Diagnostic Assessments Relating to Renal Function:

Why we do them? What do they mean?

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March 19, 2014
Why are Patients Referred?

- Usually
  - Abnormalities in blood &/or urine tests
    - Declining GFR
    - Hematuria
    - Proteinuria
    - Nephrotic syndrome
  - Symptoms relating to kidney disease
    - Nausea, vomiting, edema
  - Routine Screening
DIAGNOSIS?
Routine Laboratory Tests

- CBC - WBC, hgb, hct, plt
- Iron Studies - TIBC, Tsat, Ferr
- Electrolytes - Na, K+, Cl, HC03, Mg
- Bone Metabolism -Ca, PO4, Alk Phos, PTH
- Renal – Creatinine, Urea, GFR, BUN
- Urinalysis
- Blood Cultures
Diagnostic Tests

- Renal biopsy
- Vascular studies
- Ultrasound studies
- Radiologic studies
- Renal MRI and CT
- Cystographic studies
Evaluation

Knowledge of Renal System is Key

We're a little concerned about your potassium levels.
Initial Consultation by Nephrologist

- Routine initial testing for proper assessment
  - CBC,
  - Sodium, Potassium, Bicarbonate, Urea, Creatinine
  - Urinalysis and microscopy
  - Calcium, Phosphorus, Parathyroid hormone
  - Serum protein electrophoresis
  - Hepatitis serology and usually HIV testing
  - Renal ultrasound
  - ANA, ESR, CRP
CBC

**HGB**: 100-125 g/L in renal
- Essential in monitoring ESA

**Hct** - 0.30-0.39% in kidney disease
- Is the % of red blood cells in the whole blood volume.

**WBC** – 4.0-10.0
- Responsible for fighting infection and/or other foreign materials.

**PLATELETS** – 135-350 giga/L
- Precursors for clot formation
- Most important in determining risk of invasive procedure (i.e. kidney biopsy)
IRON PANEL

- **Serum Iron 9-32umol/L**
  - Iron is essential for ESA therapy
- **TIBC 45-81umol/L**
  - The amount iron that can be bound to transferrin
- **Ferritin – greater than 100 in Renal**
  - Refers to transferrin bound iron.
- **T Sat – greater than 20% in Renal**
  - Useful indicator combined with Ferritin (changes with infection, inflammation)
Chemistry Profile

- **Urea (Ur) 2.5-9.0 mmol/L**
  - Uremia causes nausea, vomiting, metallic taste in mouth, headache, and high potassium levels

- **Creatinine (Cr) – 50-130 umol/L**
  - Only elevates in renal failure, will rise as kidney’s decline

- **GFR 45-90 umol/L men, women 60-110**
  - Meaningless if patient on dialysis

- **Albumin (alb) 35-50 g/L**
  - Is a marker of nutritional status; low indicates to increase dietary protein

- **Sodium (Na+)135-145 mmol/L**
  - Main electrolyte which determines volume status
Chemistry

- **Potassium (k+) 3.5-5.0 mmol/L**
  - Minor changes have significant consequences

- **Magnesium (Mg) .70-1.20 mmol/L**
  - Low levels may be low due to malnourishment

- **Chloride (Cl--) 98-107mmol/L**
  - Plays a role in sodium and water balance

- **Bicarbonate (HC03) 22-30 mmol/L**
  - Measured as CO2 in some labs
Mineral Metabolism

- **Calcium (Ca+)** – 2.10-2.6 mmol/L
  - Abnormalities begin early in renal insufficiency. Long term effects include bone disease & metastatic calcification.

- **Phosphorus (PO4)** – .6-1.60 mmol/L
  - Normal PO4 and Ca+ is essential to prevent osteodystrophy

- **PTH 1.2-8.4 pmol/L** (often 2-3x normal value for RRT)
  - Often elevates as kidney function declines.
  - Low Ca+, high Phos, and low calcitrol stimulates PTH secretion, which, in turn releases Ca+ from the bones into the blood stream, resulting in abnormal bone turnover.
  - Resistance to PTH may develop in kidney disease resulting in parathyroid surgical intervention.
Chronic Renal Failure Markers

- Urea (Ur) 2.5-9.0 mmol/L
  - Principal end product of protein breakdown
  - Rises with decreasing GFR
- Creatinine (Cr) 50-130 umol/L
  - End product of muscle breakdown
  - Marker of degree of kidney disease

Cr and Ur usually rise in tandem in chronic and ESRF, but Urea levels can remain low or normal if patient is malnourished with a low protein intake. There is no set value with renal decline.
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Serum protein electrophoresis

- Multiple myeloma
  - Fairly common cause of CKD and ESRD

- Amyloidosis
  - Primary
  - Secondary to longstanding low GFR

- Chronic inflammation
- Lupus
Urinalysis and microscopy

- Hematuria
  - Marker of true glomerular disorder
  - Kidney, ureter or bladder cancer
  - Kidney stones
  - Polycystic kidney disease

- Proteinuria
  - Important glomerular disorder
  - Often high in severe diabetic nephropathy and sometimes with hypertension alone
    - Predicts risk of developing ESRD

- Casts
  - Marker of glomerular or tubular disorder
Other Diagnostic Tests

"This test is to see if we need to do more tests."
Renal biopsy

Common indications

- Rapidly declining kidney function NYD
- Severe or persistent proteinuria
- Hematuria with other signs of Kidney disease
- Acute kidney failure, unexplained
- Acute rejection to Transplant
Radiologic Studies

- Ultrasound
- Nuclear Renogram
- CT scanning
- Magnetic Resonance Imaging
- Renal arteriography
- Renal venogram
- Voiding cystourethrogram
- Retrograde pyelogram
Renal Ultrasound

Why have a Renal Ultrasound?

- Mass-detection and staging of renal tumors.
- Obstruction
- Anatomy
- Frequent UTI’s
Renal Arteriography

Invasive assessment of arterial flow (Uses contrast) Much more detailed

- Additional conditions under which the test may be performed:
  - Acute arterial occlusion of the kidney
  - Acute renal failure
  - Atheroembolic renal disease
  - Renal artery stenosis
  - Renal cell carcinoma
CT or MRI Angiogram

Non invasive assessment of arterial flow into kidneys

- Renal artery stenosis
- Fibromuscular dysplasia
- Generalized atherosclerotic changes
  - Long standing HTN
  - Smokers
- Absence of flow altogether – i.e.. Arterial thrombosis
CT of Kidneys

- The abdominal CT scan may reveal the following kidney problems:
  - Obstructive uropathy
  - Complicated UTI (pyelonephritis)
  - Kidney stones
  - Kidney swelling (hydronephrosis)
  - Kidney or ureter damage
  - Polycystic kidney disease
Renal MRI can Detect:

- Acute tubular necrosis
- Hydronephrosis (kidney swelling from the backflow of urine)
- Renal tumor
- Kidney damage
- Renal arterial obstruction
- Renal vein thrombosis
- Transplant rejection
- Chronic and Acute renal Failure
- **Cystoscopy**
  - Used to detect urinary disorders
  - Done if abnormal urine cytology

- **Retrograde pyelogram**
  - Used to diagnose chronic obstruction
  - Lower anatomy abnormalities
  - Pyelonephritis
Monitoring of declining Renal Function

- “Monthly labs”
  - Anemia
  - Iron deficiency
  - Calcium – high or low
  - PO4 – high or low
  - PTH – high or low
  - Urea levels – marker of inadequate dialysis
  - PRU – want greater than 66% generally
  - Albumin – marker of overall health and may also acute decrease in acute illness
  - Uric acid – higher risk of gout + increases HTN
Indications to start some form of dialysis (or pre-emptive transplant)

- Unmanageable hyperkalemia
- Severe metabolic acidosis
- Uremia – symptomatic
- Uremic pericarditis
  - High urea levels may cause inflammation of pericardial tissue – may cause cardiac tamponade if not aggressively treated
- Pulmonary edema or severe peripheral edema not amenable to maximal medical therapy
Questions

What do you mean, my sodium level is elevated?