Surgery and Renal Failure
General loss of kidney function with alterations in volume regulation and ionic composition of body fluids and inadequate excretion of metabolic wastes.
Glomerular Filtration Rate

- Most practical measure of renal function

- GFR (ml/min) = \(\frac{(140 - \text{age}) \times \text{weight (kg)}}{72 \times \text{serum creatinine}}\)

- GFR (ml/min) = \(\frac{(140 - \text{age}) \times \text{weight (kg)}}{72 \times \text{serum creatinine}} \times 0.15\)

Assumes stable creatinine concentration
Acute renal failure

- 5-10% of surgical patients
- 25% of patients receiving CPB
- Post-op – half of all requiring acute hemodialysis.
- Anesthetic agents, blood products, tissue injury, sepsis, antibiotics, surgical fluid loss, nephrotoxins
Acute renal failure

- Oliguric – less than 400cc urine per 24 hours

- Non-oliguric – large volumes of urine without clearance of protein metabolites

- Anuria – Bilateral artery occlusion, ureteral ligation, cortical necrosis, rapidly progressive glomerulonephritis
Acute Renal Failure

- Most common cause, post-op – ATN
  - sepsis, ischemia, nephrotoxins
  - pigmented granular casts
- Acute cortical necrosis
  - profound shock
  - disseminated intravascular coagulation
- Atheroemboli
  - vascular procedures
  - anticoagulants
Pre-renal

- Impaired renal perfusion
  - Hypotension – sepsis, anaphylaxis, neurogenic shock, anesthesia
  - Hypovolemia – hemorrhage, dehydration, third spacing
  - Renovascular obstruction – embolic, atherosclerosis, venous thrombosis
  - Cardiac failure – MI, cardiomyopathy, arrhythmia.
Post-renal

- Obstructive uropathy
  - Renal pelvis and ureters – stone, clot, tumor, infection, retroperitoneal fibrosis
  - bladder and urethra – obstructed bladder neck.

- Extravasation
  - trauma

- 5% of all cases of ARF
Intrarenal

- ATN
  - Ischemia
  - Nephrotoxins
    - endogenous: pigments, crystals, or tumors (lysis or myeloma)
    - exogenous: antibiotics, anesthetics, chemotherapeutic drugs, immuno-suppresants, contrast, organic solvents, dextran.
Intrarenal

- Glomerulonephritis
  - postinfectious: streptococcal, viral, IAA
  - Membranoproliferative
  - Rapidly progressive: SLE, Goodpasture’s, Polyarteritis nodosa,
  - Serum sickness
  - Thrombomicroangiopathy: HUS, TTP
  - DIC, malignant HTN
Intrarenal

- Interstitial nephritis
  - Drugs: PCN, cephalosporins, sulfonamides, rifampin, NSAIDS, thiazides, cimetidine
  - infection:
    - direct invasion – Staph, virus, fungi
    - indirect - exotoxin
  - infiltration: lymphoma, leukemia, sarcoid
  - idiopathic
Intrarenal

- Papillary necrosis
  - analgesics, infection, obstruction, DM

- Acute cortical necrosis
  - profound shock

- Atheroembolic syndrome
Prevention

- Maintain adequate intravascular fluid volume
- Maximize cardiac output
- Avoid hypotension
- Avoid NSAIDS – afferent arterioles
- Avoid Ace-I – efferent arterioles
- Avoid nephrotoxic agents
- Dopamine infusion - controversial
Prevention

- Carefully monitor levels of nephrotoxic agents
- Renal dosing adjustments
- Meticulous identification of urinary structures
- Diuresis
  - loop diuretics
  - mannitol
- Alkalinize urine
## Diagnosis

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FeNa = \( U_{Na} \times \frac{P_{creat}}{P_{Na}} \times U_{creat} \)
Diagnosis

- Fluid challenge
- Ultrasound
- Mag-3 scan
- CT
- Angiography
  - contrast
  - MRI
- Cystogram
Management

- Correction of fluid and electrolyte abnormalities
- Potassium
  - 10% Calcium gluconate – EKG changes
  - Insulin/glucose infusion
    30u w/ 1L D$_{10}$ @ 200cc/hr
  - Kayexalate
  - NaHCO$_3^-$
Management

- **Hemodialysis**
  - $K^+ > 5.5$ mEq/L
  - Acute fluid overload
  - BUN >80-100mg/dl
  - Persistent metabolic acidosis
  - Lack of sufficient nutritional support

- **CRRT or hemofiltration**
  - Avoids hypotension and bleeding
  - Residual renal function
  - Significant fluid overload
Elderly

- Progressive sclerosis of nephron
- Cr clearance decline 0.75 ml/min per year
- Decreased Na resorption
- Decreased proton excretion
- Decreased responsiveness to ADH
- Osmoreceptor function
- Limited bladder distensibility and emptying
- 10-50% asymptomatic bactiuria