintain on 7.5 mg/day permanently or until next transplant.

# RENAL PALLIATIVE CARE

The annual mortality in the dialysis population in Toronto is approximately 15%. Our patients are getting older, frequently with many co-morbidities. It is not that uncommon that individuals and families elect to stop dialysis or for the team to initiate end of life treatment decision-making. Dialysis patients are justifiably entitled to excellent palliative care, which focuses on physical, emotional and spiritual comfort.

Renal palliative care works best with a team approach. The staff nephrologist, who knows the patient best, should be involved in the terminal care. The renal Social Workers and Nurse Practitioners usually know the patients well, and have a lot of experience with end of life care. They can provide support to the families, and also be an excellent source of support for house staff and nurses. Additionally, nephrology nurses come to know our patients extremely well. Other members of the team may be involved including, Palliative Care, dietitians, physical and occupational therapists, dialysis nurses, chaplains, and others.

Once a decision is made to stop dialysis, death usually follows within 7-14 days. This depends in part on the patient's co-morbidities and on residual renal function. The "best death" occurs when there is a sudden cardiac arrest, secondary to hyperkalemia. Fluid overload, which may occur, can be distressing to families and patients, and can be dealt with by providing medications to ease breathing and secretions. Even when a decision not to provide further dialysis has been made, it is still our responsibility to provide excellent care. This means a plan of care including physical, emotional and spiritual comfort. This may involve family meetings, often of a multi-disciplinary nature and if possible, include the staff nephrologist.

Finally, we see more and more patients using Advanced Directives. We should inquire as to whether or not they exist, and make every effort to use them to guide us in our approach to the terminal care of the dialysis patient.

# RENAL FAILURE - DEFINITIONS AND APPROACH

## Definitions

**Creatinine Clearance (CrCl)** (mL/s) =
$\frac{(140 - \text{Age}) \times \text{Lean body wt (kg)}}{\text{Creatinine} \times 50}$ (x.85 for females) (x60 for mL/min)

GFR in ESRD = (Cl urea + Cl Cr)/2

**CrCl** = $\frac{\text{Ucr} \times \text{vol}}{\text{Scr} \times \text{t}}$

**Anuria** <50mL/d DDX: RPGN, cortical necrosis, bilat RA occlusion (dissection) Very severe ATN , HUS/TTP
**Oliguria** < 400mL/d or < 20mL/hr (minimum .4mL/kg/hr)
**Nonoliguric** >800mL/d
**Polyuria** >3L/d

**Proteinuria**: 1) Normal < 150 mg/d (alb 50%)
2) tubular <1g/d
3) glomerular >1g/d
4) nephrotic >3.5g/1.73 m BSA

## Stages of Chronic Kidney Disease (CKD)

Chronic kidney disease is defined as either kidney damage or GFR< 60 mmL/min/1.73 $m^2$ for ≥ 3 months.

Stage 1 GFR ≥ 90 Kidney damage with normal or ↑GFR

Stage 2 GFR 60-89 Kidney damage with mild ↓ GFR

Stage 3 GFR 30-59 Moderate ↓ GFR

Stage 4 GFR 15-29 Severe ↓ GFR

Stage 5 Kidney Failure GFR <15 (or dialysis)

# Creatinine assay interference by glucose in hyperglycemia

## Medical Staff Bulletin: Vol 18 No 13

Review of external laboratory quality assessment results has identified interference in plasma creatinine measurements by high concentrations of glucose. The interference is significant at plasma glucose levels of > 15 mmol/L. The degree of interference is proportional to the glucose concentration and is most significant for creatinine values in the normal range and up to 200 umol/L.

The positive bias in creatinine results has a relationship of approximately 1 umol/L of creatinine for every 1 mmol/L of glucose. For example, a measured creatinine of 100 umol/L with glucose of 20 mmol/L, the actual creatinine is approximately 80 umol/L. Take this false increase into account in the setting of hyperglycemia, and creatinine levels should be reassessed after glucose levels have normalized.

We are working with the vendor to eliminate this interference. Laboratory reports will contain a comment regarding glucose interference until further notice as follows:

**Results are falsely elevated when plasma glucose levels are >15 mmol/L. Creatinine is higher by 1 umol/L for every 1 mmol/L of glucose. Creatinine should be reassessed after glucose levels have normalized**

As described previously, the Jaffe creatinine method may be affected by icterus resulting in falsely lowered results. Also, assay-dependent increases may occur with acetoacetate, ascorbic acid, fructose, pyruvate, cephalosporins, creatine, proline and chronic lidocaine administration. In vivo inhibition of creatinine secretion can occur with cimetidine, trimethoprim (sulphamethoxazole), ciprofloxacin, or fenofibrate

The UHN Laboratory Medicine Program Management team is available to address your concerns. Please do not hesitate to contact your Site Manager if you have any questions or concerns as follows:

**TGH:** Marni Lollo, 14-5215
**TWH:** Joseph Kuzma, 13-5576
**PMH:** Maria Amenta, 14-5022

**For more information:**

Dr. Paul Yip, 14-6931
Biochemist

*Bulletin issued on July 9, 2009*

# Care and referral of adult patients with reduced renal function

Recommendations from the Canadian Society of Nephrology (CSN)

## Who should be tested for kidney disease?

The following characteristics identify individuals at high-risk of chronic kidney disease:

- Hypertension
- Diabetes mellitus
- Heart failure
- Atherosclerotic coronary, cerebral or peripheral vascular disease
- Unexplained anemia
- Family history of end stage renal disease (ESRD)
- First nation's peoples

Population screening for chronic kidney disease (CKD) is not endorsed.

## What tests to order?

eGFR is endorsed as a measure of kidney function as serum creatinine tends to be ineffective as a marker of early kidney injury.

eGFR may be reported by the laboratory based on conventional mathematical formulas

Calculators and tables are available to calculate eGFR using measured serum creatinine

Web-based calculators: http://www.ukidney.com/page32/page32.html
http://www.kidney.org/professionals/kdoqi/gfr_calculator.cfm
http://www.renal.org/eGFRcalc/GFR.pl
Downloadable calculators and PDA formats: http://www.pcel.info/gfr/
http://www.medcalc.com/

A random urine sample can identify kidney injury. Urine albumin or protein excretion should be quantified with an albumin to creatinine ratio (ACR) or a protein to creatinine ratio (PCR).

24 hour urine collections are not routinely required to assess creatinine clearance or protein excretion as they are cumbersome and often inaccurate.

## What to do with the results?

Decisions about investigation, treatment or referral should not be made based on a single isolated test of kidney function.

Serial testing of abnormal results should be performed within 1-3 months.

Most patients with non-progressive CKD can be managed by non-nephrologists (see reverse of page for management tips). Referral to a nephrologist is recommended in the following situations:

- Acute kidney failure
- eGFR <30 mL/min/1.73m2 (CKD stages 4 and 5)
- Progressive decline of eGFR
- Persistent significant proteinuria (2 out of 3 samples showing positive urine dipstick or ACR>60 mg/mmol or PCR >100 mg/mmol)
- Inability to achieve treatment targets or other difficulties in the management of the CKD patient

For more information visit the Canadian Society of Nephrology website at www.csnscn.ca

Financial support for this CSN initiative provided by unrestricted grants from Amgen Canada and Bristol Myers Squibb.

## Quick Tips on Referral and Management of Chronic Kidney Disease

Most patients with non-progressive CKD can be managed without referral to a nephrologist. The goals of therapy are listed below:

**1) Consider reversible factors**, such as medications, intercurrent illness, volume depletion, or obstruction. An abdominal ultrasound may be indicated when eGFR <60 mL/min/1.73m2.

**2) Minimize further kidney injury** by avoiding, if possible, nephrotoxins such as NSAID's, aminoglycoside antibiotics, IV contrast (if eGFR < 60 mL/min/1.73m$^2$), etc.

**3) Remember to adjust dosages of renally excreted medications.**

**4) Implement measures to slow the rate of progression of CKD:**

a. Target BP is < 130/80 mmHg. Most patients will need 3 or more medications. Diuretics and salt restriction are very useful, and if needed, consider furosemide BID dosing when eGFR < 30 mL/min/1.73m2

b. Target urine protein/creatinine ratio (mg/mmol) is < 60 (< ~ 500 mg/day) or target urine albumin/creatinine ratio (mg/mmol) is < 40.

ACEI and/or ARB are first line therapies in patients with albuminuria or proteinuria.

c. Control blood sugar in diabetes, target HbA1C < 7%.

**5) Implement measures to modify CV risk factors (NB: CV risk >> ESRD risk).**

Follow the Canadian Hypertension Education Program, the Canadian Diabetes Association, and the Canadian Cardiovascular Society guidelines as per groups at highest risk for CV disease.

**6) Referral to a nephrologist is recommended for**:

a. acute kidney failure
b. eGFR < 30 mL/min/1.73m2. (CKD stage 4 and 5)
c. progressive decline of eGFR
d. urine protein/creatinine ratio (PCR) > 100 mg/mmol (~900 mg/24 hours) or urine albumin to creatinine ratio (ACR) > 60 mg/mmol (~500 mg/24 hr)
e. inability to achieve treatment targets

For more information visit the Canadian Society of Nephrology website at www.csnscn.ca

Financial support for this CSN initiative provided by unrestricted grants from Amgen Canada and Bristol Myers Squibb.

## Approach to Acute Kidney Injury (AKI)

### PRERENAL

1) True volume depletion
- Renal losses : diuretics, osmotic diuresis (eg. glucose), hypoaldosteronism, Na wasting nephropathy, DI
- GI losses : vomiting, diarrhea, bleeding
- Skin or respiratory losses (insensible losses, sweat, burns) N= 800mL-1L/d, ↑20% with each 1° C
- Third space sequestration (intestinal obstruction, crush injury/ skeletal #, pancreatitis)

2) Hypotension (shock/sepsis)
3) Edematous states (heart failure, cirrhosis, nephrosis)
4) Selective renal ischemia (hepatorenal, NSAIDs, bilat RAS, dissecting AA, ACEI, CSA)

| | Prerenal | ATN (heme granular casts) |
|---|---|---|
| Uosmol (mosmol/L) | >500 | <350 |
| Una (mEQ/L) | <20 | >40 |
| FENa | <1 | >3 |
| Uspec. gravity | >1.015 | <1.015 |

Urinalysis - bland

**POST RENAL**

| Anatomical | Functional |
|---|---|
| prostatic hypertrophy | DM |
| cervical Ca | anticholinergic meds |
| strictures | Neurogenic bladder |
| tumour | |
| external compression eg. colon ca | |
| stones, clots, sloughed papillae | |
| retroperitoneal tumours/fibrosis | |

Diagnosis by U/S demonstrating hydronephrosis.
Urinalysis – bland
Remember: ***"The presence of urine does not exclude obstruction"***
**RENAL**

*Preglomerular (vascular), Tubular, Interstitial, Glomerular*

**Preglomerular**
- accelerated HTN, malignant HTN
- scleroderma
- cholesterol or atheroembolic disease
- thrombotic microangiopathy eg. HUS/TTP

Urinalysis: often bland, sometimes proteinuria, occasionally RBCs,

eosinophils

**Tubular**
- Polycystic Kidney Disease, Multiple Myeloma

- ATN *(ischemia→prerenal insuff→ATN→cortical necrosis)*
  shock, sepsis, drugs (eg NSAIDs, antibiotics), contrast, rhabdomyolysis

| Endogenous | Exogenous |
|---|---|
| Ca++ | Antibx eg. AMGs, Ampho B |
| Uric acid | Contrast dye |
| Hemoglobinuria | ChemoRx (esp. cisplatin, MTX) |
| Myoglobinuria | Cyclosporin A |
| *(rhabdo)* | Acyclovir |
| | NSAIDs |
| | ACEI |

Urinalysis: tubular epithelial cells, granular casts "muddy brown", hemegranular casts, eosinophils, RBC's, crystals (NOT RBC cast = GN)

**Interstitial**

**Acute**
- Idiopathic
- Drugs:
  - Antibx: penicillin, methicillin, amp, rifampin, sulpha, cipro, pentamidine
  - NSAIDs (and other antiinflamm other than prednisone)
  - Diuretics: thiazides, lasix, bumetanide (sulpha derivatives)
  - CNI's - cyclopsorin A, tacrolimus, Dilantin, allopurinol,
- Infection: Streptococcus, leptospirosis, Rocky Mtn spotted fever, Legionnaire's, EBV, CMV, acute pyelonephritis
- Systemic: lymphoma, leukemic infiltration, SLE,
- Renal transplant rejection, toxic radiation

Urinalysis**:** casts, WBC, WBC casts, eosinophils

**Chronic**
- Therapeutic and environmental agents, e.g. analgesics, lithium, heavy metals (lead, cadmium)
- Immunologic conditions, e.g. sickle cell disease, lymphoproliferative diseases
- Metabolic disorders, e.g. uric acid nephropathy, cystinosis

- Infections - systemic or local

## Glomerular

- Nephrotic Syndrome: Proteinuria >3.5g/1.73 m BSA/d, ↓albumin <30, ↑chol, peripheral edema
- Nephritic: active urine sediment, > 5 RBC/HPF, RBC casts, HTN, ↓GFR, +/- proteinuria

| **NEPHROTIC** | **NEPHRITIC** |
|---|---|
| | **Focal Proliferative** |
| 1) Minimal change | 1) IgA = Berger's = Mesangioproliferative |
| • Hodgkin's D | • Advanced liver D, |
| • NSAID | • Sprue |
| | • Dermatitis herpetiformis |
| 2) FSGS | |
| | 2) HSP |
| • HIV/AIDS | |
| • Heroin abuse | 3) Alport's (Familial nephritis) |
| • Reflux nephropathy | |
| • Massive obesity | 4) SLE. |
| 3) Membranous | |
| • SLE, Sjogren's | **Diffuse Proliferative** |
| • Sacroid, sickle cell D. | |
| • Ca: lung, breast, colon, stomach, lymphoma | 1) Post Infectious |
| • Meds: Gold, Cd, Captopril, probenicid D-penicillamine | • Grp A Beta hemolytic strep<br>• Bacterial endocarditis<br>• Infected ventriculoatrial shunts |
| 4) Diabetes Mellitus | 2) Membranoproliferative |
| 5) Amyloidosis/MM | • malaria, Hep B&C, chronic infec$^{n}$ |

- "shunt" nephritis, Sickle cell D

6) MPGN - rare
- SLE, HUS/TTP, mixed cryo
- Congenital complement defic'y

3) Cryoglobulinemia

4) SLE

5) RPGNs

**Rapidly Progressive Glomerular Nephritis (RPGN)**

| Anti-GBM | Immune Mediated | ANCA associated |
|---|---|---|
| • Anti-GBM D | • MPGN | • Wegener's (C-ANCA) |
| • Goodpasteur's | • Post Strep GN | • PAN (C & P ANCA) |
| | • IgA (<3%) | • Churg Strauss - P-ANCA |
| | • SBE/shunt nephritis | |
| | • Cryoglobulinemia | |
| | • SLE | |
| | • Idiopathic crescenteric GN | |

| Immunofluorescence | Disease | Rx |
|---|---|---|
| • lumps/bumps | SLE | Immunosuppressants |
| • linear | Anti GBM | Cytotoxic drugs eg. cyclophosphamide |
| | Goodpasteur's | Plasmapheresis |
| • none (pauci-immune) | ANCA associated Ds. | Cyclophosphamide No plasmapheresis |

Urine Sediment in DDX of ARF

**Normal or few RBC or WBC**

Prerenal azotemia
Arterial thrombosis or embolism
Preglomerular vasculitis
HUS/TTP
Scleroderma crisis
Postrenal azotemia

**Granular casts**

ATN (muddy casts)
Glomerulonephritis or vasculitis
Interstitial nephritis

**RBC casts**
GN or vasculitis
Malignant HTN
Rarely IN

**WBC casts**
AIN or exudative GN
Severe pyelonephritis
Marked leukemic or lymphomatous infiltration

**Eosinophiluria (>5%)**
Allergic IN (Antibx>NSAIDs)
Atheroembolic disease

**Crystalluria**
Acute urate nephropathy
Calcium oxalate (ethylene glycol toxicity)
Acyclovir
Sulfonamides
Radiocontrast agents

## Contrast Nephropathy

### Definition
Proportional rise in creatinine (25-50%) within 48-72 hrs of receiving radiocontrast medium - other causes ruled out

### Presentation
Creatinine peak 4-5 days, with return to baseline 7-10 days
Usually non-oliguric
Low FeNa
UA – mild protein; Micro – bland or granular casts

### Risk Factors

- Pre-existing renal insufficiency (CRI)
- Diabetes
  - -No CRI risk is similar to non-diabetics
  - -With CRI risk = 2x CRI alone
  - -Often oliguric, requiring dialysis
- CHF- related ECFV↓ +/- renal vasoconstriction
- MM - related ECFV↓ +/- CRI
- Contrast agent
  - -High volume
  - -High osmotic>low osmotic >isosmotic medium

**Prevention**

- Avoid contrast, if necessary - Low contrast volumes
- Isosmotic medium in CRI (Standard at UHN)
- ECFV repletion/hydration

**Recommendations**

- Measure renal function before, 48h and 72 hrs after contrast
- Assess clinical circumstances and ensure adequate hydration

If the patient is in hospital then give

- Normal Saline IV 1mL/kg/hr 6 -12hrs before and 12-24 hrs after procedure.
- N-Acetylcysteine (Mucomyst) 600 mg po BID on the day before and day of procedure, along with hydration

If the patient has not been in hospital, or there is no time available to give an overnight infusion, give

- NaHCO3 (150cc in 850 cc D5W) at rate of 3 mL/kg/hr starting one hr before procedure and continue at 1 mL/kg/hr for 6 hrs after the contrast study.
- N-acetylcysteine (Mucomyst) 1200 mg po BID on day of procedure

Hold diuretic, ACEI/ARB, Calcinurine inhibitors and metformin. Avoid nephrotoxins, e.g. NSAIDS

**References**

KI 1998, vol 53, p. 230-242
AJKD 1994, vol 24, p. 713-727
JAMA 2004;29:2328
NEJM 2000, vol 343 (3) p 180-184

## A comparison of the RIFLE and AKIN definition and classification schemes for Acute Kidney Injury (AKI)

| RIFLE category | Serum creatinine criteria | UO criteria |
|---|---|---|
| **(A) The Acute Dialysis Quality Initiative (ADQI) criteria for the definition and classification of AKI (i.e. RIFLE criteria)** | | |
| Risk | Increase in serum creatinine ≥1.5X baseline or decrease in GFR ≥ 25% | <0.5 mL/kg/h for ≥6 h |
| Injury | Increase in serum creatinine ≥2.0X baseline or decrease in GFR ≥ 50% | <0.5 mL/kg/h for ≥12 h |
| Failure | Increase in serum creatinine ≥3.0X baseline or decrease in GFR ≥ 75% or an absolute serum creatinine ≥354 µmol/L with an acute rise of at least 44 µmol/L | <0.3 mL/kg/h ≥24 h or anuria ≥12 h |
| **AKIN** | Serum creatinine criteria | UO criteria |
| **(B) The Acute Kidney Injury Network (AKIN) criteria for the definition and classification of AKI** | | |
| Stage 1 | Increase in serum creatinine ≥26.2 µmol/L or increase to ≥150–199% (1.5- to 1.9-fold) from baseline | <0.5 mL/kg/h for ≥6 h |
| Stage 2 | Increase in serum creatinine to 200–299% (>2–2.9 fold) from baseline | <0.5 mL/kg/h for ≥12 h |
| Stage 3 | Increase in serum creatinine to ≥300% (≥3-fold) from baseline or serum creatinine ≥354 µmol/L with an acute rise of at least 44 µmol/L or initiation of RRT | <0.3 mL/kg/h ≥24 h or anuria ≥12 h |

A comparison of the RIFLE and AKIN criteria for acute kidney injury in critically ill patients Sean M. Bagshaw[1], Carol George[2], Rinaldo Bellomo and for the ANZICS Database Management Committe Nephrology Dialysis Transplantation 2008 23(5):1569-1574; doi:10.1093/ndt/gfn009

# Glomerulopathies

## Focal Segmental Glomerular Sclerosis (FSGS)

**Pathology**

| ***Glomerular*** | ***Interstitium*** | ***Variants*** |
|---|---|---|
| • Focal lesions | - Tubular atrophy | Classic |
| • Segmental scarring | - Fibrosis | - Tip |

- Adhesions - Hypercellular
- Intracapillary foam cells - Collapsing

**Natural History**

- 3-15% of all biopsies 7-12% of all proteinuria
- Most common progressive type in children & black population (all ages)
- Increasing frequency in past decade
- Children M:F = 1:1
- Adults M:F = 2:1

***Presentation***

- Nephrotic 70% children, 50% adults
- Asymptomatic proteinuria 30-50%

***Associated Findings***

- Hypertension 25% children, 50% adults
- Impaired GFR 20-40%
- Microhematuria 40-60%

***Course***

- Spontaneous complete remission 5-8%
- Rapid progressive renal failure 10-15%
- Slowly progressive renal failure 40-60%
- Persistent proteinuria 20-30%

**Prognostic Factors**

| ***Good*** | ***Bad*** |
|---|---|
| • Complete remission | Interstitial fibrosis |
| • Steroid responsive | Impaired GFR |
| | Persistent high grade proteinuria |

**Treatment**

- Establish diagnosis is *primary*
- Symptomatic Rx
- Rx of co-morbid condition e.g. hyperlipidemia
- Nephrotic patients: Prednisone 1 mg/kg/day x 3-6 mos
  If no response: cyclophosphamide 1-1.5 mg/kg x 3-6 mos* or
  Cyclosporine 4-6 mg/kg x 6 mos

- Subnephrotic/stable GFR: limit Rx to steroids or observation only

Recommendations

1) Initial - prednisone 0.5-1 mg/kg x 6 mos (grade C)
2) Resistant/dependent: cyclosporine 3-5 mg/kg x 4-12 mos (Grade D) or Cyclophosphamide 2.5 mg/kg x 3 mos*

## Membranous GN

### Pathology

- Diffuse, uniform thickening of GBM
- Minimal mesangial cell proliferation
- "Staging" dependent on position of deposits on EM

### Natural History

- 5-10% of all biopsies
- 10-20% of all proteinurias
- common cause of adult nephrotic syndrome
- rare in children (<1% under age 16 - usually d/t maligancy)
- secondary causes 20-30% of cases, malignancy ↑ with age

#### *Presentation*

| | |
|---|---|
| • Nephrotic | 60-70% |
| • Asymptomatic proteinuria | 30-40% |

#### *Associated finding*

| | |
|---|---|
| • Renal insufficiency | 10% |
| • Hypertension | 10-20% |
| • Microhematuria | 40-60% |
| • Renal vein thrombosis | 5-30% |

#### *Course* ($1^0$ only)

| | |
|---|---|
| • Spontaneous remission | 20-30% |
| • Persistent proteinuria | 30-40% |
| • Progressive renal failure | 20-30% |

### Prognostic Factors

***Good*** ***Bad***

- Complete remission
- Low level proteinuira (<3.5g/d)
- Female sex

Persistent high grade proteinuria
Renal insufficiency
Hypertension
Male sex

**Treatment**

- Low risk = chlorambucil/prednisone routine (Grade A)
- High risk = a) cyclosporine 4-5 mg/kg x 6-12 mos +/- prednisone (A/B)
  b) chlorambucil/prednisone routine (A/B)
  c) cyclophosphamide 2 mg/kg x 4-12 mos +/- prednisone (C/D)*
- Mod/high risk = aggressive Rx of HTN, hyperlipidemia, thrombotic risk

* Remember to follow up re. side effects of Cyclophosphamide /prednisone.

## Membranoproliferative GN (MPGN)

**Pathology**

- *Glomerular*
  - mesangial cell proliferation
  - matrix expansion (tram tracks)
- *Variants*

  Type I - subendothelial (+/- mesangial) deposits - most common
  Type II - dense deposits - abnormal material in GBM - rare
  Type III - mixed - subendothelial + subepithelial - rare

**Natural History**

- Uncommon - 1-3% of all biopsies, 3-5% of all proteinuria
- ↓ing frequency in past 2 yrs (vs. 2ndary ↑ng, esp Hep B & C)
- Children - predominance of type II vs. adult type
- Predominantly Caucasians affected

***Presentation***

- Nephrotic 40-60%
- Asymptomatic 20-40%
- Acute nephritic syndrome 10-30%

***Associated Findings***

- Hypertension 30%
- Microhematuria 60-70%
- Impaired GFR 30-50%

- Hypocomplementemia 80-90%
- Type I - classic pathway C3↓ C4↓
- Type II (III) - alt pathway C3↓ C4N

***Course***

- Spontaneous remission 20-30%
- Slowly preogressive renal failure 40-50%
- Persistent proteinuria 20-30%

**Prognostic Factors**

| ***Good*** | ***Bad*** |
|---|---|
| Spontaneous remission | Persistent heavy proteinuria |
| | Interstitial fibrosis |

**Treatment**

All ages with N GFR, subnephrotic proteinuria: no specific Rx (Grade B/C)

Children - nephrotic +/- ↓GFR: prednisone 40mg/$m^2$ x 6-12 mos
+ conservative measures (B/C)
Adults - nephrotic +/- ↓GFR: ASA 325 mg +/- dipyridamole 100 mg TID x 12 mo + conservative measures (B/C)

## IgA Nephropathy

**Pathology**

- Mesangium cell proliferation (focal or diffuse)
- Mesangium matrix expansion
- IgA in mesangium on IF

**Natural History**

- 10-25% of all biopsies
- 5-15% of all proteinuria
- Most common glomerular pathology
- Uncommon in children
- Rare in blacks
- Family history 10-20%
- Secondary causes 10-20% of cases

***Presentation***

- Microscopic hematuria 70-95%

- Macroscopic hematuria 15-40%
- Asymtomatic proteinuria 5-25%
- Acute renal failure 2-15%
- Nephrotic syndrome 2-10%

***Associated Findings***

- Hypertension 10-20%
- Renal insufficiency 10-25%

***Course***

- Spontaneous remission 10-15%
- Progressive renal failure
  - Slow 10-50%
  - Rapid 5-10%
- Persistent microhematuria 30-50%
- Persistent proteinuria 15-30%

**Prognostic Factors**

| ***Good*** | ***Bad*** |
|---|---|
| Microhematuria alone | Hypertension |
| Recurrent macrohematuria alone | Moderate proteinuria (1-4 g/d) |
| | Renal insufficiency |
| | Male |
| | Age >35 |

**Treatment**

- No adverse profile - ACEI
- Adverse profile - ACEI + a) Fish oil b) Prednisone OD x 1-2 years
- Unstable - IV IG x 3 mos and IM IG x 6 mos

## Management of Hyponatremia

Nephrology is frequently called to assist with management of Hyponatremia, both acute (<48 hrs) and chronic (>48 hrs). Acute Hyponatremia can manifest with obvious neurological changes, whereas chronic may have more subtle changes. The Staff Nephrologist must always be involved in management of hyponatremia.

It is critical to avoid rapid correction of severe chronic Hyponatremia (severe is defined as < 120 mmol/L). As a guideline, it is generally advisable

to give DDAVP to prevent water diuresis. Consider giving DDAVP early and prophylactically to give slow predictable rate of correction.

Suggested management:

Foley catheter and hourly urine output
Electrolytes Q.4.h in first 24 h
Urine electrolytes Q.12.h.
DDAVP 1-2 ug IV or SC to *all* patients in ER with untreated severe chronic Hyponatremia

| Risk factors* | Δ Na per day | |
|---|---|---|
| | Target | Maximum |
| No risk factors | 8 | 12 |
| Any risk factor | 4 | 8 |

*Risk factors: hypokalemia, malnutrition, alcoholism, liver disease, $P_{Na}^{+}$ < 105 mmol/L

## Pregnancy & HTN

**Types:** 1) pre-existing i.e. present before 20 wks gestation
2) Gestational (transient) - no proteinuria
3) Pre-eclampsia/eclampsia - + proteinuria
4) Pre-existing + superimposed gestational

**When to admit:**
BP ≥ 170/110

PET suspected or diagnosed

**When to Rx:**
BP ≥ 140/90 and:
- symptoms
- chronic HTN
- < 28 weeks
- PET

Otherwise Rx BP > 150/95

**Monitor** (if outpt follow weekly)**:**
- ↑ uric acid (↑ perinatal complications)
- CBC (↓ Plts);
- Liver enzymes
- 24 hr urine protein
- fetal monitor

**Treatment**: aim for reducing BP over at least 24 hrs (be careful not to let the BP plummet, as there is no placental autoregulation)

| **BP >170/110** | **BP <170/110** | **C/I** |
|---|---|---|
| Hydralazine po | Methyldopa | ACEI |
| Labetolol IV | Labetolol po | ARB |
| Nifedipine SL | Nifedipine | |

**Goals:**
for chronic HTN BP <170/110 (nadir at 20 wks)

Postpartum HTN - **All antihypertensives safe for breastfeeding**
- BP highest 3-5 days post delivery
- May last 6 mos

# MEDICATIONS IN CKD

## Dose adjustments of drugs for renal failure

Estimate CrCl using Cockcroft-Gault equation:

$$\text{CrCl (mL/s)} = \frac{(140-\text{age}) \times \text{wt (kg)}}{50 \times \text{SCr (umol/l)}} \quad (\times 0.85 \text{ for women})$$

Do not use MDRD (eGFR) for drug dosing as it has not been validated.

Commonly prescribed drugs that require dose adjustment:
- Antibiotics (penicillins, cephalosporins, quinolones, Vancomycin, Septra)
- H2 receptor blockers
- Allopurinol
- Analgesics
- Antivirals (gancyclovir, acyclovir)

## Dose adjustment for dialysis

Consider:
- Type of dialysis (HD vs. PD. vs. CRRT)
- Drug properties (MW, protein binding, water solubility, metabolism)
- Drugs that are renally cleared are usually dialyzable (except Vancomycin)
- Most antibiotics (penicillins & cephalosporins) are dosed after dialysis
- Dose antibiotics per UHN Guidelines for Antimicrobial Use
- Discuss with Nephrology fellow/staff or pharmacist

## Common problems in the ESRD population and their therapies

### Bleeding Complications

- Platelet dysfunction in the uremic environment contributes to bleeding
- Before invasive procedures, advisable to use FFP's or DDAVP
  DDAVP dosing: 0.3 ug/kg/hr to max 20 ug
  Max 20 ug in 100 mL N/S over 20 min
- To stop bleeding, apply direct pressure for prolonged period of time.
  May require Gelfoam

Never use Thrombostat (high incidence of anaphylaxis in HD pts)

## Anemia – **Erythropoiesis Stimulating Agents (ESA's)**

- Decreased erythropoietin (EPO) production in renal failure contributes to anemia, there are 2 main ESA's - Darbepoetin (Aranesp®) and erythropoietin (Eprex®)
- Most patients require ESA supplementation +/- IV or po iron
- Iron should be monitored (see Iron Assessment Algorithm)
- Darbepoetin (Aranesp®) guidelines: 0.45 mcg/kg s.c. or IV once weekly
- For those on chronic HD at TGH, Aranesp® is given Tuesdays and Fridays.
- Because of very rare pure red cell aplasia seen with some ESA recipients, pts on HD are to receive Aranesp, and PD/pre-dialysis patients to receive subcutaneous Eprex® only from a multi-dose vial, or use Aranesp®.
- The patient may experience an increase in blood pressure; therefore, BP should be well controlled **prior** to initiating ESA's, and monitored following.
- Goal hemoglobin: 110-125

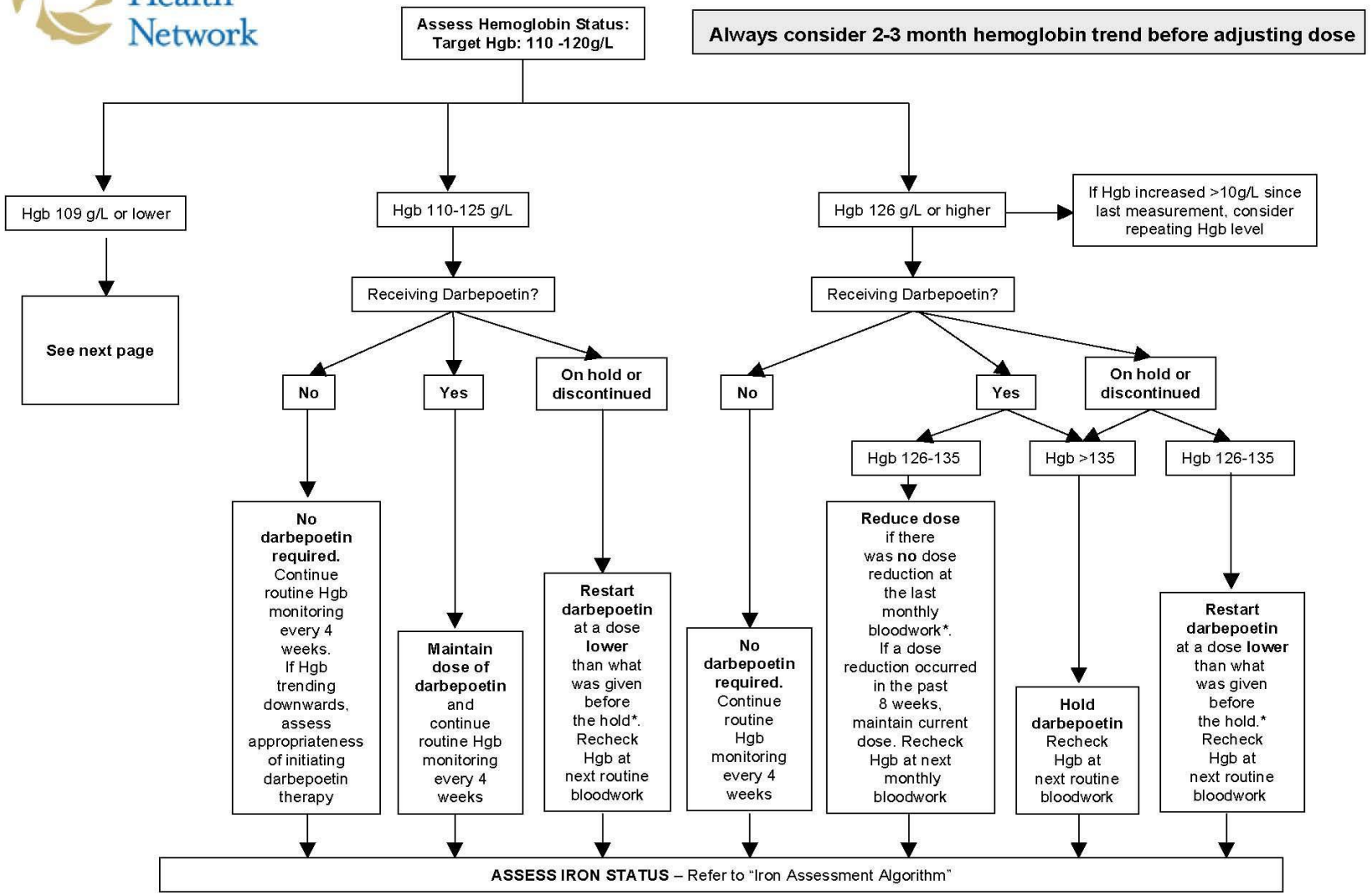
Common causes of non-response to EPO include:
- Iron deficiency - Blood loss (active bleeding or hemolysis)
- Infection - Active inflammatory disease
- Malignancy - Hyperparathyroidism

### Anemia Management Protocol for HD

The following protocol was developed for hemodialysis patients by Marisa Battistella, Pharm D. It is for those being managed with IV Iron. Oral iron is also an option (see "Iron" section).

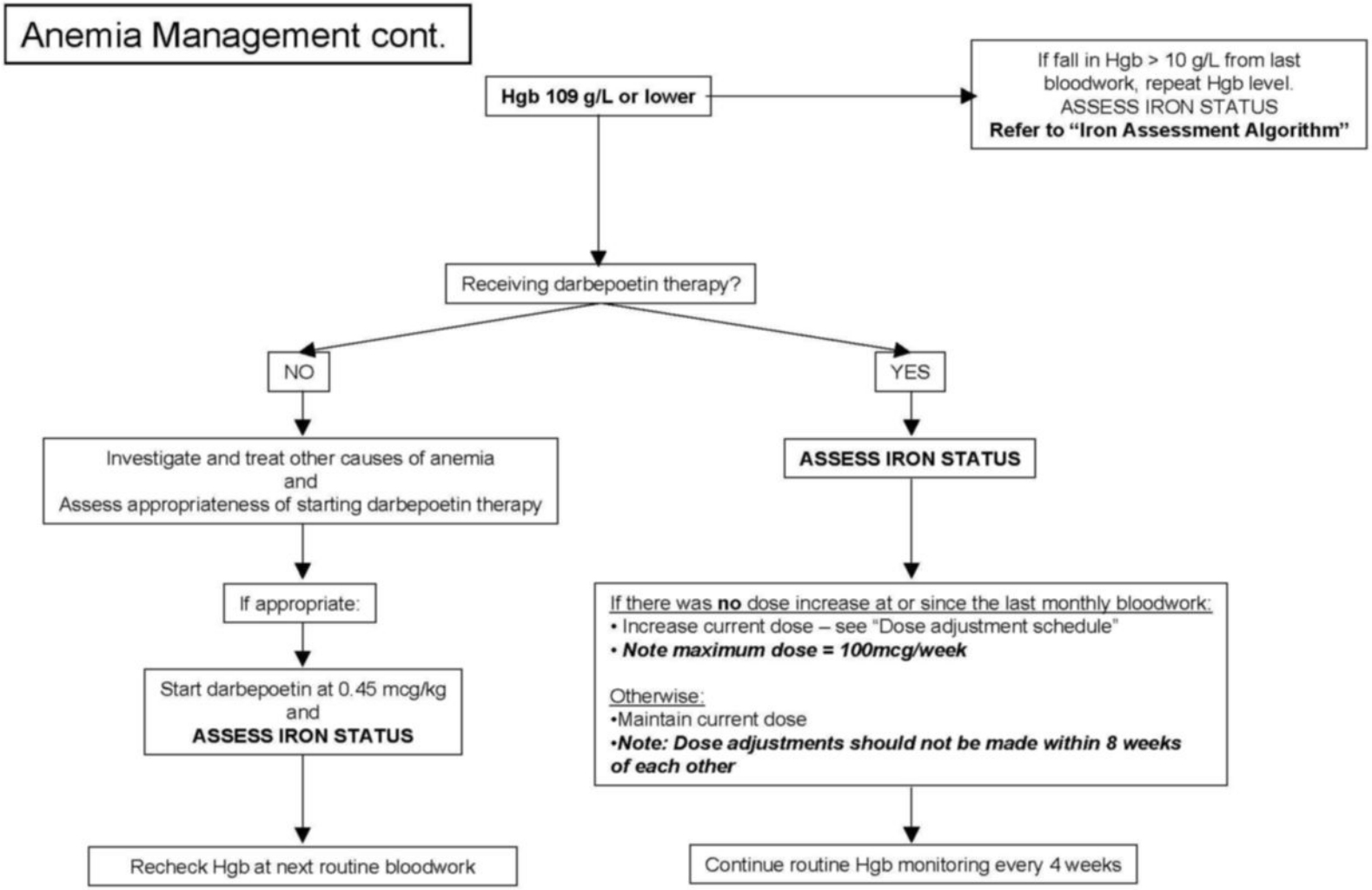
University Health Network

# Anemia Management Protocol

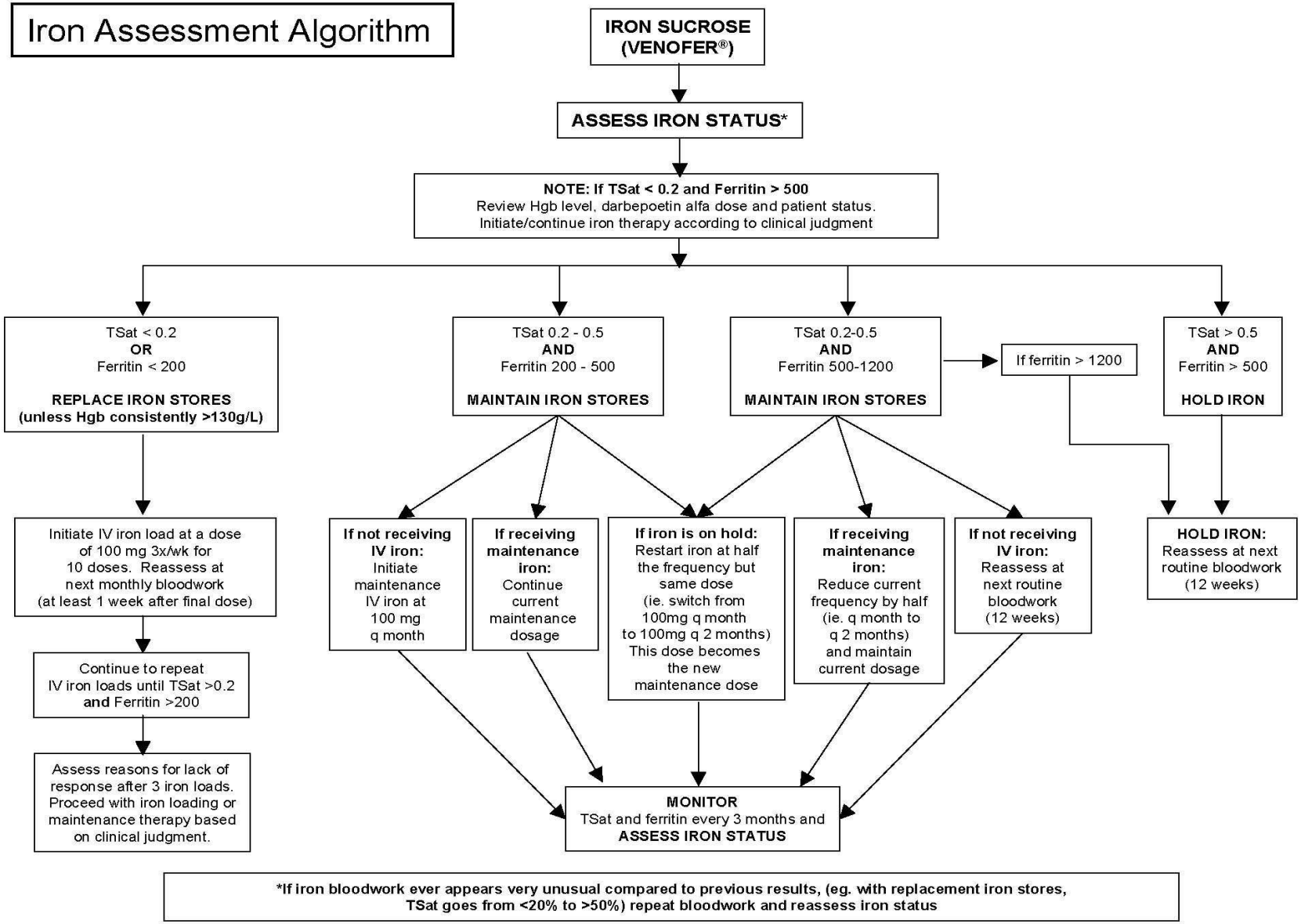



* **See "Dose adjustment schedule for patients using Darbepoetin Alfa"**

# Anemia Management cont.



# Iron Assessment Algorithm



## Dose Adjustment Schedule for Patients using Darbepoetin Alfa

| Current Dose | Increase Dose To | Reduce Dose To |
|---|---|---|
| 10 mcg q2wk | 10 mcg/wk | 10 mcg monthly or D/C darbepoetin Reassess monthly |
| 10 mcg/wk | 20 mcg/wk | 10 mcg q2wk |
| 20 mcg/wk | 30 mcg/wk | 10 mcg/wk |
| 30 mcg/wk | 40 mcg/wk | 20 mcg/wk |
| 40 mcg/wk | 50 mcg/wk | 30 mcg/wk |
| 50 mcg/wk | 60 mcg/wk | 40 mcg/wk |
| 60 mcg/wk | 80 mcg/wk | 50 mcg/wk |
| 80 mcg/wk | 100 mcg/wk | 60 mcg/wk |
| 100 mcg/wk | Max dose 100mcg/wk | 80 mcg/wk |

## Conversion from Eprex® to Aranesp®

Aranesp is the standard ESA used at UHN, however some individuals may come in on Eprex® and need to be converted to Aranesp. A simple method of conversion is to multiply Eprex® dose by 4 and use 1st 2 digits as the Aranesp® dose.

A more specific method is to multiply weekly Eprex® dose by conversion factor in table below. Aranesp® dose is the 1st 2 digits rounded off. E.g. Pt gets Eprex® 8,000 u/week with Hgb 122 → 8,000 x 4 = **32**,000, therefore give **30** ug Aranesp®

Prefilled syringes available in 10, 20, 30, 40, 50, 60, 80,100 and 150 ug.

Aranesp® start dose: 0.45 ug/kg/wk

Give Aranesp® once per week or once per 2 weeks.

Order Aranesp® IV for patients on HD and SC for all others.

## Conversion Factors Eprex® to Aranesp®

| Eprex Dose | Hemoglobin | |
|---|---|---|
| U/week | <120 g/L | ≥120 g/L |
| <15,000 | **5x** | **4x** |
| ≥15,000 | **4x** | **3x** |

Remember to fill out registration form for new Aranesp® therapy and send to Dr. Richardsons office (8NU-861).

### Guidelines for Registering Renal Failure Patients for ESA (Erythropoietin or Darbepoietin) at UHN and MSH

1. Complete a Ministry of Health EPO registration form (available in the HD units, PD unit, the nephrology ward and through Dr. Richardson's office)
- Include the patient's MRN for identification purposes as well as name
- Fill out all spaces including MOH insurance number
- In the section "type of dialysis" check "none" if they are predialysis or transplanted
- In the section "Physician" print the name of the staff physician and your name if different – a signature is not required
- For patients not on dialysis, indicate if they are predialysis or transplant

2. **For center hemodialysis patients**
- After completing the form, send it to Dr. Richardson's office (8NU-861)
- Write an order for erythropoietin in the patient's chart

3. **For peritoneal dialysis patients**
- After completing the registration form, make a photocopy of the top page
- Write a prescription for erythropoietin
- Give the patient **both** the prescription **and** the copy of the registration form to take to TGH pharmacy. The registration form will serve as proof the patient has been registered
- Give the registration form to the ward clerk who will send it to Dr. Richardson's office

4. **For office or clinic outpatients at TWH, TGH, MSH or PMH**
- After completing the registration form, make a photocopy of the top page
- Write a prescription for erythropoietin
- Give the patient **both** the prescription **and** the copy of the registration form to take to either TWH or TGH pharmacy. The registration form will serve as proof the patient has been registered
- Send the registration form to Dr. Richardson's office. There is no need to phone the office since the copy of the registration form has been given to the patient to take to pharmacy

5. For **inpatients** at TGH, TWH, MSH or PMH being registered for EPO for the **first** time
- After completing the registration form make a copy of the top page

- Order Aranesp/Eprex in Electronic Patient Record (EPR); give a copy of the registration form to the ward pharmacist
- Send the registration form to Dr. Richardson's office

6. For **inpatients** at TGH, TWH, MSH or PMH who are receiving erythropoietin at other dialysis centers and are transferred here temporarily for care and require erythropoietin
- Write an order for erythropoietin in the chart
- Add a statement to the effect that the patient is registered for erythropoietin at another center
- **Do NOT fill out a registration form for these patients**

7. Note that if a patient comes to the outpatient pharmacy with a prescription for EPO who is not on the registration list or who does not have a photocopy of the registration form, the patient will be asked to return to their nephrologist's office or clinic to be properly registered, or if they go to an outside pharmacy, they will be charged the cost of the meds. **Revised July 2002**

## Iron

1) IV iron. Two forms used are iron dextran and iron saccharate (iron sucrose). Please refer to the sections on IV iron for HD and PD specifically.
2) Oral iron. The recommended oral iron therapy is 200 mg elemental iron OD or Ferrous gluconate 600 mg TID or Ferrous fumarate 300 mg BID

How to advise patients on how to take iron po:
- Absorbed best on empty stomach, either 1 hr pre or 2 hrs after meals
- Iron and phosphate binders (calcium & aluminum) bind together so they should be taken 1 -2 hrs apart
- Separate other drugs that interact with iron such as cipro, L-Thyroxine, methyldopa.

## Vitamin deficiency

- Replavite 1 tab daily, a water soluble vitamin that contains B vitamins, vitamin C and folic acid
- Other multivitamins may contain fat soluble vitamins which may accumulate and cause toxicity and should not be substituted

## Hyperphosphatemia

Calcium carbonate is used as a phosphate binder given with meals
Calcium carbonate 1250mg = $Ca^{++}$ 500mg
Tums regular strength = $CaCO_3$ 500mg = $Ca^{++}$ 200mg
Tums extra strength = $CaCO_3$ 750mg = $Ca^{++}$ 300mg

Tums ultra = $CaCO_3$ 1000mg = $Ca^{++}$ 400mg

- For severe hyperphosphatemia with hypercalcemia, aluminum hydoroxide can be used short term e.g. Amphogel 15-30 mL TID with meals x 5 days then reassess
- Sevelamer (Renagel)/Lanthanum (Fosrenol) - Ca-free $PO_4$ binders - useful for pts with both hyperphosphatemia and hypercalemia - expensive and as yet not covered by ODB - requires "Exceptional Access Program" (formerly "Section 8") form from pharmacist.

## Hypophosphatemia

- Hold $PO_4$ binders.

Patients on HD or SLED may develop hypophosphatemia. One way of correcting this is to add Fleet $PO_4$ enema (concentrated sodium phosphate) to the acid concentrate. 100 mL of Fleet enema contains approximately 175 mmol of phosphate – which gets diluted 1:45 by the dialysis machine.

There are 2 sizes of acid jugs, 5.0 and 4.5 L - determine from the nurse which size is being used:

For <u>5.0 L</u> acid jugs:

| Amount of Fleet enema | Final Dialysate Concentration |
|---|---|
| 125 mL | 1.0 mmol/L |
| 100 mL | 0.8 mmol/L |
| 50 mL | 0.4 mmol/L |

For <u>4.5 L</u> acid jugs:

| Amount of Fleet enema | Final Dialysate Concentration |
|---|---|
| 120 mL | 1.0 mmol/L |
| 95 mL | 0.8 mmol/L |
| 47 mL | 0.4 mmol/L |

NOTE: **NEVER** ADD FLEET ENEMA DIRECTLY TO BAGS USED FOR CVVHD AS THIS WILL CAUSE SEVERE HYPERPHOSPHATEMIA.

## Hypocalcemia/ ↑PTH

- The kidneys' production of 1,25 dihydroxy Vitamin $D_3$ (the active form of vitamin D) declines in CKD; therefore, calcium absorption from the GI tract is also diminished leading to hypocalcemia and hyperparathyroidism
- May use Calcium carbonate between meals as calcium supplement.
- Calcitriol = Rocaltrol, the pharmacological replacement of active vit $D_3$ which increases gut absorption of $Ca^{++}$ (and $PO_4$) and suppresses PTH
- Dose of rocaltriol ranges from 0.25 ug 3x/wk to 1.0 ug OD (may be given po, or IV pulse with HD)
- If pts 25-OHD level is <75, give ergocalciferol, 50,000 u / week x 2 weeks, rpt level, if still low, give once/month x 3 months.
- Cinacalcet (Sensipar) is a new calcimimetic, which is available, however is not covered by ODB, and is very costly. Payment needs to be determined (check private plans) before prescribing this medication.
- Goal PTH = 20-30 pmol/L (normal 7-8); normalization may be a risk factor for adynamic bone disease

## Hyperkalemia

Initial monitoring and diagnosis

1. Perform 12-lead ECG unless pt undergoing continuous ECG monitoring
2. Hyperkalemia is not always associated with ECG changes; but no ECG changes does not mean that potential for arrhythmia does not exist.
3. Transfer to monitored setting or arrange for telemetry if $K^+ > 7$ mmol/L or if ECG changes attributable to hyperkalemia present independent of $K^+$ level
4. Measure serum creatinine, bicarbonate, calcium and glucose. Note that with restoration of normal blood sugar the K+ may shift back into cells
5. Discontinue $K^+$ administration (including IP KCl) or meds contributing to hyperkalemia (eg ramipril).

For treatment:

<u>Shifting potassium into cells and protecting the heart:</u>

1. Give one amp of calcium gluconate unless the patient is hypercalcemic.
2. Give 20 units regular insulin intravenously as a bolus; if the patient is not hyperglycemic give 50 mL intravenously of 50% glucose in water.
3. Give 2-3 puffs albuterol (Ventolin®) with MDI, or inhalation Rx by RT.
4. If the serum bicarbonate is < 20 mmol/L and the patient is not volume overloaded, give 1-2 amps (44-88 mEq) of sodium bicarbonate.

<u>Removing potassium from the body:</u>

1. If the patient is hemodialysis-dependent already, arrange for urgent hemodialysis through the HD unit. Hyperkalemia is unusual in the peritoneal dialysis patient; however, it will respond to rapid-cycling PD (see section on PD orders).
2. If the patient is not dialysis-dependent, determine whether it is likely that you will be able to increase urine potassium excretion quickly - unlikely if the patient is oligo-anuric and has a rapidly rising serum creatinine due to acute tubular necrosis or if the patient has cardiogenic shock. It is more likely if the patient has pre-renal failure due to hypovolemia, which can be corrected or if the hyperkalemia is in large part drug-induced such as with ACE-inhbitors, NSAIDS, sprironolactone etc.

To increase urine volume and potassium excretion the following methods may be appropriate depending on the situation:

1. Volume resuscitation with isotonic saline if the patient has prerenal failure and is volume depleted
2. High dose furosemide if/when the patient is euvolemic or volume overloaded (ie160-240 mg IV)
3. IV sodium bicarbonate if the patient is acidotic and hypovolemic - aim to get serum bicarbonate to > 20 mmol/L.
4. If the patient is on an ACEi, ARB, spironolactone or NSAIDs, consider giving 0.2 mg Florinef orally to increase aldosterone effect.
5. If the patient is obstructed, consider nephrostomy tubes and adequate volume replacement.

It is imperative to continue to monitor the patient's serum potassium, bicarbonate and creatinine during therapy as well as urine flow to be sure that conservative therapy is in fact succeeding. If serum potassium is not decreasing then dialysis should be strongly considered.

Follow up

- Repeat $K^+$ determination within 2 hr of initial exam (unless pt on dialysis)
- Repeat ECG if any changes on the first ECG
- Continue appropriate therapy and continue monitoring q 2-4 hr until $K^+ \leq$ 5.5 mmol/L

Use of Potassium exchange resins

Occasionally, in chronic dialysis patients, exchange resins may be used to treat or prevent hyperkalemia if for some reason they have to delay or

miss a dialysis e.g. due to machine breakdown at home, access problems, weather, travel etc.

Oral: Calcium resonium 30 gm in Lactulose 30 mL or Sodium polystyrene (Kayexalate) 30 gm in Lactulose 30 mL but be aware of sodium load with Kayexalate. Takes 4-6 hr for effect. May also be given by enema (30 gm in100 mL water) (less effective than oral).

## Constipation

AVOID

- Magnesium containing products (MOM, Mag citrate)
- Bulk forming laxatives in fluid restricted patients e.g. Metamucil or Prodiem
- Fleet enemas d/t high phosphate content (may use Fleet Mineral Oil)

SAFER

- Docusate sodium, Lactulose, senna
- Stimulant laxatives (bisacodyl, cascara)
- Glycerin suppositories prn
- Tap water or mineral oil enemas for severe constipation
- Colyte/Golytely for bowel preps or lower dose (250-500 mL) for very severe constipation.

## Anaphylaxis

Epinephrine:

IM: Usual dose for adults is 0.01 mg per kg to a maximum of 0.5 mg (0.5 mL) from the 1 mL, 1 mg per mL amps (1:1000). This means anyone 45 to 50 kg or more gets a standard dose of 0.5 mg.
The IM route is preferred over SC since absorption is more rapid with IM route. Dose may be repeated in 5 to 15 minutes as needed.

IV: Using the 1 mg per mL (1:1,000) concentration in 1 mL amps, dilute 1 mL with 9 mL of Sterile Water for injection to give the 0.1 mg per mL concentration. This helps to insure a slow iV injection (e.g., over 5 to 10 minutes); dose may be repeated at 5 to 15 minute intervals as needed.

(Estelle F, Simons R. Anaphylaxis. J Allergy Clin Immunol 2010 ; 125 (Suppl Feb) :S16181)

# Analgesia

## Opioid Analgesic Comparison Chart

| | Doses Equivalent to Morphine 10 mg IM or SC | | | Brand Name | Duration of Analgesia | Consideration in CKD | |
|---|---|---|---|---|---|---|---|
| **Opioid** | **IM or SC **** | **Oral **** | **Conversion Injection to Oral** | | | **Caution** | **Dialyzability** |
| Meperidine | 75 mg | 300 mg | 4 | Demerol® | 2 to 3 h | AVOID: metabolite normeperidine can precipitate seizures | No (HD)<br>Unlikely (PD) |
| Codeine | 120 mg | 200 mg | 1.5 | Codeine tablet/syrup | 3 to 4h | Caution: consider decrease starting dose to 50% due to prolonged half life | No data (HD)<br>Unlikely (PD) |
| | | | | Compounds (Tylenol #1, #2, #3) | 3 to 4h | | |
| | | | | Codeine Contin CR | 12 h | | |
| Morphine | 10 mg | 30 mg | 3 | Morphine tablet/syrup (MS-IR ® / Statex®) | 3 to 4h | Metabolite morphine 6 glucoronide has narcotic activity increase risk of side effects | Yes (HD)<br>No (PD) |
| | | | | M- Eslon® capsule | 12 h | | |
| | | | | MS Contin® SR tablet | 12 h | | |
| Oxycodone | NA | 15 mg | NA | Oxy-IR® | 3 to 4 h | Caution | Yes (HD)<br>No data (PD) |
| | | | | Oxycontin® CR | 12 h | | |
| | | | | Percocet® (oxycodone + acetaminophen) | 3 to 4 h | | |
| Hydromorphone | 1.5 mg | 7.5 mg | 5 | Dilaudid® | 3 to 4 h | Caution due high potency narcotic | No data (HD)<br>No data (PD) |
| | | | | Hydromorphone Contin | 12 h | | |
| Fentanyl | 100 ug | NA | NA | Duragesic® Patch | 72 hours | Decrease starting dose by 50% | No (HD)<br>No data (PD) |

* Opiods are in order of increasing potency

** All above dose equivalencies are compared to 10 mg of **injectable morphine**. For example, Codeine 120 mg IM = Morphine 10 mg IM = Hydromorphone 1.5 mg IM

Other Considerations:

- It is easier to keep pts out of pain than to get them out of pain, consider standing analgesia with breakthrough as needed.
- Acetaminophen (Tylenol) +/- codeine – max 4 gm acetaminophen/day
- NSAIDs - remember pts are at a higher risk of GI bleed therefore, misoprostal or a proton pump inhibitor should be added for prophylaxis
- All opioids – start at small doses and titrate up for pain relief as excessive sedation may occur

## HS Sedation

AVOID

- Chloral hydrate as the active metabolite may accumulate and cause excessive sedation

SAFER

- Benzodiazepines such as lorazepam and oxazepam are hepatically metabolized and safer.

## Anti-seizure medications

- Carbamazepine, diazepam, phenobarbital, valproic acid are hepatically metabolized, however, the effect might be enhanced due to low albumin and level should be interpreted with caution.

- Phenytoin (Dilantin) dosing is unchanged but blood levels require careful interpretation with renal failure:

Corrected blood Dilantin level: measured level $\div$ [(albumin x 0.1) + 0.1]

## VTE (DVT) Prophylaxis for Transplant and Nephrology

| Patient group | Recommended Thromboprophylaxis options[2,3,4] | Initiation | Duration[3] |
|---|---|---|---|
| **Multi-Organ Transplant**<br><br>***This lists what is currently contained on pre-printed order sets/EPR screens.*** | **Kidney-Pancreas**<br>• **Pre-op:** UFH 5000 units SC 60 mins prior to incision<br>• **Post-op:** UFH 5000 units SC q 12h<br><br>**Kidney**<br>• **New transplants – UFH 5000 units SC bid, 1st dose given pre-op in the OR; continue until discharge**<br>• **Readmissions – UFH 5000 units SC bid from admission until discharge**<br>• **Patients who should not receive UFH: 1) already on full-dose anticoagulation for other reasons 2) patients with heparin allergy/HIT 3) patients who are actively bleeding 4) patients who are fully mobile and with a short expected length of stay (<48 hours)**<br>• **For patients in category 2, consider fondaparinux +/- TED stockings; for patients in category 3, use TED stockings**<br>• **For patients who will be undergoing renal biopsy, hold the dose of UFH prior to the biopsy**<br><br>**Laproscopic Kidney Donor**<br>• **Pre-op:** UFH 5000 units SC 60 mins prior to incision and T.E.D.s/SCDs in OR<br>• **Post-op:** UFH 5000 units SC q 12h and T.E.D.s/SCDs until POD #2 | 60 mins prior to incision<br><br>pre-op in the OR<br><br>admission | until discharge<br><br>until discharge |

| | | | |
|---|---|---|---|
| **Nephrology** | • **UFH 5000 units SC bid**<br>• **Assessment: tunneled catheter = higher risk for VTE.**<br>• **Patients who should NOT receive UFH:**<br>  • **1) fully anticoagulated (Warfarin).**<br>  • **2) Heparin allergy/HIT.**<br>  • **3) active bleed**<br>  • **4) fully mobile with short expected length of stay (<48 hr)**<br>  • **See Footnote 6**<br>• **If HIT or heparin allergy, no heparin - initiate hematology consult**<br>• **If high risk of bleeding (e.g. w/u for hemorrhagic CVA, planned invasive procedure within 24 hr), or admitted with bleed (footnote 6), calf-length TED stockings. When bleeding risk allows, resume/initiate UFH.**<br>• **Note: HD or IP heparin does NOT provide VTE prophylaxis**<br>• **Note: Enoxaparin can accumulate in renal failure, thus avoid.** | 1st dosing time after admission | Until Discharge |

**Abbreviations:**
**ASAP** = as soon as possible **LMWH** = low-molecular-weight heparin
**T.E.D.s** = ThromboEmbolic Deterrent stockings **TP** = thromboprophylaxis
**VTE** = venous thromboembolism

**Footnotes to the Table:**

1. For all patients in whom it is possible and appropriate, early and frequent mobilization and ambulation are essential.
2. ***In general, for weight less than 40 kg or creatinine clearance <30 mL/min, it is suggested that the prophylactic LMWH dose be reduced to the next lower pre-filled syringe dose (i.e., from enoxaparin 40 mg to 30 mg SC once daily). In general, for weight greater than 100 kg, consider doubling the LMWH dose (i.e., from enoxaparin 40 mg once daily to 40 mg SC BID). At weights >120 kg, even higher doses should be considered.***
3. The duration of TP is not based on mobility status alone.
4. Absolute contraindications to anticoagulant TP are: active, clinically-important bleeding, platelets less than $30 \times 10^9$/L, major bleeding disorder, heparin-induced thrombocytopenia (a contraindication to heparin and LMWH). Relative contraindications to anticoagulant TP are: recent intracranial hemorrhage, recent peri-spinal bleeding, recent high-risk bleeding surgery.

## Approach to Post Parathyroidectomy Management

**Post parathyroidectomy, many patients develop 'Hungry Bone' syndrome, leading to marked and severe hypocalcemia, despite normal or elevated PTH, thus need to be carefully monitored and managed. Each patient must be considered individually, however, the following is a suggested approach for management.**

**Measure serum Ca 2-4x/day for first 4 days in hospital (time of greatest risk), then consider decreasing to 2x/day until pt no longer needs IV Calcium, then daily until stable, and plan for regular monitoring as an out patient.**

**Start oral Ca 2-4 gm elemental Ca/day as soon as pt able to swallow (ideally between meals if PO4 is normal or low)**

**If patient is symptomatic (Chvostek's or Trousseau's sign) or Ca is < 1.9 mmol/L: Order 1-2 gm Ca gluconate in 50 mL D5W, infuse over 10 – 20 min, followed by 10% Ca gluconate slow infusion. (ie add 100 mL of 10% Ca gluconate to 1L D5W or Normal saline) run at 50 mL/hr then titrated to keep serum Calcium (corrected for albumin) at the lower end of normal range.**

**Consider oral Vit D. In a placebo-controlled trial, postop oral calcitriol in doses up to 4 mcg/day ameliorated the postoperative decline in the serum calcium concentration** (Clair F, Leenhardt L, Bourdeau A, et al. Effect of calcitriol in the control of plasma calcium after parathyroidectomy. A placebo-controlled, double-blind study in chronic hemodialysis patients. Nephron 1987; 46:18.)

**Dialysis is another method of correcting the hypocalcemia. A high calcium bath (1.75 mmol/L) can be used in patients undergoing hemodialysis. Alternatively, intravenous calcium can be administered during dialysis, thereby allowing an earlier switch to outpatient management. Similarly, one to three ampules of calcium gluconate can be added to each bag of peritoneal dialysate in patients treated with continuous ambulatory peritoneal dialysis**

(www.uptodate.com)

**It is very important to follow Ca beyond the first 4 days as it can drop suddenly, thus a discharge plan must include close out-pt follow up of Ca soon after discharge.**

# Drug Dosing for HD, CAPD and CRRT

| Drug | Method | Renal Failure dose | Dose after HD | Dose during CAPD | Dose during CRRT |
|---|---|---|---|---|---|
| D = Dose | I = Prolonged Interval | NA = Not Available | | | |
| Acarbose | D | Avoid | Unknown | Unknown | Avoid |
| Acebutolol | D | 30-50% | None | None | 50% |
| Acetazolamide | I | Avoid | Unknown | Unknown | Avoid |
| Acetohexamide | I | Avoid | Unknown | None | Avoid |
| Acetohydrox-aminic acid | D | Avoid | Unknown | Unknown | Unknown |
| Acetaminophen | I | Q8H | None | None | q6h |
| ASA | I | Avoid | After HD | None | q4-6h |
| Acrivastine | D | Unknown | Unknown | Unknown | Unknown |
| Acyclovir | D,I | See UHN Guide | See UHN Guide | Dose for RF | 3.5 mg/kg/d |
| Adenosine | D | 100% | None | None | 100% |
| Albuterol | D | 50% | Unknown | Unknown | 75% |
| Alcuronium | D | Avoid | Unknown | Unknown | Avoid |
| Alfentanil | D | 100% | Unknown | Unknown | 100% |
| Allopurinol | D | 25% | ½ dose | Unknown | 50% |
| Alprazolam | D | 100% | None | Unknown | NA |
| Alteplase (tPA) | D | 100% | Unknown | Unknown | 100% |
| Altretamine | D | Unknown | Unknown | Unknown | Unknown |
| Amantadine | I | q7d | See UHN Guide | None | q48-72h |
| Amikacin | D,I | 20-30% q24-48h | See UHN Guide | 15-20mg/L/d | 30-70% q12-18h |
| Amiloride | D | Avoid | NA | NA | NA |
| Amiodarone | D | 100% | None | None | 100% |
| Amitriptyline | D | 100% | None | Unknown | NA |
| Amlodipine | D | 100% | None | None | 100% |
| Amoxapine | D | 100% | Unknown | Unknown | NA |
| Amoxicillin | I | See UHN Guide | See UHN Guide | 250mg q12h | NA |
| Amphotericin | I | q24-36h | See UHN Guide | See UHN Guide | q24h |
| Ampicillin | I | See UHN Guide | See UHN Guide | 250mg q12h | q6-12h |
| Amrinone | D | 50-75% | Unknown | Unknown | 100% |
| Anistreplase | D | 100% | Unknown | Unknown | 100% |
| Astemizole | D | 100% | Unknown | Unknown | NA |
| Atenolol | D,I | 30-50% q96h | 25-50 mg | None | 50%q48h |
| Atovaquone | - | 100% | None | Unknown | Unknown |
| Atracurium | D | 100% | Unknown | Unknown | 100% |
| Auranofin | D | Avoid | None | None | None |
| Azathioprine | D | 50% | Yes | Unknown | 75% |
| Azithromycin | D | 100% | None | None | None |
| Azlocillin | I | q8h | Dose after HD | Dose for RF | q6-8h |
| Aztreonan | D | 25% | 0.5g after HD | Dose for RF | 50-75% |
| Benazepril | D | 25-50% | None | None | 50-75% |
| Bepridil | - | Unknown | None | None | Unknown. |
| Betamethazone | D | 100% | Unknown | Unknown | 100% |
| Betaxolol | D | 50% | None | None | 100% |
| Bezafibrate | D | 25% | Unknown | Unknown | 50% |

| Drug | Method | Renal Failure dose | Dose after HD | Dose during CAPD | Dose during CRRT |
|---|---|---|---|---|---|
| D = Dose | I = Prolonged Interval | NA = Not Available | | | |
| Bisoprolol | D | 50% | Unknown | Unknown | 75% |
| Bleomycin | D | 50% | None | Unknown | 75% |
| Bopindolol | D | 100% | None | None | 100% |
| Bretylium | D | 25% | None | None | 25-50% |
| Bromocriptine | D | 100% | Unknown | Unknown | Unknown |
| Brompheniramine | D | 100% | Unknown | Unknown | NA |
| Budesonide | D | 100% | Unknown | Unknown | 100% |
| Bumetanide | D | 100% | None | None | NA |
| Bupropion | D | 100% | Unknown | Unknown | NA |
| Buspirone | D | 100% | None | Unknown | NA |
| Busulfan | D | 100% | Unknown | Unknown | 100% |
| Butorphanol | D | 50% | Unknown | Unknown | NA |
| Capreomycin | I | q48h | Dose after HD | None | q24h |
| Captopril | D,I | 50% q24h | 25-30% | None | 75% q12-18h |
| Carbamazepine | D | 100% | None | None | None |
| Carbidopa | D | 100% | Unknown | Unknown | Unknown |
| Carboplatin | D | 25% | 50% | Unknown | 50% |
| Carmustine | D | Unknown | Unknown | Unknown | Unknown |
| Carteolol | D | 25% | Unknown | None | 50% |
| Carvedilol | D | 100% | None | None | 100% |
| Cefaclor | D | 50% | 250 mg after HD | 250mg q8-12h | NA |
| Cefadroxil | I | q24-48h | 0.5-1.0g afterHD | 0.5g/d | NA |
| Cefamandole | I | q12h | 0.5-1.0g afterHD | 0.5-1.0g q12h | q6-8h |
| Cefazolin | I | See UHN Guide | See UHN Guide | See UHN Guide | q12h |
| Cefepime | I | q24-48h | 1g after HD | Dose for RF | Not recommend |
| Cefixime | D | 50% | 300 mg after HD | 200 mg/d | Not recommend |
| Cefmenoxine | D,I | 0.75g q12h | 0.75g after HD | 0.75g q12h | 0.75g q8h |
| Cefmetazole | I | q48h | Dose after HD | Dose for RF | q24h |
| Cefonicid | D,I | 0.1g/d | None | None | None |
| Cefoperazone | D | 100% | 1g after HD | None | None |
| Ceforanide | I | q24-48h | 0.5-1.0g afterHD | None | 1 g/d |
| Cefotaxime | I | See UHN Guide | See UHN Guide | 1g/d | 1g q12h |
| Cefotetan | D | See UHN Guide | See UHN Guide | 1g/d | 750 mg q12h |
| Cefoxitin | I | q24-48h | 1g after HD | 1g/d | q8-12h |
| Cefpodoxime | I | q24-48h | 200 mg after HD | Dose for RF | NA |
| Cefprozil | D,I | 250 mg q24h | 250 mg after HD | Dose for RF | Dose for RF |
| Ceftazidime | I | See UHN Guide | See UHN Guide | See UHN Guide | q24-48h |
| Cefibuten | D | 25% | 300 mg after HD | Dose for RF | 50% |
| Ceftizoxime | I | q24h | 1g after HD | 0.5-1.0g/d | q12-24h |
| Ceftriaxone | D | 100% | See UHN Guide | 750 mg q12h | 100% |
| Cefuroxime axetil | D | See UHN Guide | See UHN Guide | Dose for RF | NA |
| Cefuroxime sodium | I | See UHN Guide | See UHN Guide | Dose for RF | 1g q12h |
| Celiprolol | D | 75% | Unknown | None | 100% |
| Cephalexin | I | See UHN Guide | See UHN Guide | Dose for RF | NA |
| Cephalothin | I | q12h | Dose after HD | 1g q12h | 1g q8h |
| Cephapirin | I | q12h | Dose after HD | 1g q12h | 1g q8h |
| Cephradine | D | 25% | Dose after HD | Dose for RF | NA |
| Cetirizine | D | 30% | None | Unknown | NA |

| Drug | Method | Renal Failure dose | Dose after HD | Dose during CAPD | Dose during CRRT |
|---|---|---|---|---|---|
| D = Dose | I = Prolonged Interval | NA = Not Available | | | |
| Chloral hydrate | D | Avoid | None | Unknown | NA |
| Chlorambucil | D | Unknown | Unknown | Unknown | Unknown |
| Chloramphenicol | D | 100% | See UHN Guide | None | None |
| Chlorazepate | D | 100% | Unknown | Unknown | NA |
| Chlordiazepoxide | D | 50% | None | Unknown | 100% |
| Chloroquine | D | 50% | See UHN Guide | None | None |
| Chlorpheniramine | D | 100% | None | Unknown | NA |
| Chlorpromazine | D | 100% | None | None | 100% |
| Chlorpropamide | D | Avoid | Unknown | None | Avoid |
| Chlorthalidone | I | Avoid | NA | NA | NA |
| Cholestyramine | D | 100% | None | None | 100% |
| Cibenzoline | D,I | 66% q24h | None | None | 100% q12h |
| Cidofovir | D | Avoid | Unknown | Unknown | Avoid |
| Cilastin | D | Avoid | Avoid | Avoid | Avoid |
| Cilazapril | D,I | 10-25% q72h | None | None | 50%q24-48h |
| Cimetidine | D | 25% | None | None | 50% |
| Cinoxacin | D | Avoid | Avoid | Avoid | Avoid |
| Ciprofloxacin | D | See UHN Guide | See UHN Guide | 250mg q8h (200 if IV) | 200 mg IV q12h |
| Cisapride | D | 50% | Unknown | Unknown | 50-100% |
| Cisplatin | D | 50% | Yes | Unknown | 75% |
| Cladribine | D | Unknown | Unknown | Unknown | Unknown |
| Clarithromycin | D | See UHN Guide | See UHN Guide | None | None |
| Clavulanic acid | D | 50-75% | Dose after HD | Dose for RF | 100% |
| Clindamycin | D | 100% | See UHN Guide | See UHN Guide | None |
| Clodronate | D | Avoid | Unknown | Unknown | Unknown |
| Clofazimine | -- | 100% | None | None | Unknown |
| Clofibrate | I | Avoid | None | Unknown | q12-18h |
| Clomipramine | D | Unknown | Unknown | Unknown | NA |
| Clonazepam | D | 100% | None | Unknown | NA |
| Clonidine | D | 100% | None | None | 100% |
| Cloxacillin | | See UHN Guide | See UHN Guide | | |
| Codeine | D | 50% | Unknown | Unknown | 75% |
| Colchicine | D | 50% | None | Unknown | 100% |
| Colestipol | D | 100% | None | None | 100% |
| Cortisone | D | 100% | None | Unknown | 100% |
| Cotrimoxazole | See UHN Guide | | See UHN Guide | | |
| Cyclophosphamide | D | 75% | ½ dose | Unknown | 100% |
| Cycloserine | I | q24h | None | None | q12-24h |
| Cyclosporine | D | 100% | None | None | 100% |
| Cytarabine | D | 100% | Unknown | Unknown | 100% |
| Dapsone | -- | Unknown | None | Dose for RF | Unknown |
| Daunorubicin | D | 100% | Unknown | Unknown | Unknown |
| Delavirdine | -- | 100% | None | Unknown | Unknown |
| Desferrioxamine | D | 100% | Unknown | Unknown | 100% |
| Desipramine | D | 100% | None | None | NA |
| Dexamethasone | D | 100% | Unknown | Unknown | 100% |
| Diazepam | D | 100% | None | Unknown | 100% |

| Drug | Method | Renal Failure dose | Dose after HD | Dose during CAPD | Dose during CRRT |
|---|---|---|---|---|---|
| D = Dose | I = Prolonged Interval | NA = Not Available | | | |
| Diazoxine | D | 100% | None | None | 100% |
| Diclofenac | D | 100% | None | None | 100% |
| Dicloxacillin | D | 100% | None | None | NA |
| Didanosine | I | q24-48h | Yes | Dose for RF | Dose for RF |
| Diflunisal | D | 50% | None | None | 50% |
| Digitoxin | D | 50-75% | None | None | 100% |
| Digoxin | D,I | 10-25% q48h | None | None | 25-75%q36h |
| Dilevalol | D | 100% | None | None | Unknown |
| Diltiazem | D | 100% | None | None | 100% |
| Diphenhydramine | D | 100% | None | None | None |
| Dipyridamole | D | 100% | Unknown | Unknown | NA |
| Dirithromycin | -- | 100% | None | Unknown | 100% |
| Disopyramide | I | q24-40h | None | None | q12-24h |
| Dobutamine | D | 100% | Unknown | Unknown | 100% |
| Doxacurium | D | 50% | Unknown | Unknown | 50% |
| Doxazosin | D | 100% | None | None | 100% |
| Doxepin | D | 100% | None | None | 100% |
| Doxorubicin | D | 100% | None | Unknown | 100% |
| Doxycycline | D | 100% | See UHN Guide | None | 100% |
| Dyphilline | D | 25% | ⅓ dose | Unknown | 50% |
| Enalapril | D | 50% | 20-25% | None | 75-100% |
| Epirubicin | D | 100% | None | Unknown | 100% |
| Ebastine | D | 50% | Unknown | Unknown | 50% |
| Erythromycin | D | See UHN Guide | See UHN Guide | None | None |
| Esmolol | -- | -- | None | None | Unknown |
| Estazolam | D | 100% | Unknown | Unknown | NA |
| Ethacrynic Acid | I | Avoid | None | None | NA |
| Ethambutol | I | q48h | See UHN Guide | Dose for RF | q24-36h |
| Ethchlorvynol | D | Avoid | None | None | NA |
| Ethionamide | D | 50% | None | None | None |
| Ethosuximide | D | 100% | None | Unknown | Unknown |
| Etodolac | D | 100% | None | None | 100% |
| Etomidate | D | 100% | Unknown | Unknown | 100% |
| Etoposide | D | 50% | None | Unknown | 75% |
| Famcyclovir | I | See UHN Guide | See UHN Guide | Unknown | Unknown |
| Famotidine | D | 10% | None | None | 25% |
| Fazadinium | D | 100% | Unknown | Unknown | 100% |
| Felodipine | D | 100% | None | None | 100% |
| Fenoprofen | D | 100% | None | None | 100% |
| Fentanyl | D | 100% | Unknown | Unknown | 100% |
| Fexofenadine | I | q24h | Unknown | Unknown | q12-24h |
| Flecainide | D | 50-75% | None | None | 100% |
| Fleroxacin | D | 50% | 400 mg post HD | 400 mg/d | NA |
| Fluconazole | D | See UHN Guide | See UHN Guide | See UHN Guide | 100% |
| Flucytosine | I | q24h | Yes | 0.5-1.0 g/d | q16h |
| Fludarabine | D | 50% | Unknown | Unknown | 75% |
| Flumazenil | D | 100% | None | Unknown | NA |

| Drug | Method | Renal Failure dose | Dose after HD | Dose during CAPD | Dose during CRRT |
|---|---|---|---|---|---|
| D = Dose | I = Prolonged Interval | NA = Not Available | | | |
| Flumarizine | D | 100% | None | None | None |
| Fluorouracil | D | 100% | Yes | Unknown | 100% |
| Fluoxetine | D | 100% | Unknown | Unknown | NA |
| Flurazepam | D | 100% | None | Unknown | NA |
| Flurbiprofen | D | 100% | None | None | 100% |
| Flutamide | D | 100% | Unknown | Unknown | Unknown |
| Fluvastatin | D | 100% | Unknown | Unknown | 100% |
| Fluvoxamine | D | 100% | None | Unknown | NA |
| Foscarnet | D | 6 mg/kg | See UHN Guide | Dose for RF | 15 mg/kg |
| Fosinopril | D | 75-100% | None | None | 100% |
| Furosemide | D | 100% | None | None | NA |
| Gabapentin | D,I | 300 mg/d | Yes | -- | 300 mg q12-24h |
| Gallamine | D | Avoid | NA | NA | Avoid |
| Ganciclovir | I | See UHN Guide | See UHN Guide | Dose for RF | 2.5 mg/kg/d |
| Ganciclovir oral | D,I | 500 mg q48-96h | Yes | Dose for RF | NA |
| Gemfibrozil | D | 100% | None | Unknown | 100% |
| Gentamycin | D,I | 20-30% q24-48h | See UHN Guide | 3-4 mg/L/d | 30-70%q12h |
| Glibornuride | D | Unknown | Unknown | Unknown | Avoid |
| Gliclazide | D | Unknown | Unknown | Unknown | Avoid |
| Glipizide | D | 100% | Unknown | Unknown | Avoid |
| Glyburide | D | Avoid | None | None | Avoid |
| Gold Na thiomalate | D | Avoid | None | None | Avoid |
| Griseofulvin | D | 100% | None | None | None |
| Guanabenz | D | 100% | Unknown | Unknown | 100% |
| Guanadrel | I | q24-48h | Unknown | Unknown | q12-24h |
| Guanethidine | I | q24-36h | Unknown | Unknown | Avoid |
| Guanfacine | D | 100% | None | None | 100% |
| Haloperidol | D | 100% | None | None | 100% |
| Heparin | D | 100% | None | None | 100% |
| Hexobarbital | D | 100% | None | Unknown | NA |
| Hydralazine | I | q8-16h | None | None | q8h |
| Hydrocortisone | D | 100% | Unknown | Unknown | 100% |
| Hydroxyurea | D | 20% | Unknown | Unknown | 50% |
| Hydroxyzine | D | Unknown | 100% | 100% | 100% |
| Ibuprofen | D | 100% | None | None | 100% |
| Idarubicin | -- | Unknown | Unknown | Unknown | Unknown |
| Ifosfamide | D | 75% | Unknown | Unknown | 100% |
| Iloprost | D | 50% | Unknown | Unknown | 100% |
| Imipenem | D | See UHN Guide | See UHN Guide | Dose for RF | 50% |
| Imipramine | D | 100% | None | None | NA |
| Indapamide | D | Avoid | None | None | NA |
| Indinavir | -- | 100% | None | Dose for RF | Unknown |
| Indobufen | D | 25% | Unknown | Unknown | NA |
| Indomethacin | D | 100% | None | None | 100% |
| Insulin | D | 50% | None | None | 75% |

| Drug | Method | Renal Failure dose | Dose after HD | Dose during CAPD | Dose during CRRT |
|---|---|---|---|---|---|
| D = Dose | I = Prolonged Interval | NA = Not Available | | | |
| Ipratropium | D | 100% | None | None | 100% |
| Isoniazid | D | 50% | See UHN Guide | Dose for RF | Dose for RF |
| Isosorbide | D | 100% | 10-20 mg | None | 100% |
| Isradipine | D | 100% | None | None | 100% |
| Itraconazole | D | See UHN Guide | See UHN Guide | See UHN Guide | 100 mg q12-24h |
| Kandamycin | D,I | 20-30% q24-48h | ⅔ dose after HD | 15-20 mg/L/d | 30-70% q12h |
| Ketamine | D | 100% | Unknown | Unknown | 100% |
| Ketanserin | D | 100% | None | None | 100% |
| Ketoconazole | D | 100% | See UHN Guide | None | None |
| Ketoprofen | D | 100% | None | None | 100% |
| Ketorolac | D | 50% | None | None | 50% |
| Labetolol | D | 100% | None | None | 100% |
| Lamivudine | D,I | 25 mg/d (50mg 1st dose) | Yes | Dose for RF | 50-150 mg/d (full 1st dose) |
| Lamotrigine | D | 100% | Unknown | Unknown | 100% |
| Lansoprazole | D | 100% | Unknown | Unknown | Unknown |
| L-dopa | D | 100% | Unknown | Unknown | 100% |
| Levofloxacin | D | See UHN Guide | See UHN Guide | Dose for RF | 50% |
| Lidocaine | D | 100% | None | None | 100% |
| Lincomycin | I | q12-24h | None | None | NA |
| Linezolid | | See UHN Guide | See UHN Guide | | |
| Lisinopril | D | 25-50% | 20% | None | 50-75% |
| Lispro insulin | D | 50% | None | None | None |
| Lithium carbonate | D | 25-50% | Yes | None | 50-75% |
| Lomefloxacin | D | 50% | Dose for RF | Dose for RF | NA |
| Loracarbef | I | q3-5d | Yes | Dose for RF | q24h |
| Lorazepam | D | 100% | None | Unknown | 100% |
| Losartan | D | 100% | Unknown | Unknown | 100% |
| Lovastatin | D | 100% | Unknown | Unknown | 100% |
| LMW heparin | D | 50% | Unknown | Unknown | 100% |
| Maprotiline | D | 100% | Unknown | Unknown | NA |
| Meclofenamic acid | D | 100% | None | None | 100% |
| Mefenamic acid | D | 100% | None | None | 100% |
| Mefloquine | -- | 100% | None | None | Unknown |
| Melphalan | D | 50% | Unknown | Unknown | 75% |
| Meperidine | D | 50% | Avoid | None | Avoid |
| Meprobamate | I | q12-18h | None | Unknown | NA |
| Meropenem | D,I | 250-500 mg q24h | See UHN Guide | Dose for RF | 250-500 mg q12h |
| Metaproterenol | D | 100% | Unknown | Unknown | 100% |
| Metformin | D | Avoid | Unknown | Unknown | Avoid |
| Methadone | D | 50-75% | None | None | NA |
| Methenamine mandelate | D | Avoid | NA | NA | NA |
| Methicillin | I | q8-12h | None | None | q6-8h |
| Methimazole | D | 100% | Unknown | Unknown | 100% |
| Methotrexate | D | Avoid | None | None | 50% |
| Methyldopa | I | q12-24h | 250 mg | None | q8-12h |

| Drug | Method | Renal Failure dose | Dose after HD | Dose during CAPD | Dose during CRRT |
|---|---|---|---|---|---|
| D = Dose | I = Prolonged Interval | NA = Not Available | | | |
| Methyl prednisolone | D | 100% | Yes | Unknown | 100% |
| Metoclopramide | D | 50% | None | Unknown | 50-75% |
| Metocurine | D | 50% | Unknown | Unknown | 50% |
| Metolazone | D | 100% | None | None | NA |
| Metoprolol | D | 100% | 50 mg | None | 100% |
| Metronidazole | D | See UHN Guide | See UHN Guide | See UHN Guide | 100% |
| Mexiletine | D | 50-75% | None | None | None |
| Mezlocillin | I | q8h | None | None | q6-8h |
| Miconazole | D | 100% | None | None | None |
| Midazolam | D | 50% | NA | NA | NA |
| Midodrine | -- | Unknown | 5mg q8h | Unknown | 5-10 mg q8h |
| Miglitol | D | Avoid | Unknown | Unknown | Avoid |
| Milrinone | D | 50-75% | Unknown | Unknown | 100% |
| Minocycline | D | 100% | See UHN Guide | None | 100% |
| Minoxidil | D | 100% | None | None | 100% |
| Mitomycin C | D | 75% | Unknown | Unknown | Unknown |
| Mitoxantrone | D | 100% | Unknown | Unknown | 100% |
| Mivacurium | D | 50% | Unknown | Unknown | Unknown |
| Moricizine | D | 100% | None | None | 100% |
| Morphine | D | 50% | None | Unknown | 75% |
| Moxalactam | I | q24-48h | Yes | Dose for RF | q12-24h |
| Nabumetone | D | 100% | None | None | 100% |
| N-Acetylcysteine | D | 75% | Unknown | Unknown | 100% |
| N-Acetyl-Procainamide | D,I | 25% q12-18h | None | None | 50% q8-12h |
| Nadolol | D | 25% | 40 mg | None | 50% |
| Nafcillin | D | 100% | None | None | 100% |
| Nalidixic acid | D | Avoid | See UHN Guide | Avoid | NA |
| Naloxone | D | 100% | NA | NA | 100% |
| Naproxen | D | 100% | None | None | 100% |
| Nefazodone | D | 100% | Unknown | Unknown | NA |
| Nelfinavir | -- | Unknown | Unknown | Unknown | Unknown |
| Neostigmine | D | 25% | Unknown | Unknown | 50% |
| Netilmicin | D,I | 10-20% q24-48h | ⅔ dose after HD | 3-4 mg/L/d | 20-60% q12h |
| Nevirapine | D | 100% | None | Dose for RF | Unknown |
| Nicardipine | D | 100% | None | None | 100% |
| Nicotinic acid | D | 25% | Unknown | Unknown | 50% |
| Nifedipine | D | 100% | None | None | 100% |
| Nimodipine | D | 100% | None | None | 100% |
| Nisoldipine | D | 100% | None | None | 100% |
| Nitrazepam | D | 100% | Unknown | Unknown | NA |
| Nitrofurantoin | D | Avoid | See UHN Guide | NA | NA |
| Nitroglycerine | D | 100% | Unknown | Unknown | 100% |
| Nitroprusside | D | 100% | None | None | 100% |
| Nitrosourea | D | 25-50% | None | Unknown | Unknown |
| Nizatidine | D | 25% | Unknown | Unknown | 50% |

| Drug | Method | Renal Failure dose | Dose after HD | Dose during CAPD | Dose during CRRT |
|---|---|---|---|---|---|
| D = Dose | I = Prolonged Interval | NA = Not Available | | | |
| Norfloxacin | I | Avoid | NA | NA | NA |
| Nortriptyline | D | 100% | None | None | NA |
| Ofloxacin | D | 25-50% | 100 mg bid | Dose for RF | 300 mg/d |
| Omeprazole | D | 100% | Unknown | Unknown | Unknown |
| Ondansetron | D | 100% | Unknown | Unknown | 100% |
| Orphenadrine | D | 100% | Unknown | Unknown | NA |
| Ouabain | I | q36-48h | None | None | q24-36h |
| Oxaprozin | D | 100% | None | None | 100% |
| Oxatomide | D | 100% | None | None | NA |
| Oxazepam | D | 100% | None | Unknown | 100% |
| Oxcarbazepine | D | 100% | Unknown | Unknown | Unknown |
| Paclitaxel | D | 100% | Unknown | Unknown | 100% |
| Pancuronium | D | Avoid | Unknown | Unknown | 50% |
| Paroxetine | D | 50% | Unknown | Unknown | NA |
| Para-aminosalicylate | D | 50% | Yes | Dose for RF | Dose for RF |
| Penbutolol | D | 100% | None | None | 100% |
| Penicillamine | D | Avoid | 1/3 dose | Unknown | Avoid |
| Penicillin G | D | See UHN Guide | See UHN Guide | Dose for RF | 75% |
| Penicillin VK | D | 100% | See UHN Guide | Dose for RF | NA |
| Pentamidine | I | q48h | See UHN Guide | None | None |
| Pentazocine | D | 50% | None | Unknown | 75% |
| Pentobarbital | D | 100% | None | Unknown | 100% |
| Pentopril | D | 50% | Unknown | Unknown | 50-75% |
| Pentoxifylline | D | 100% | Unknown | Unknown | 100% |
| Pefloxacin | D | 100% | None | None | 100% |
| Perindopril | D | 50% | 25-50% | Unknown | 75% |
| Phenelzine | D | 100% | Unknown | Unknown | NA |
| Phenobarbital | I | q12-16h | Yes | ½ normal dose | q8-12h |
| Phenylbutazone | D | 100% | None | None | 100% |
| Phenytoin | D | 100% | None | None | None |
| Pindolol | D | 100% | None | None | 100% |
| Pipecuronium | D | 25% | Unknown | Unknown | 50% |
| Piperacillin | I | See UHN Guide | See UHN Guide | Dose for RF | q6-8h |
| Piretanide | D | 100% | None | None | NA |
| Piroxicam | D | 100% | None | None | 100% |
| Plicamycin | D | 50% | Unknown | Unknown | Unknown |
| Pravastatin | D | 100% | Unknown | Unknown | 100% |
| Prazepam | D | 100% | Unknown | Unknown | NA |
| Prazosin | D | 100% | None | None | 100% |
| Prednisolone | D | 100% | Yes | Unknown | 100% |
| Prednisone | D | 100% | None | Unknown | 100% |
| Primaquine | -- | 100% | Unknown | Unknown | Unknown |
| Primidone | I | q12-24h | ⅓ dose | Unknown | Unknown |
| Probenecid | D | Avoid | Avoid | Unknown | Avoid |
| Probucol | D | 100% | Unknown | Unknown | 100% |
| Procainamide | I | q8-24h | 200 mg | None | q6-12h |

| Drug | Method | Renal Failure dose | Dose after HD | Dose during CAPD | Dose during CRRT |
|---|---|---|---|---|---|
| D = Dose | I = Prolonged Interval | NA = Not Available | | | |
| Promethazine | D | 100% | None | None | 100% |
| Propafenone | D | 100% | None | None | 100% |
| Propofol | D | 100% | Unknown | Unknown | 100% |
| Propoxyphene | D | Avoid | None | None | NA |
| Propanolol | D | 100% | None | None | 100% |
| Propylthiouracil | D | 100% | Unknown | Unknown | 100% |
| Protriptyline | D | 100% | None | None | NA |
| Pyrazinamide | D | Avoid | See UHN Guide | Avoid | Avoid |
| Pyridostigmine | D | 20% | Unknown | Unknown | 35% |
| Pyrimethamine | D | 100% | None | None | None |
| Quazepam | D | Unknown | Unknown | Unknown | NA |
| Quinapril | D | 75% | 25% | None | 75-100% |
| Quinidine | D | 75% | 100-200 mg | None | 100% |
| Quinine | I | q24h | Yes | Dose for RF | q8-12h |
| Ramipril | D | 25-50% | 20% | None | 50-75% |
| Ranitidine | D | 25% | ½ dose | None | 50% |
| Reserpine | D | Avoid | None | None | 100% |
| Ribavirin | D | 50% | Yes | Dose for RF | Dose for RF |
| Rifabutin | -- | 100% | None | None | Unknown |
| Rifampin | D | 50-100% | See UHN Guide | See UHN Guide | Dose for RF |
| Ritonavir | -- | 100% | None | Dose for RF | Unknown |
| Saquinavir | -- | 100% | None | Dose for RF | Unknown |
| Secobarbital | D | 100% | None | None | NA |
| Sertraline | D | 100% | Unknown | Unknown | NA |
| Simvastatin | D | 100% | Unknown | Unknown | 100% |
| Sodium valproate | D | 100% | None | None | None |
| Sotalol | D | 15-30% | 80 mg | None | 30% |
| Sparfloxacin | D,I | 50% q48h | Dose for GFR<10 | Unknown | 50-75% |
| Spectinomycin | D | 100% | None | None | None |
| Spironolactone | I | Avoid | NA | NA | Avoid |
| Stavudine | D,I | 50% q24h | Yes | Unknown | Unknown |
| Streptokinase | D | 100% | NA | NA | 100% |
| Streptomycin | I | q72-96h | See UHN Guide | 20-40 mg/L/d | q24-72h |
| Streptozotocin | D | 50% | Unknown | Unknown | Unknown |
| Succinylcholine | D | 100% | Unknown | Unknown | 100% |
| Sufentanil | D | 100% | Unknown | Unknown | 100% |
| Sulbactam | I | q24-48h | Yes | 0.75-1.5 g/d | 750 mg q12h |
| Sulfamethoxazole | I | q24h | 1g after HD | 1g/d | q18h |
| Sulfinpyrazone | D | Avoid | None | None | 100% |
| Sulfisoxazole | I | q12-24h | 2g after HD | 3g/d | NA |
| Sulindac | D | 100% | None | None | 100% |
| Sulotroban | D | 10% | Unknown | Unknown | Unknown |
| Tamoxifen | D | 100% | Unknown | Unknown | 100% |
| Tazobactam | D | See UHN Guide | See UHN Guide | Dose for RF | 75% |
| Teicoplanin | I | q72h | Dose for RF | Dose for RF | q48h |
| Temazepam | D | 100% | None | None | NA |

| Drug | Method | Renal Failure dose | Dose after HD | Dose during CAPD | Dose during CRRT |
|---|---|---|---|---|---|
| D = Dose | I = Prolonged Interval | NA = Not Available | | | |
| Teniposide | D | 100% | None | None | 100% |
| Terazosin | D | 100% | Unknown | Unknown | 100% |
| Terbutaline | D | Avoid | Unknown | Unknown | 50% |
| Terfenadine | D | 100% | None | None | NA |
| Tetracycline | I | q24h | See UHN Guide | None | q12-24h |
| Theophylline | D | 100% | ½ dose | Unknown | 100% |
| Thiazides | D | Avoid | NA | NA | NA |
| Thiabendazole | | See UHN Guide | | | |
| Thiopental | D | 75% | NA | NA | NA |
| Ticarcillin | D,I | 1-2g q12h | 3g after HD | Dose for RF | 1-2g q8h |
| Ticlopidine | D | 100% | Unknown | Unknown | 100% |
| Timolol | D | 100% | None | None | 100% |
| Tobramycin | D,I | 20-30% q24-48h | See UHN Guide | See UHN Guide | 30-70% q12h |
| Tocainide | D | 50% | 200mg | None | 100% |
| Tolazamide | D | 100% | Unknown | Unknown | Avoid |
| Tolbutamide | D | 100% | None | None | Avoid |
| Tolmetin | D | 100% | None | None | 100% |
| Topiramate | D | 25% | Unknown | Unknown | 50% |
| Topotecan | D | 25% | Unknown | Unknown | 50% |
| Torsemide | D | 100% | None | None | NA |
| Tranexamic acid | D | 10% | Unknown | Unknown | Unknown |
| Tranylcypromine | D | Unknown | Unknown | Unknown | NA |
| Trazodone | D | Unknown | Unknown | Unknown | NA |
| Triamcinolone | D | 100% | Unknown | Unknown | Unknown |
| Triamterene | I | Avoid | NA | NA | Avoid |
| Triazolam | D | 100% | None | None | NA |
| Trihexyphenidyl | D | Unknown | Unknown | Unknown | Unknown |
| Trimethadione | I | q12-24h | Unknown | Unknown | q8-12h |
| Trimethoprim | I | q24h | Yes | q24h | q18h |
| Trimetrexate | D | Avoid | Unknown | Unknown | Unknown |
| Trimipramine | D | 100% | None | None | NA |
| Tripelennamine | D | Unknown | Unknown | Unknown | NA |
| Triprolidine | D | Unknown | Unknown | Unknown | NA |
| Tubocurarine | D | Avoid | Unknown | Unknown | 50% |
| Urokinase | D | Unknown | Unknown | Unknown | Unknown |
| Valacyclovir | D,I | 0.5 g q24h | Yes | Dose for RF | Unknown |
| Valganciclovir | | See UHN Guide | See UHN Guide | | |
| Vancomycin | D,I | See UHN Guide | See UHN Guide | See UHN Guide | 500 mg q24-48h |
| Vecuronium | D | 100% | Unknown | Unknown | 100% |
| Venlafaxine | D | 50% | None | Unknown | NA |
| Verapamil | D | 100% | None | None | 100% |
| Vidarabine | D | 75% | Yes | Dose for RF | 100% |
| Vigabatrin | D | 25% | Unknown | Unknown | 50% |
| Vinblastine | D | 100% | Unknown | Unknown | 100% |

| Drug | Method | Renal Failure dose | Dose after HD | Dose during CAPD | Dose during CRRT |
|---|---|---|---|---|---|
| D = Dose | I = Prolonged Interval | NA = Not Available | | | |
| Vincristine | D | 100% | Unknown | Unknown | 100% |
| Vinorelbine | D | 100% | Unknown | Unknown | 100% |
| Voriconazole | | See UHN Guide | See UHN Guide | | |
| Warfarin | D | 100% | None | None | None |
| Zafirlukast | D | 100% | Unknown | Unknown | 100% |
| Zalcitabine | I | q24h | Unknown | Unknown | Unknown |
| Zidovudine | D,I | 100 mg q8h | Dose for RF | Dose for RF | 100 mg q8h |

Adapted from: Arnoff, G.R. in Manual of Nephrology, Fifth Edition, Edited by Robert W. Schriver, Lippincott Williams & Wilkins Press 2000. ISBN 0-7817-2172-5

UHN 2009 Guidelines for Antimicrobial Use. The University Health Network, Toronto, Ont.

# Antibiotic Dosing in Renal Impairment

**Dose Adjustment of Select Medications Based on Calculated Creatinine Clearance (CrCl)**

| | ***Creatinine Clearance (CrCl) in mL/min*** | | | |
|---|---|---|---|---|
| **Drug** | **≥50** | **25-49** | **10-24** | **<10** |
| (***Note:*** The following dosage recommendations are ***not*** intended for endocarditis or meningitis treatment) | | | | |
| *acyclovir (IV)* | 5-10 mg/kg q8h | 5-10 mg/kg q12h | 5-10 mg/kg q24h | 50% dose q24h |
| *acyclovir (PO)* | | | | |
| *genital herpes* | 400 mg tid | 400 mg tid | 400 mg tid | 200 mg q12h |
| *varicella zoster* | 800 mg 5x/day | 800 mg 5x/day | 800 mg tid | 800 mg q12h |
| *amikacin* (initial dosing, once daily dosing) | **CrCl ≥60** 15 mg/kg q24h | **CrCl 40-59** 15 mg/kg q36h | **CrCl 20-39** 15 mg/kg q48h | **CrCl <20** Not recommended† |
| | **Adjust dose based on serum drug levels*** | | | |
| *amikacin* (initial dosing, traditional dosing) | **CrCl ≥50** 5-7.5 mg/kg load, *then* 4-5 mg/kg IV q8h | CrCl 15-49 5-7.5 mg/kg load, *then* 3-5 mg/kg IV q12h | **< 15** 5-7.5 mg/kg load, *then* 2-3 mg/kg IV q24h | |
| | **Adjust dose based on serum drug levels*** | | | |
| *amoxicillin/ clavulanic acid* | 250/125 mg - 500/125 mg q12h | 250/125 mg - 500/125 mg q12h | 250/125 mg - 500/125 mg q12h | 250/125 mg - 500/125 mg q24h |
| *amphotericin B lipid complex (ABELCET)* | 5 mg/kg IV q24h | | | 5 mg/kg IV q24-36h |
| *amphotericin B liposome (AMBISOME)* | 3-6 mg/kg IV q24h | | | 3-6 mg/kg IV q24-36h |
| *ampicillin* | 1-2 g q4-6h | 1-2 g q6-12h | 1-2 g q6-12h | 1-2 g q12-24h |
| *azithromycin* | No adjustments required | | | |
| *caspofungin* | No adjustments required | | | |
| *cefazolin* | 1-2 g q8h | 1-2 g q12h | 1-2 g q12h | 1-2 g q24h |
| *ceftazidime* | 1-2 g q8h | **CrCl <30** 1-2 g q12h | 1-2 g q24h | 50% dose q24-48h |

| Drug | ***Creatinine Clearance (CrCl) in mL/min*** | | | |
|---|---|---|---|---|
| | **≥50** | **25-49** | **10-24** | **<10** |
| *ceftriaxone* | No adjustments required | | | |
| *cefuroxime axetil (PO)* | 500 mg q12h | 500 mg q12h | 500 mg q12h | 500 mg q24h |
| *cephalexin* | 250-500 mg q6h | **CrCl <40** 250-500 mg q8-12h | 250-500 mg q8-12h | 50% dose q12-24h |
| *ciprofloxacin (PO)* | 500-750 mg q12h | **CrCl <30** 500-750 mg q24h | 500-750 mg q24h | 500-750 mg q24h |
| *ciprofloxacin (IV)* | 400 mg q12h | **CrCl <30** 400 mg q24h | 400 mg q24h | 400 mg q24h |
| *clarithromycin* | 250-500 mg q12h | **CrCl <30** 50% dose q12h | 50% dose q12h | 50% dose q12h |
| *clindamycin* | No adjustments required | | | |
| *cloxacillin* | No adjustments required | | | |
| *cotrimoxazole (IV)* | 8-10 mg/kg in 2-4 divided doses daily | **CrCl <30** 50% dose in 2-4 divided doses daily | 50% dose in 2-4 divided doses daily | Not recommended† |
| *PCP pneumonia* | 15-20 mg/kg in 2-4 divided doses daily | **CrCl <30** 50% dose in 2-4 divided doses daily | 50% dose in 2-4 divided doses daily | Not recommended† |
| *cotrimoxazole (PO)* (DS = TRIMETHOPRIM 160 MG, SULFAMTHOXAZOLE 800 MG) | 1DS bid | 1DS q24h | 1DS q24h | Not recommended† |
| *erythromycin* | 500-1000 mg q6h | 500-1000 mg q6h | 500-1000 mg q6h | 50-70% dose q6h |
| *famciclovir* *genital herpes* | 250 mg q12h | **CrCl <40** 125 mg q12h | **CrCl <20** 125 mg daily | 125 mg daily |
| *varicella zoster* | **CrCl >60** 500 mg tid **CrCl >50** 500 mg q12h | **CrCl <40** 500 mg q24h | **CrCl <20** 500 mg q48h | 500 mg q48h |

| Drug | ***Creatinine Clearance (CrCl) in mL/min*** | | | | |
|---|---|---|---|---|---|
| | **≥50** | | **25-49** | **10-24** | **<10** |
| *fluconazole* | 50-400 mg q24h | | 50% dose q24h | 50% dose q24h | 25% dose q24h |
| *ganciclovir (IV)* | **CrCl >70** | **CrCl 50-69** | | | |
| Treatment | 5 mg/kg q12h | 2.5 mg/kg q12h | 2.5 mg/kg q24h | 1.25 mg/kg q24h | |
| Maintenance | 5 mg/kg q24h | 2.5 mg/kg q24h | 2.5 mg/kg q24h | 0.625 mg/kg q24h | |
| *gentamicin* (initial dosing, once daily dosing) | **CrCl ≥60** 5 mg/kg q24h | | **CrCl 40-59** 5 mg/kg q36h | **CrCl 20-39** 5 mg/kg q48h | **CrCl <20** Not recommended† |
| | **Adjust dose based on serum drug levels*** | | | | |
| *gentamicin* (initial dosing, traditional dosing) | **CrCl ≥50** 1.5-2 mg/kg load, *then* 1.25 mg/kg IV q8h | | CrCl 15-49 1.5-2 mg/kg load, *then* 1 mg/kg IV q12h | **CrCl <15** 1.5-2 mg/kg load, *then* 0.5-1 mg/kg IV q24h | |
| | **Adjust dose based on serum drug levels*** | | | | |
| *imipenem/cilistatin* | 500 mg q6h | | **CrCl <30** 500 mg q8-12h | 500 mg q12h | 500 mg q12h (<1 g/day); **CrCl <5** Not recommended unless on hemodialysis† |
| *intraconazole* | No adjustments required | | | | |
| *ketoconazole* | No adjustments required | | | | |
| *linezolid* | No adjustments required | | | | |
| *metronidazole* | No adjustments required | | | | |
| *moxifloxacin* | No adjustments required | | | | |
| *penicillin G* | 1-4 MU q4-6h | | 1-4 MU q8-12h | 1-4 MU q8-12h | 1-4 MU q12h |
| *piperacillin/ tazobactam* | 4.5 g q8h | | **CrCl <40** 3.375 g q8h | **CrCl <20:** 3.375 g q12h | 3.375 g q12h |

| Drug | ***Creatinine Clearance (CrCl) in mL/min*** ≥50 | 25-49 | 10-24 | <10 |
|---|---|---|---|---|
| *tobramycin* (initial dosing, once daily dosing) | **CrCl ≥60**<br>5 mg/kg q24h | **CrCl 40-59**<br>5 mg/kg q36h | **CrCl 20-39**<br>5 mg/kg q48h | **CrCl <20**<br>Not recommended† |
| | **Adjust dose based on serum drug levels*** | | | |
| *tobramycin* (initial dosing, traditional dosing) | 1.5-2 mg/kg load, *then*<br>1.25 mg/kg IV q8h | CrCl 15-49<br>1.5-2 mg/kg load, *then*<br>1 mg/kg IV q12h | | **CrCl <15**<br>1.5-2 mg/kg load, *then* 0.5-1 mg/kg IV q24h |
| | **Adjust dose based on serum drug levels*** | | | |
| *valganciclovir* | | | | |
| Induction | 450 mg q12h | 450 mg q24h | 450 mg every 2 days | Not recommended† |
| Maintenance | 450 mg q24h | 450 mg every 2 days | 450 mg 2x/week | Not recommended† |
| *vancomycin* | **CrCl ≥65**<br>1 g q12h<br>***or*** 15 mg/kg q12h<br>**CrCl 50-64**<br>1 g q24h | **CrCl 35-49**<br>1 g q24-36h | **CrCl 21-34**<br>1 g q48h | CrCl ≤20<br>15-20 mg/kg loading dose |
| | **Adjust dose based on serum drug levels*** | | | |
| *voriconazole (IV)* | 6 mg/kg q12h x 24h, *then*<br>4 mg/kg IV q12h | Not recommended due to diluent† | | |
| *voriconazole (po)* | No adjustments required | | | |

* Consult with pharmacist for dosage adjustment

† Pharmacist to discuss therapeutic alternatives with physician

**References**


1. McEvoy GK, ed. AHFS Drug Information. Bethesda, MD; American Society of Health-System Pharmacists, Inc. 2002.

2. Aronoff GR, Bennett WB, Berns JS, et al. Drug Prescribing in Renal Failure: Dosing Guidelines for Adults, Fourth Edition. Philadelphia, PA; American College of Physicians. 2002.

3. Welbanks L, ed. Compendium of Pharmaceuticals and Specialties, 37th Ed. Ottawa, ON; Canadian Pharmacists Association 2002.

4. MICROMEDEX(R) Healthcare Series Vol. 123, expires 3/2005.


*Updated by*: Carmen Ma, BScPhm, Staff Pharmacist, Nephrology – Oct, 2002

*Revised by*: Michael Wong – 2005

## Antibiotic Dosing Guidelines in Hemodialysis

When making a dosage schedule for patients on hemodialysis, the dose adjustment for the degree of renal function must be determined first, and then the effect of dialysis on the total body clearance of the drug must be taken into account.

For practical purposes, it is most convenient to separate antibiotics into four groups:

1. **HEMODIALYZABLE with a LONG $t_{1/2}$**
   A dose of these drugs should be given immediately after hemodialysis (e.g., the order should be written: cefazolin 1 g daily, give post-dialysis on dialysis days)
2. **HEMODIALYZABLE with a SHORT $t_{1/2}$**
   It is difficult for hemodialysis to have a significant effect on total body clearance for these drugs due to their intrinsically short half-life. Since most of the drugs in this category have a high therapeutic index, it is unnecessary to alter the dose or to supplement the dose after dialysis, with a few exceptions.
3. **NOT HEMODIALYZABLE with a LONG $t_{1/2}$**
4. **NOT HEMODIALYZABLE with a SHORT $t_{1/2}$**

***Note:*** A **LONG $t_{1/2}$** will be one that allows for a dosing interval of 24 hrs or more.

Drugs for which the recommended dosing interval is every 8 to 18 hours and which are hemodialyzable result in the most complex dosing schedule. The time interval from the end of dialysis, when serum levels are low, until the next dose could be between 4 and 14 hours and would therefore be of clinical importance. Also, the amount of additional antibiotic needed at the end of dialysis would be dependent on how close the previous dose was to the start of dialysis, and this could change from day to day. Therefore, the doses suggested have sometimes been modified from those in the literature to avoid q8h-q18h dosage. A q6h interval with the same total daily dose may be given. In this way, there are never more than a couple of hours with low (subtherapeutic) serum levels.

The usual recommended trough concentrations of drugs are not applicable in patients with severe renal impairment. Because of the extended t1⁄2 of drugs in these patients, the usual trough concentrations are not achievable without an extended period of subtherapeutic concentrations.

The following recommendations are made assuming:

- Normal hepatic function
- Adult patients
- Patient's glomerular filtration rate (GFR) <10 mL/min (0.16 mL/sec)
- Standard hemodialysis schedules of 3 to 6 hours of hemodialysis every 2 to 3 days

***Note:*** The following dosage recommendations for antimicrobials are not intended for treatment of endocarditis or meningitis. For endocarditis and meningitis, target levels to be determined on a case by case basis by the Infectious Disease Service or the medical team.

**Table 2: Dosing Guidelines in Hemodialysis and CVVHD**

| ***Drug*** | ***Recommended Dose for IHD*** | ***Dose after IHD*** | ***Recommended Dose for CVVHD*** |
|---|---|---|---|
| *acyclovir* | 2.5-5 mg/kg IV q24h<br>200 mg PO q12h (*Herpes simplex*)<br>800 mg PO q12h (*Herpes zoster*) | yes | 5-10 mg/kg IV q12-24h<br>No adjustment necessary for PO |
| *amantadine* | 200 mg PO once a week | no | 100 mg PO q48-72h |
| *amikacin* | 5 mg/kg IV load, *then*<br>2.5 mg/kg IV post hemodialysis*<br>**Adjust dose based on trough level**** | yes | 5-7.5 mg/kg load, *then*<br>3-4.5 mg/kg IV q12h<br>**Adjust dose based on trough level**** |
| *amoxicillin* | 250 mg PO q12h<br>***or*** 500 mg PO q24h | yes | 500 mg PO q8-12h<br>(liquid available) |
| *amoxicillin/clavulanic acid* | 250/125 mg PO q12h<br>***or*** 500/125 mg PO q24h | yes | - |
| *ampicillin (IV)* | 1-2 g IV q12-24h | yes | 1-2 g IV q6-12h |
| *caspofungin* | 70 mg IV load, *then*<br>50 mg IV q24h | no | 70 mg IV load, *then*<br>50 mg IV q24h |

| ***Drug*** | ***Recommended Dose for IHD*** | ***Dose after IHD*** | ***Recommended Dose for CVVHD*** |
|---|---|---|---|
| *cefazolin* | 1 g IV q24h<br>***or*** 2 g IV post hemodialysis* | yes | 1 g IV q12h |
| *cefotaxime* | 1-2 g IV q24h | yes | 1 g IV q12h |
| *ceftazidime* | 1 g IV q24h<br>***or*** 1-2 g post hemodialysis* | yes | 1-2 g IV q12-24h |
| *ceftriaxone* | 1-2 g IV q24h | no | 1-2 g IV q12-24h |
| *cefuroxime axetil (PO)* | 250-500 mg PO q12h<br>***or*** 500 mg PO q24h | yes | 250-500 mg PO q12h<br>(liquid available) |
| *cephalexin* | 250-500 mg PO q12h | yes | 250-500 mg PO q12h<br>(liquid available) |
| *chloramphenicol* | 0.25-1 g IV q6h (12.5 mg/kg q6h) | no | - |
| *chloroquine* | 500 mg PO x 1 dose, *then*<br>250 mg PO weekly (malaria) | no | - |
| *ciprofloxacin* | 250-500 mg PO q24h<br>200-400 mg IV q24h | no | 500 mg PO q12-24h<br>400 mg IV q12-24h |
| *clarithromycin* | 250-500 mg PO q12h | yes | - |
| *clindamycin* | 150-300 mg PO q6h<br>300-600 mg IV q8h | no | 150-300 mg PO q6h<br>300-600 mg IV q8h |
| *cotrimoxazole (PO)* (DS = trimethoprim 160 mg , sulfamethoxazole 800 mg | 1 DS tablet PO q24h<br>(for indications other than PCP) | yes | 1DS PO q24h<br>(liquid available) |
| *doxycycline* | 100 mg PO daily | no | 100 mg PO daily |
| *erythromycin* | 250-500 mg IV/PO q6h<br>(1 g q6h causes predictable reversible deafness) | no | 250-500 mg IV q6h |
| *ethambutol* | Not recommended in patients with GFR <10 mL/min[†] | N/A | 15-25 mg/kg q24h<br>(No dose adjustment necessary) |
| *famciclovir* *Herpes simplex*<br>*Herpes zoster* | 125 mg PO q24h<br>500 mg PO q48h | yes | 125 mg PO q12-24h<br>500 mg PO q12-24h |

| *Drug* | ***Recommended Dose for IHD*** | ***Dose after IHD*** | ***Recommended Dose for CVVHD*** |
|---|---|---|---|
| *fluconazole* | 400 mg IV/PO loading dose, *then*<br>100-400 mg IV/PO daily to q2days | yes | 100–400 mg IV/PO q24h |
| *foscarnet*<br>(See guidelines for details) | 45-60 mg/kg post hemodialysis | N/A | |
| *ganciclovir (IV)* | *Treatment:* 1.25 mg/kg IV post hemodialysis*<br>*Maintenance:* 0.625 mg/kg IV post hemodialysis* | yes | 2.5 mg/kg IV q24h<br>(treatment and maintenance) |
| *gentamicin* | 2 mg/kg IV loading dose, *then*<br>1 mg/kg IV post hemodialysis*<br>**Adjust dose based on trough level**** | yes | load, *then*<br>12h<br>**Adjust dose based on trough level**** |
| *imipenem/cilastatin* | 250-500 mg IV q12h | yes | 500mg IV q6-8h |
| *isoniazid* | 300 mg PO daily | yes | 300 mg PO daily |
| *itraconazole (PO)* | 100-200 mg PO q12h<br>(Take tablets with food; take solution on empty stomach) | no | 100-200 mg PO q12h<br>(liquid available) |
| *ketoconazole* | 200-400 mg PO daily | no | 200-400 mg PO daily |
| *linezolid* | 600 mg PO/IV q12h | yes | 600 mg PO/IV q12h<br>(No adjustment necessary) |
| *meropenem* | 500 mg IV q24h | yes | 250-500 mg IV q12h |
| *metronidazole* | 500 mg IV/PO q12h<br>*C. difficile:* 500 mg PO q8h | yes | 500 mg IV/PO q12h<br>*C. difficile:* 500 mg PO q8h |
| minocycline | *200 mg PO x 1 dose,* then<br>*100 mg PO q12h* | *no* | *200 mg PO x 1 dose,* then<br>*100 mg PO q12h* |
| moxifloxacin | *400 mg IV/PO q24h*<br>(No adjustment necessary) | | *400 mg IV/PO q24h*<br>(No adjustment necessary) |

| ***Drug*** | ***Recommended Dose for IHD*** | ***Dose after IHD*** | ***Recommended Dose for CVVHD*** |
|---|---|---|---|
| nalidixic acid | *Not recommended in patients with GFR <10 mL/min*[†]<br><br>*(Metabolites accumulate)* | *N/A* | *Not recommended*[†] |
| *nitrofurantoin* | Not recommended in patients with GFR < 30 mL/min[†] | N/A | Not recommended[†] |
| *penicillin G* | 1 Million Units (MU) IV q8-12h<br>(maximum dose = 10 MU/day) | yes | 0.5-3 MU IV q6h |
| *penicillin VK* | 300 mg PO q6h | yes | 300 mg PO q6h |
| *pentamidine isethionate* | 3-4 mg/kg IV q24h | no | 4 mg/kg IV q24h |
| *piperacillin/ tazobactam* | 3.375 mg IV q12h | yes | 3.375 mg IV q6-8h |
| *pyrazinamide* | 40 mg/kg PO 3x/week<br>(Give 24 hours **before** the start of each hemodialysis) | no | 25-30 mg/kg q24h |
| *rifampin* | 300-600 mg PO q24h | no | 300-600 mg PO q24h |
| *streptomycin* | 15 mg/kg IV loading dose, *then*<br>9 mg/kg IV post hemodialysis* | yes | 15 mg/kg q24-72h |
| *tetracycline* | 250-500 mg PO q24h<br>(Note: doxycycline is preferred) | yes | 250-500 mg q12h |
| *tobramycin* | 2 mg/kg IV loading dose, *then*<br>1 mg/kg IV post hemodialysis*<br>**Adjust dose based on trough level**** | yes | load, *then*<br>12h<br>**Adjust dose based on trough level**** |
| *valganciclovir* | Not recommended in hemodialysis[†] | N/A | *Induction:* 450 mg PO q24h<br>*Maintenance:* 450 mg PO q48h |
| *vancomycin* | Discuss dosing with pharmacist | | |

| *Drug* | ***Recommended Dose for IHD*** | ***Dose after IHD*** | ***Recommended Dose for CVVHD*** |
|---|---|---|---|
| *voriconazole (IV)* | Not recommended in patients with GFR <50 mL/min due to vehicle for IV preparation† | N/A | Not recommended due to vehicle for IV preparation† |
| *voriconazole (PO)* | 400 mg PO q12h x 2 days, *then* 200 mg PO q12h | N/A | 400 mg PO q12h x 2 days, *then* 200 mg PO q12h |

* Only give on hemodialysis days.
** Consult with pharmacist for dosage adjustment.
† Pharmacist to discuss therapeutic alternatives with physician.

**References**


1. Aronoff GR, Bennett WB, Berns JS, et al. Drug Prescribing in Renal Failure: Dosing Guidelines for Adults, Fourth Edition. Philadelphia, PA; American College of Physicians. 2002.

2. Aweeka FT, Jacobson MA, Martin-Munley S, et al. Effect of renal disease and hemodialysis on foscarnet pharmacokinetics and dosing recommendations. J Acquire Immune Defic Syndr Hum Retrovirol 1999;20:350-357.

3. McEvoy GK, ed. AHFS Drug Information 2000. Bethesda, MD; American Society of Health-System Pharmacists, Inc. 2002.

4. Welbanks L, ed. Compendium of Pharmaceuticals and Specialties, 37th Ed. Ottawa, ON; Canadian Pharmacists Association 2002.

5. MICROMEDEX(R) Healthcare Series Vol. 123 expires 3/2005.

6. Medical Information from:
Bayer Inc.
Hoffmann-LaRoche Limited
Janssen-Ortho Inc.
AstraZeneca Pharma Inc.



*Updated by:* Carmen Ma, BScPhm, Staff Pharmacist, Nephrology – October 2002
*Revised* by: Marisa Battistella, PharmD - May 2006

# Nephrogenic systemic fibrosis (NSF) and Gd-enhanced MRI

Gd-enhanced MRI should be avoided in dialysis patients, or with any pt with CrCl < 30 mL/min unless absolutely necessary. If done in this group, Nephrology to be consulted first.

- Any patient needing MRI on who is on HD, is to be dialysed directly after the MRI for 3 consecutive days as prophylaxis against NSF
- Patients on PD should have insertion of temporary line and have HD daily X3 since Gd is not likely removed at an adequate rate by PD.

## UHN Policy for NSF:

Nephrogenic systemic fibrosis (NSF) is a recently identified fibrosing disorder. It was initially described as causing thickening and hardening of the skin overlying the trunk and extremities. Subsequent studies showed that some patients had fibrosis of deeper structures including muscle, fascia, lungs, and the heart. This disease, while rare, has a significant mortality rate.

The vast majority of cases, or according to some publications, all cases of NSF, have occurred in patients with kidney failure. The risk appears greatest in patients in end-stage renal disease (ESRD). Increasing epidemiologic evidence has implicated gadolinium-containing contrast agents (Gd). Based on the number of reported cases, risk appears to be greater with increasing dose of Gd, and with certain types of Gd-agents. The greatest number of NSF cases reported to date has been in patients that have received Omniscan (gadodiamide).

**General Guidelines**

If the patient has ESRD, the patient should be examined with an alternate imaging modality, other than contrast-enhanced MRI (CEMRI), such as CT, or unenhanced MRI. If CEMRI is thought to be essential, a nephrology consult must be obtained. Nephrology will arrange for dialysis (HD or PD) to be done immediately after the CE-MRI.

Omniscan should never by used in any patient with renal failure (Cr > 150 umol/L or GFR < 30 mL/min). An alternative Gd-agent should be used, such as: Magnevist, Gadovist, Prohance, or Multihance, depending on the preference of the supervising radiologist, and the availability of the agent. If Omniscan is the agent to be used for CE-MRI in any patient, the dose used should never exceed the recommended dose on the Omniscan package insert.

**Specific Guidelines: Ordering & Performing Gd-Enhanced MRI & MRA**

PATIENTS WITH RENAL FAILURE

1. All clinicians who order MRI should clearly identify on the requisition if the patient is receiving hemodialysis, peritoneal dialysis, or is in renal failure. For those in renal failure but not on dialysis a recent serum creatinine or GFR will be required. The referring physician must consult with a radiologist to determine the best imaging strategy for the patient. Alternative imaging modalities, other than CEMRI, will be considered to determine whether they are acceptable.

- Patients on dialysis. If the patient is on dialysis, a nephrologist must be consulted prior to doing Gd-enhanced MRI of any kind. In general terms, these patients should be examined with an alternate imaging modality, other than CEMRI, such as CT, or unenhanced MRI. If CEMRI is thought to be essential to the health and well-being of the patient, and there is no acceptable imaging alternative, nephrology will arrange for hemodialysis to be done immediately after the CEMRI.
- Patients in moderate renal failure. (creatinine > 150 umol/L, GFR < 30 mL/min). One of the usual alternatives to CEMRI is CECT, however CECT carries some risk of further worsening renal function in patients with renal impairment (contrast-induced nephropathy). Accordingly, the best imaging strategy for patients with moderate renal failure must be discussed with a radiologist prior to booking the study. The radiologist will weigh the risk-benefit ratio of doing CT, CECT, NCMRI or CEMRI in consultation with the referring physician. A nephrology consult may be required.

PATIENTS WITH NO HISTORY OF RENAL FAILURE

1. UHN and MSH currently have a preferred provider arrangement with the supplier of Omniscan, the most frequently used agent in our hospitals. Since there has not been shown to be any significantly increased risk of NSF in patients with normal renal function with the administration of Omniscan, continue to use Omniscan for CEMRI in patients with no history of renal failure.
2. Regardless of the contrast agent used, do not exceed the recommended dose as delineated in the package insert on a mL/kg basis. The only exception to this rule shall be when direct instructions are given by a radiologist to exceed this dose. The usual indication for a larger dose shall be MRA.
3. If the indication for contrast-enhancement is MRA of the Head, Neck, Heart, Chest, Abdomen or Pelvis, then Gadovist is recommended. Magnevist, Prohance or Multihance may also be used, depending on availability of the agent and the preference of the supervising radiologist.
4. If the indication for contrast-enhancement is MRA of the Legs or Feet, then Magnevist is recommended. Gadovist, Prohance or Multihance may also be used, depending on availability of the agent and the preference of the supervising radiologist.
5. If the radiologist, nurse or MRI technologist has any concerns about the reliability of the patient's renal history, do not use Omniscan. Use an alternate agent, or obtain a serum creatinine or GFR, to obtain an objective measure of the patient's renal function.

** For purposes of this policy, patients should be asked whether or not they have impaired renal function. If they reply, "I do not know if my renal function is impaired", we will handle these patients as if they did not have impaired renal function. *(Rationale: All patients reported to have had NSF have had severe renal impairment; most were on dialysis. Thus it is extremely unlikely that a patient could have a degree of renal function impairment that would be of concern to us, and be unaware of it).*

Walter Kucharczyk, MD, FRCP(C)
Director, MRI at UHN and MSH
*In consultation with Dr. Ed Cole, Head, Division of Nephrology, UHN*

The risk of the study has to be weighed against the potential benefits. Furthermore, consideration should be given as to whether a different imaging study could be substituted.

# Hospital Policy for Gd-MRI and GD-MRA

**(MRD = "Manufacturers' Recommended Dose")**
**(RPD = Radiologist to Prescribe Dose)**
**(* = depends on availability of agent and radiologist's preference)**
**(shaded areas indicate change from pre-NSF practice, effective May 10, 2007)**

| Renal Function | Standard CEMRI | | CEMRA | | Dialysis | Neprhology Or Radiology Consult Required? |
|---|---|---|---|---|---|---|
| | Agent(s) | Dose | Agent(s) | Dose | | |
| Normal renal function | Omniscan | MRD | *Any of: Magnevist Gadovist Prohance Multihance | RPD | | NO |
| Moderate renal failure (GFR<30 mL/min) | *Any of: Magnevist Gadovist Prohance Multihance | MRD | Strong relative contra-indication *Any of: Magnevist Gadovist Prohance Multihance | RPD | Hemodialysis may be required ASAP Post-MRI | Rad ± Nephro |
| Severe renal failure (defined as being on dialysis or almost on dialysis) | *An alternate imaging test to CEMRI is recommended *Omniscan NOT to be used | ------- | CEMRA contraindicated in this patient group | ------- | Hemodialysis will be required ASAP Post-MRI | Rad + Nephro |
| Reliability of the patient's renal history is uncertain | *Any of: Magnevist Gadovist Prohance Multihance | MRD | *Any of: Magnevist Gadovist Prohance Multihance | RPD | | NO |

## How To Order Catheter insertions, biopsy, Doppler, anaesthesia

Order Tunnelled U/C catheter: Under Nephrology Order set: Diagnostics → "Abd/Thoracic Angio". Enter comment if necessary.

Order Kidney Biopsy: Order entry →Procedure tab, type in "Biopsy" →Select "Abd Biopsy"(goes under Interventional)→ Kidneys (5) →Left (as approp) →Tomorrow (4) →Reason Screen: (2) see Comment Field →(8) Comment: "localization for kidney biopsy" →OK→Accept (A). If probs, call biopsy room 14-8257.

Book Arterial Doppler: In Electronic Patient Record (EPR), Order Entry → Diagnostics→ Vascular Lab→ Arterial Doppler

Book Anaesthesia consult: Fax 3698 or email to AnesthesiaORSecretary@uhn.on.ca Include name, MRN, DOB, diagnosis, location, planned OR, staff MD.

## TELEPHONE DIRECTORY

| | |
|---|---|
| Emerg TG | 14-3947 |
| TW | 13-2777 |
| Chiropodist - Tracy Oliver | 6007 pgr 790-6771 |
| Fracture Clinic TW | 13-5858 |
| Hemodialysis Unit HW | 4072 fax 4892 |
| Hemodialysis Unit HE | 5707 fax 3084 |
| Hemodialysis Unit TR | 597-3422 ext 3801 fax 977-8719 |
| Home Peritoneal Dialysis Unit 12ES | 5672 fax 4169 |
| Home Hemodialysis | 3736 fax 4379 |
| Interventional Radiology / Angio | 5339 |
| Kidney Foundation: Roselyn | 3821, (905) 278-3003 x 4973 |
| Labs | 5898 |
| Rapid Response | 3542 |
| Micro | 2526 |
| Mt Sinai Hospital | (416) 596-4200 or (17+ extension) |
| NPs: Betty Kelman | 8501 pgr 790-7758 |
| Diane Watson | 8238 pgr 790-7775 |
| O'Neill Centre | 536-1116 fax ext 250 |
| On Call Room | 2541 |
| Psych Consult | 4451 |
| Pathology – Dr Rohan John | 14-4560 |
| PD catheter coordinator, Zita | 2358 |
| Princess Margaret Hospital | (416) 946-2000 or (16 + extension) |
| Renal Coordination Office - | |
| Evie 3588 | Maria 6053 |
| Monica 3056 | Diane 6389 |
| Social Workers: Zoe Levitt | 3618 pgr 719-2876 |
| Michela Veridirame | 3983 pgr 719-2812 |
| Melissa Rubin | 6047 pgr 719-3731 |
| Marla Scipione, MSW, 4768, pgr 719-2668 | |
| Toronto Western Hospital | (416) 603-2581 or (13+ extension) |
| Toronto Rehab | (416) 597-3422 |
| Translation Services | 13-6400 |
| Vascular Access Coordinator- Cyndi | 3518 |
| Vascular Lab | 3589 |

| Nephrologists (Assistant) | Address | Office | Pager |
|---|---|---|---|
| Dr. J. Bargman (Shelagh) | 8N-840 | 4804 | 790-6317 |
| Dr. C. Cardella (Janet) | 11C-1258 | 4480 | 790-4932 |
| Dr. D. Cattran (Jocelyn) | 11C-1256 | 4187 | 790-9036 |
| Dr. C. Chan (Tara) | 8N-842 | 3073 | 790-9833 |
| Dr. D. Cherney (Marion) | 8N-845 | 6121 | 790-7711 |
| Dr. E. Cole (May) | RFE 1S-409 | 4669 | 778-3582 |
| Dr. S. Fenton (Gail) | 8N-855 | 4073 | 790-7752 |
| Dr. V. Jassal (Tara) | 8N-857 | 3196 | 790-8803 |
| Dr. J. Kim (Beth) | 11C-1138 | 5729 | 790-0255 |
| Dr. A. Logan (Anna) | MSH 4-435 | 586-5187 | 380-5187 |
| Dr. C. Lok (Julia) | 8N-844 | 4140 | 790-8645 |
| Dr. R. McQuillan (assoc) | 8N | 5617 | 790-9027 |
| Dr. J. Miller (Kathie) | 8N-846 | 4966 | 790-9078 |
| Dr. R. Parekh | HSC (647)244-4046 | | 235-7854 |
| Dr. Y. Pei (Christina) | 8N-838 | 4257 | 790-8988 |
| Dr. H. Reich (Marion) | 8N-849 | 3439 | 719-1102 |
| Dr. R. Richardson (Susan) | 8N-861 | 3889 | 790-9663 |
| Dr. D. Ryan | MSH 4-435 | 586-5174 | |
| Dr. J. Schiff (David) | 11C-1182 | 3961 | 790-8296 |
| Dr. J. Scholey (Veronica) | 8N-859 | 5093 | 719-4569 |
| Dr. M. Silverman (Lisa) | 8N-848 | 4064 | 790-8918 |
| Dr. K. Tinckham (Lisa) | 301-67 College | 5142 | 790-1368 |
| Dr. C. Whiteside | U of T | | |

**Doctors for Surgical Procedures**

| | |
|---|---|
| Dr. M. Cattral | 3760 |
| Dr. G. Roche-Nagle | 3552 |
| Dr. L. Tse | 3275 |
| Dr. T. Lindsay | 4620 |
| Dr. D. Goldstein (for parathyroidectomy) | 4767 |
| Dr. G. Oreopoulos (Vascular) | 3275 |

**Doctors for PD catheter insertions**

| | |
|---|---|
| Dr. T. Penner | 13-6220 |
| Dr. M. Robinette | 14-3855 |
| Dr. M. Simons (Angio) | 13-6276 |

# Toronto & Area Nephrology

CREDIT VALLEY Mississauga **HD 905-813-1100 x7488 PD 905-813-4230**

| | | | |
|---|---|---|---|
| **Arturo Wadgymar** | **905-820-8770** | **Gordon Wong** | **905-820-8770** |
| **Don Kim** | **905-857-4772** | **George Wu** | **905-820-8770** |
| **Jennifer Lipscombe** | **905-820-8770** | **David Perkins** | **905-820-8770** |
| **Phil Boll** | **905-820-8770** | | |

HALTON HealthCare Oakville Trafalgar **905- 845-2571 HD: 905-338-4492**

| | | | |
|---|---|---|---|
| **Daniel Sapir** | **905-815-8910** | **Sanjaya Pandeya** | **905-815-9283** |

HUMBER RIVER REGIONAL **416-249-8111 HD: 243-4610 PD: 658-2241**

| | | | |
|---|---|---|---|
| **Andreas Pierratos** | **658-2241** | **David Mendelssohn** | **243-4223** |
| **Murray Berall** | **658-2241** | **Harold Bornstein** | **658-2241** |
| **Gavril Hercz** | **658-2241** | **Gihad Nesrallah** | **658-2241** |
| **Carl Saiphoo** | **658-2241** | | |

HOSPITAL FOR SICK CHILDREN **(416) 813-1500 HD: 813-7563**

| | | | |
|---|---|---|---|
| **Denis Geary** | **813-6283** | **Diane Hebert** | **813-6287** |
| **Elizabeth Harvey** | **813-5082** | **Valerie Langlois** | **813-6283** |
| **Rachel Pearl** | **813-7654** | **Tino Piscione** | **813-7654** |

LAKERIDGE HEALTH, Oshawa **(905) 576-8711 HD: ext 6751 Whitby ext 6221 PD: ext 3125**

| | | | |
|---|---|---|---|
| **Andrew Steele** | **905-721-4337** | **Donna Birbrager** | **905-721-4064** |
| **George Buldo** | **905-723-8551** | **Chuck Wei** | **905-686-3351** |
| **Ilan Lenga** | **905-721-4339** | **Nancy Barrese** | **905-576-8711** |

PETERBOROUGH **HD: (705) 876-5078**

| | | | |
|---|---|---|---|
| **Darth Hanson** | **705- 750-1786** | **Eliot Beaubien** | **705- 750-1786** |
| **Vincent Cheung** | **705- 750-1786** | **Srinu Kammila** | **705- 750-1786** |

ROYAL VICTORIA HOSP, Barrie **HD: (705) 728-9090**

| | | | |
|---|---|---|---|
| **Merali Krishnan** | **705-728-9846** | **Derek Benjamin** | **705-728-9843** |

SCARBOROUGH CENTENARY **(416) 284-8131**

| | |
|---|---|
| **Patricia Chan** | **335-9889** |

SCARBOROUGH GENERAL **(416) 438-2911 HD: ext 6638 PD: ext 8183**

| | | | |
|---|---|---|---|
| **Paul Tam** | **279-0855** | **Rob Ting** | **279-0855 X 238** |
| **Janet Roscoe** | **438-9000** | **Jason Fung** | **279-0855 X 238** |
| **Tabo Sikaneta** | **279-0855 X 238** | **Paul Ng** | **279-0855 X 245** |
| **Steven Chow** | **279-0855 X 245** | **Gordon Ngai** | **279-0855 X 245** |

**SOLDIER'S MEMORIAL,** Orillia **(705) 325-2201 HD (705) 327-9129**

| | | | |
|---|---|---|---|
| **Leo Lam** | **705-329-0644** | **Vas Poulopoulos** | **705-325-0077** |

SUNNYBROOK **(416) 480-6100 HD: 480-4488 PD: 480-4489**

| | | | |
|---|---|---|---|
| **Shelley Albert** | **480-6950** | **David Naimark** | **480-4769** |
| **Matt Oliver** | **480-4755 X7061** | **Gemini Tanna** | **480-6100 x4755** |
| **Sheldon Tobe** | **480-6901** | **Ali Zahirieh** | **480-6100 x2796** |

**Michelle Hladunewich 480-6100 x 5954**

**ST.MICHAEL'S** **(416) 360-4000** **HD: 864-5228** **PD: 864-5794**

| | | | |
|---|---|---|---|
| **Marc Goldstein** | **864-5290 fax 3042** | **Phil McFarlane** | **867-3702** |
| **Ziv Harel** | | **Kamel Kamel** | **867-7479** |
| **Jeff Perl** | **864- 6016** | **Ramesh Prasad** | **867-3722** |
| Susan Quaggin | 586-8266 | Jordan Weinstein | 276-0506 |
| **Jeff Zaltzman** | **867-7444** | **Martin Schreiber** | **867-7454** |

**ST.JOSEPH'S HEALTH CE**NTRE **HD: 530-6395** **PD: 530-6787**

| | | | |
|---|---|---|---|
| **Adriana Berbece** | **530-6227** | **Stavros Karanicolas** | **530-6239** |
| **Joanna Sassal** | **530-6227** | **Amrit Kang** | **530-6227** |
| **Myurathy Rao** | **530-6227** | | |

TORONTO EAST GENERAL **(416) 461-8272** **HD: 469-6167**

| | | | |
|---|---|---|---|
| **Steven Chow** | **698-0883** | **Paul Ng** | **461-0939** |
| **Patricia Chan** | **335-9889** | **Anita Dunn** | |

TRILLIUM HEALTH CENTRE Mississauga **(905) 848-7100**

| | | | |
|---|---|---|---|
| **Marion Hockley** | **905-272-1104** | **Kiran Kundhal** | **416-622-4762** |

WILLIAM OSLER Brampton **(905) 494-2120** **HD: 905-494-6580**

| | | | |
|---|---|---|---|
| **Jasdip Sachdeva** | **905-453-0715** | **Hitesh Mehta** | **905-453-0715** |
| **Xi Shan** | **905-453-0715** | **Bajinder Reen** | **905-742-7161** |
| **Sandra Donnelly** | **905-453-0715** | **Sahar Kajbat** | **905-453-0715** |

YORK CENTRAL **HD: 905-883-1212x3249** **PD: 905- 883-2581** **Vaughan HD 905-883-2106**

| | | | |
|---|---|---|---|
| **Bharat Nathoo** | **905-508-5911** | **Esther Szaky** | **905-508-5911** |
| **Arif Manuel** | **905-508-5911** | **Michael Pandes** | **905-508-5911** |
| **Andre Charest** | **905-508-5911** | **Prince Aujula** | **905-508-5911** |
| **Edwin Fong** | **905-508-5911** | | |

DMC Markham
**905-470-9992**

DMC Pickering
**905-831-1200**

DMC Peterborough
**705-876-8737**

Sheppard Centre Self Care Dialysis
**416-223-2013 Fax 416-223-3221**

Sussex Centre Self Care Dialysis
**905-272-8334 Fax 905-272-4534**

# Calendars of Weekly Rounds - Nephrology

| | Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|---|
| 0800 | Sign In Rounds 8N-828 Conference Room | Sign In Rounds 8N-828 Conference Room | Sign In Rounds 8N-828 Conference Room | Sign In Rounds 8N-828 Conference Room | Sign In Rounds 8N-828 Room |
| 0830 | Teaching Rounds 8N-828 Conf Room | Fluid & Electrolyte Rounds 8N-828 Conf Room | Teaching Rounds 8N-828 Conf Room | Teaching Rounds 8N-828 Conf Room | Renal Rounds 12 N 1276 |
| 0900 | | | | | |
| 1000 | | | Yellow Team Patient Care Rounds 7C-746 | | |
| 1100 | | | | | |
| 1200 | | | | Home Dialysis Rounds 12 N 1276 for Nephrology Trainees | |
| 1230 | | Dialysis Journal Club – 8N-828 Conf Rm | | | |
| 1300 | | | | | |
| 1400 | | | | | |
| 1500 | | | Education Rounds 11C-1135 | | |
| 1600 | | | City Wide Nephrology Rounds 11C-1135 | Renal Biopsy Rounds 10ES-316 | Sign Out Rounds 8N-828 Conf Room |
| 1700 | Signout to On Call | Signout to On Call | Signout to On Call | Signout to On Call | |

# Calendar of Weekly Rounds - Transplant

| | Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|---|
| 0715 | | | Weekly rounds, discussion of inpatients 11C-1272 (Coffee/pastries ) | | |
| 0800 | | | Multi-Organ Transplant Rounds, Astellas Conference Room, 11C-1135 | Outpatients issues/patients for listing meeting, 12C (Transplant Fellows only) | |
| 0830 | | | | | Renal Rounds, 12 North (NU)-1276 (Coffee and light breakfast) |
| 0900 | | Post-Transplant Clinic (Drs. Cardella and Cattran), Transplant Clinic, 12C | Post-Transplant Clinic (Dr. Cole), Transplant Clinic, 12C Kidney-Pancreas Clinic (Dr. Schiff), Transplant Clinic, 12C | | |
| 0930 | | | | | Post-Transplant Clinic (Dr. Schiff), Transplant Clinic, 12C |
| 1000 | Ward Rounds, 7C | | | Ward Rounds, 7C | |
| 1100 | | | | | |
| 1200 | | | | | |
| 1230 | | | Journal Club, 11C-1235 (lunch provided) | | |
| 1300 | | Post-Transplant Clinic (Dr. Tinckam), Transplant Clinic, 12C | | Pre-Transplant Clinic (Drs. Cole and Schiff), Transplant Clinic, 12C | |
| 1400 | | | | | |
| 1500 | | | Education Rounds 11C-1145 | | |
| 1600 | Transplant Seminar, Fellows' Room, 11C | | City Wide Nephrology Rounds 11C-1135 | Renal Biopsy Rounds 10ES-316 | |