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Cool Beans

The Nephrology Fellowship Survival Guide

For the fellows, by the fellows

Baylor College of Medicine
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Chapters

Chapter 1: Navigating Your Way

THE METHODIST HOSPITAL

Places to Know

- Start your rounds on Dunn 4 West Transplant Unit Physician Dictation Room – **be ready by 8:30AM**. All units have work-rooms, but we usually work from Dunn 4W (transplant floor). Okay to leave purse/bag there, but I do not advise to leave valuables
- Hemodialysis Unit is on Fondren 4th Floor
- Pre-Transplant Clinic is Out-Patient Tower 26th Floor (cross over on the skybridge)
- Biopsy conference is in the same place; Outpatient (OPC) 26th Floor in front of the clinic- EVERY Monday at noon, lunch provided
- Physician Services Lounge is on 1st Floor Main Building near the main elevators

Transplant meeting

Starts at 8:30am (9 am on Wednesday) on the 4th floor conference room (Dunn 431)

- Be ready to briefly presents all your post op and pre-op transplant patient and any patient admitted with a recent transplant (< 2 years), this a multidisciplinary meeting with the surgeons, pharmacist and social worker.
- The surgery PA (Laura), transplant pharmacist, and surgery transplant fellow are very important to know. The transplant protocol is on our shared drive.

Rounds start after the transplant meeting

- Tuesday-Thursday: pre-transplant clinic on 26th floor of Outpatient Center. You usually see around 2 patients per day. Were you will determine transplant eligibility for candidates and annual updates on patient on the waiting list. Get a workspace on wheels and log-

Chapter TWO:
Acute Kidney Injury and CRRT

KDIGO guideline define AKI as any of the following:

- Increase in SCr by ≥0.3mg/dl (≥ 26.5lmol/l) within 48 hours; or
- Increase in SCr to ≥1.5 times baseline, which is known or presumed to have occurred within the prior 7 days; or
- Urine volume <0.5ml/kg/h for 6 hours.

AKI Staging

Stage	Serum Creatinine	Urine output
1	1.5-1.9 x baseline OR ≥0.3 mg/dl (≥26.5µmol/l) increase	<0.5 ml/kg/h for 6-12 hours
2	2.0-2.9 x baseline	<0.5 ml/kg/h for ≥ 12 hours
3	3.0 x baseline OR Increase in sCr to ≥ 4.0 mg/dl (≥353.6 µmol/l) OR Initiation of renal replacement therapy OR, in patients <18 years, decrease in eGFR to <35 ml/min per 1.73 m²	<0.3 ml/kg/h for ≥ 24 hours OR Anuria for ≥ 12 hours

Type AKI	Urinalysis	U Na	FeNa	FeUrea	Bun:Cr
Pre-renal	High specific gravity; Normal or hyaline casts	<20	<1	<35	>20:1
Intrinsic	ATN: low specific gravity, muddy brown casts, renal tubular epithelial cells Vascular: normal or hematuria GN: Proteinuria, hematuria, RBC casts, dysmorphic RBCs Interstitial: Mild proteinuria, hematuria, WBCs, WBC casts, eosinophils	>20	>2	>50	<20:1
Post-renal	Normal or hematuria	>20			>20:1

WBCs, occasional granular casts

FeNa = (UNa x SCr / SNa x UCr) x 100
FeUrea = (Uurea x SCr / BUN x UCr) x 100

Continuous and Prolonged Renal Replacement Therapy (CRRT/PIRRT)

CRRT is primarily employed in the ICU with critically ill patients that have a more delicate hemodynamic status and less capacity to accommodate large volume and solute removal in a short period of time. It has practical advantages for volume control in dynamic patients and has been associated with lower length of stay in the ICU. Modes of continuous renal replacement therapy vary depending on whether convection or diffusion (or a combination of both) is primarily utilized for solute clearance. Convection is the hydrostatic force across a membrane while diffusion is the movement of solute across a concentration gradient. While there are theoretical and practical reasons to prefer one modality over another, there are no proven benefits for one modality over another regarding mortality or renal recovery. Continuous veno-venous hemodialysis (CVVHD) is the work-horse of CRRT in the medical center, and as the name implies is continuous solute clearance via diffusion.. We mostly use CVVHD at the medical center except BT. We also have the ability to do SLED/ SHIFT therapy at all of the centers (St. Luke's, Methodist, BT, MDA and VA). There are two commonly used machines for CRRT, namely Prismaflex and NxStage. NxStage is utilized at all pavilions in the medical center except Texas Children's Hospital.

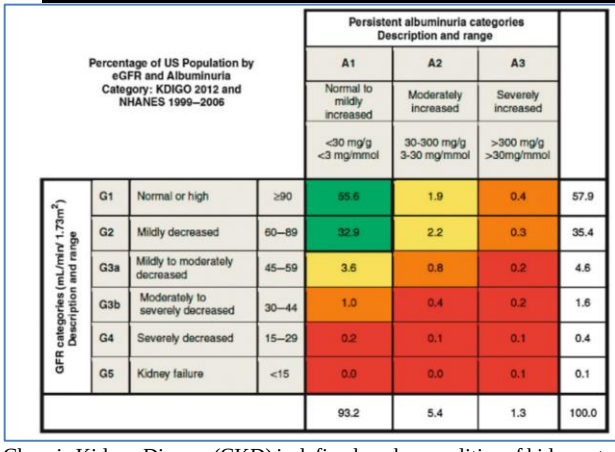
Modalities of CRRT:

1. SCUF – Slow Continuous Ultra filtration: This mode of CRRT uses the principle of ultrafiltration purely to remove excess fluid from the body neither dialysis solution nor replacement fluid is used. It works by pumping the patient's blood through a filter which separates the fluid and molecules according to the size of the filter pores. These are generally very small in this mode so as

not to lose different solutes. Convection does also occur in this mode, however, is restricted by the filter pore. This mode offers less in terms of solute clearance, and therefore can limit abrupt falls in plasma osmolality (before equilibration) that induce further decreases in extracellular volume.

2. Continuous veno-venous hemofiltration (CVVH) uses convection. Hydrostatic force is applied across the membrane and with this fluid removal there is some accompanied 'solvent drag' that brings solute along-side. Therefore, CVVH requires larger (than other modalities) volume removal in order to achieve adequate clearance. Replacement fluid serves to maintain hemodynamic stability. Replacement fluid can be given pre-filter or post-filter. Pre-filter dilutes solute and reduces efficiency of clearance, but has the advantage of reducing filter clotting. Post-filter has the opposite effects. Calculating a filtration fraction can help you determine where to place replacement fluid with an ideal filtration fraction around 15%. We do not regularly prescribe CVVH in the medical center though NxStage Machine can do it.
3. CVVHD – Continuous Veno-Venous Hemodialysis: This mode of CRRT is driven by diffusion of molecules across a semi-permeable membrane along a concentration gradient. A dialysate with similar chemistry to normal blood is pumped counter-current to the blood through the filter. Any molecules that are in greater concentration in the blood are drawn across into the dialysate and removed from the body. Molecules which are low in the blood are also replaced by the normal levels in the dialysate. Generally diffusive principles are more effective for removing small sized molecules. In this mode replacement fluids are not administered.
4. CVVHDF – Continuous Veno-Venous Hemodiafiltration: This mode utilizes both diffusion and convection. Some portion of solute clearance is achieved with diffusion via counter-current

Chapter THREE: Chronic Kidney Disease



Percentage of US Population by eGFR and Albuminuria Category: KDIGO 2012 and NHANES 1999–2006				Persistent albuminuria categories Description and range			
				A1	A2	A3	
				Normal to mildly increased	Moderately increased	Severely increased	
				<30 mg/g <3 mg/mmol	30-300 mg/g 3-30 mg/mmol	>300 mg/g >30mg/mmol	
GFR categories (mL/min/ 1.73m^2) Description and range	G1	Normal or high	≥90	55.6	1.9	0.4	57.9
	G2	Mildly decreased	60–89	32.9	2.2	0.3	35.4
	G3a	Mildly to moderately decreased	45–59	3.6	0.8	0.2	4.6
	G3b	Moderately to severely decreased	30–44	1.0	0.4	0.2	1.6
	G4	Severely decreased	15–29	0.2	0.1	0.1	0.4
	G5	Kidney failure	<15	0.0	0.0	0.1	0.1
				93.2	5.4	1.3	100.0

Chronic Kidney Disease (CKD) is defined as abnormalities of kidney structure or function that are present for >3 months and have health implications. CKD is classified based on cause, GFR category (G1 to G5), and albuminuria category (A1 to A3).

Prognosis and Prevalence of CKD in the United States by GFR and Albuminuria category. Colors reflect the ranking of relative risk for kidney disease progression and cardiovascular risk. Green: Low risk, Yellow: Moderately increased risk, Orange: High risk and Red: Very high risk. Cells how the proportion of adult population in the United states.

The prevalence of CKD is about 11.5% of the U.S adult population**.** Data from National Health and Nutritional Examinations Surveys from 1999-2006. **KDIGO 2012 Clinical Practice guidelines for the management of CKD. Kidney int Suppl. 2013; 3:1-150.**

Clinical markers of Kidney damage:

1. Albuminuria and albumin to creatinine ratio (ACR): > 30 mg/g (3.4 mg/mmol) or greater.
2. Abnormal Urinary sediment. Such as white or red blood cell and casts.
3. Electrolyte and other abnormalities caused by tubular disorders.
3. Imaging abnormalities. Such as echogenic small kidneys, polycystic kidneys or hydronephrosis.
4. Pathologic abnormalities: Kidney biopsy can reveal glomerular, interstitial or tubular disease.
5. History of kidney transplantation.

Reduced GFR: Glomerular filtration rate (GFR) is generally considered to be the best available index of overall kidney function. Declining GFR is the hallmark of progressive kidney disease that should be reviewed in every patient visit. Measured GFR varies in normal individuals by age, sex, dietary protein intake, and possibly by race-ethnicity. Based upon clearance measurements in healthy people and in people with kidney disease, the widely accepted threshold defining a decreased GFR is less then 60ml/min per 1.73 m^2. Kidney failure is defined as a GFR<15ml/min per 1.73m^2 or treatment by dialysis. (see figure on previous page)**. GFR<60min/min per 1.73 m persistent for 3 months or more is diagnostic of CKD.**

Some elderly individuals have lower GFR (45-59ml/min per 1.73 m^2) with no other evidence of kidney damage. These people have only moderately increased risk of CKD progression. They likely need no treatment but should be monitored closely.

Etiology of Chronic Kidney Disease:
The most common reported causes of CKD are diabetes mellitus and hypertension, less frequent causes are primary glomerular, tubulointerstitial, and cystic diseases.

Risk factors for CKD development or progression:
Non-modifiable: Old age, male sex, black race, family history of DM or CKD, APOL 1 allele and low birth weight.
Modifiable: Albuminuria, hypertension, episodes of AKI, underlying cause of kidney disease (e.g diabetic nephropathy), obesity, hyperlipidemia, smoking, high protein diet, metabolic acidosis, hyperphosphatemia, hyperuricemia, hyperglycemia and elevated plasma soluble urokinase receptor (suPAR).
1. Hypertension: Hypertension is a known risk factor for progressive GFR decline. Multiple risk factor intervention trial (MRFIT) and African American Study of Kidney Disease (AASK) trial showed elevated blood pressure as a risk factor for progression of non-diabetic kidney disease.
2. Albuminuria: Is an independent risk factor in both diabetic and non-diabetic kidney disease. Modification of diet in renal disease study (MDRD) showed in a population that is predominantly non diabetic, those with albuminuria had the highest risk of progressive kidney disease. The Ramipril Efficacy in Nephropathy (REIN) trial also showed similar results.
3. Recurrent AKI: Multiple studies have shown that in patients with preexisting CKD, AKI is risk factor for development of progressive chronic kidney failure. **(2) JAMA 1997 Dec 17;278(23):2069-74; (3) *JAMA* 2002. 288(19):2421-2431; (4) N Engl J Med 1994; 330:877-884; (5) *Lancet* 1997; 349:1857-1863.**

Management of Chronic Kidney Disease:

Detection: Screening not recommended in general population but accepted in those at high risk. Reasonable approach to CKD testing, at minimum includes, eGFRcr and urine Albumin to creatinine ratio. Test all patients with hypertension, diabetes, CVD, cancer, HIV infection, and before imaging procedures with iodine based or Gadolinium based contrast. Need for other testing including urine analysis or imaging depends on the nature of risk factors. Limited data on optimal testing frequency for CKD screening in high-risk patients. Annual testing is recommended for patients with hypertension, diabetes and HIV. Until evidence is available, others at increased risk be tested at least every 3 years.

Evaluation: Goals of evaluation are 1) to identify the duration and cause of CKD, 2) to assess severity based on GFR and albuminuria, 3) to identify the complications and risk of progression to kidney failure. Evaluation includes thorough history and physical exam and laboratory testing and imaging studies. Patient with GFR < 60ml/min per 1.73 m^2 should have assessment of *hemoglobin, serum calcium, phosphate, albumin, parathyroid hormone and 25 hydroxy vitamin D levels.* Test for traditional risk factors for CVD, such as lipid panel, insulin resistance and inflammation. Evaluate for symptoms of CVD or detect asymptomatic CVD in patients with multiple risk factors. Some elderly individuals have eGFR <60 ml/min per 1.73 m^2 but no other risk factor or marker of CKD. Extensive evaluation of etiology of CKD may be deferred in