PATHOPHYSIOLOGY OF ACUTE KIDNEY INJURY

AKI Lesion	Etiology	Pathophysiology Histology	Lab Findings and Diagnosis	Treatment
PRE-RENAL AZOTEMIA	**Decreased renal perfusion** e.g. ECF depletion secondary to hemorrhage, non-intake, diuresis, severe CHF, burns	Reversible drop in GFR due to reduced RBF	**Urinalysis** is NML Plasma BUN/Cr : > 40 Urine Na+ : < 20 mEq/L UrineCr/PlasmaCr : > 40 UrineOsm/PlasmaOsm : > 1.5 RFI : < 1 **FE Na+ : < 1%**	**IF HYPOVOLEMIC:** Rapid volume resuscitation with IV NML saline **IF HYPERVOLEMIC:** Restrict free water Restrict solutes if there is edema Diuresis **OBSTRUCTION:** Urologic surgery or ablation **DIALYSIS** Severe hyperkalemia Uremic symptoms Refractory acidosis ECF overload (e.g. CHF) BUN > 100 mg/dL Pulmonary edema
ACUTE TUBULAR NECROSIS	**Ischemia** Can be secondary to pre-renal disease (i.e. low perfusion) **Toxic** *Radiocontrast* (most common agent): massive vasoconstriction *Myoglobin*: rhabdomyolysis *Aminoglycosides*: endocytosed and stored in lysosomes → rupture of PCT cells *Amphotericin B* Antiretrovirals, Bisphosphonates Typically occurs in the context of renal hypoperfusion.	**Initiation** The initial lesion is in the PCT due to oxygen load Ischemia → ATP depletion → loss of polarity → loss of adhesion → epithelial necrosis and sloughing → reperfusion → increased ROS production by Xanthine Oxidase (upregulated transformation of ATP to hypoxanthine) → damage in bilayer and genome **Extension** Release of cytokines → recruitment of inflammatory cells → leukostasis + platelet activation + microthrombosis → distal ischemia Early: acute renal failure with rapid rise in serum creatinine Diuretic Phase: plateau of creatinien and increased urine output Recovery: GFR normalizes	**Urinalysis** 1 – 2+ protein Renal tubular cell casts Muddy brown cats No hematuria Plasma BUN/Cr : < 40 Urine Na+ : > 40 mEq/L UrineCr/PlasmaCr : < 20 UrineOsm/PlasmaOsm : < 1 RFI : > 2 **FE Na+ : > 2%**	

		Histology Tubular necrosis (PCT) with loss of cellular adhesion		
ACUTE INTERSTITIAL NEPHRITIS	Hypersensitivity Reactions β-Lactam ABx NSAIDs	Inflammation of the renal interstitium (connective tissue) **Histology** Inflammatory infiltrate into the renal stroma (typically neutrophils + eosinophils) *These changes are not seen with AIN due to NSAIDs*	**Urinalysis** 1 – 2+ protein Leukocytes (PMNs, eosinophils) Leukocyte casts No hematuria Fe Na+ < 1%	
GLOMERULONEPHRITIS	**Autoimmune** Goodpasture's Syndrome (circulating Ab against renal and pulmonary basement membrane antigens) Systemic Vasculitis (Wegener's granulomatosis, microscopic polyangiitis) Post-infective	**Histology** Glomerular inflammation with crescentic cell masses in the urinary space. Capillary wall necrosis.	**Urinalysis** Dysmorphic RBCs RBC casts 3 – 4+ protein (massive proteinuria)	
POST-RENAL OBSTRUCTION	**Bilateral obstruction of the urinary tract** Anticholinergics (bladder obstruction) BPH Prostatic Carcinoma Unilateral renal calculus with solitary outflow tract		ROS: hesitancy, urgency, nocturia Medicaitons (antihistamines, anticholinergics) U/S for hydronephrosis Distension of bladder Palpable prostatic hypertrophy	