Objectives

1. What unique disease processes should you consider in dialysis patients presenting with chest pain, dyspnea, altered mental status?
2. What potential high-risk vascular access complications can present to the ED and how do you treat them?

Who cares?

- ESRD is becoming an epidemic
- Incidence in U.S. \(\uparrow\) 4x since 1980
- 2003: >300,000 patients on dialysis
- 2010: projected to double!
- #1 cause (40%): diabetes
- #2 cause (25%): hypertension

Common ED presentations

- Chest pain*
- Dyspnea*
- Altered mental status*
- Fever*
- Electrolyte/acid-base disturbances*
- Vascular access complications*
- Hypotensive/hypertensive
- Abdominal pain
- Hematologic
- Cardiac arrest

Chest pain - DDx

- Cardiovascular
  - ACS
  - Pericarditis/pericardial tamponade
  - Aortic dissection
  - Valvular heart disease
- Pulmonary
  - Pleuritis
  - Pulmonary embolism
  - Pneumonia
  - Pneumothorax
- GI
  - Peptic ulcer disease
  - Esophageal disorders
  - Pancreatitis
  - Cholecystitis
- Musculoskeletal disorders
  - Costochondritis
  - Rib fx - renal osteodystrophy
- Miscellaneous
  - Herpes zoster
  - Air embolism
  - Anaphylactoid reaction
  - Tunneled catheter malposition

Case #1:

Mr. Cyrus is a 59 yo M who is BIBA from dialysis where he developed sudden onset of severe SOB, cough, chest pain at the conclusion of dialysis.

VS: BP 75/30, HR 150, RR 30, O2 sat 93% NRB.

What should you worry about and what are your next management steps?
Acute coronary syndrome

• 50% deaths in ESRD - ischemic heart disease
• 20% annual probability – CHF or ACS admission
• 25-40% of HD pts have LV dysfunction.
• Risk factors: DM, hyperlipidemia, HTN
• Silent ischemia is more common.
• HD pts symptomatic at lesser degree of coronary artery obstructions (50% vs. 75%)

CP during dialysis

• Most likely ischemic.
• Dialysis = stress test
• BOTTOM LINE: take CP during dialysis seriously!

Utility of cardiac markers?

• Trop T vs. Trop I
  – 733 asymptomatic ESRD patients*
  – 20% Trop T; 0.4% Trop I elevations pre-dialysis
  – Elevation of TnT > TnI! predictor of all-cause mortality at 2 yr follow up.

* Apple et al, 2002

RESULTS

• 22 pts (15%) had MCE – 11 pts died, 5 pts MI, 9 pts new CHF
• ½ MCE's ~1 wk of ED visit
• If + TnI! odds ratio for MCE within 30 days: 10-15X
• Same regardless of CP on presentation.
• ROC test threshold – Tn I = 0.3 ng/l

CK-MB in ESRD

CK-MB

– Normal CK-MB: < 5%
– Renal patients: 30-50% have ↑CK-MB >5%
  (but usually < 8%)
Interventions

- Similar to non-HD patients (ASA, NTG, Heparin, Plavix, G2B3A inhibitors, PCI)
- Consider correctible factors: anemia, volume overload, hypertension

ACS in ESRD... in a

- CP during dialysis = ischemia
- ½ deaths in HD pts = ischemia
- Tn I is more reliable than Tn T in renal patients
- Elevated troponins can predict mortality
- Tn I elevation is a significant predictor for major cardiovascular events within 30 days of ED presentation.
- Treatment is same, but think of the reversible causes

Pericarditis

- 10-20% patients on HD
- Causes of pericarditis:
  - Neoplastic
  - Autoimmune
  - Viral
  - Bacterial
  - Uremia
  - TB
  - Endocrine
  - Idiopathic

Uremic Pericarditis

- 6-10% patients with advanced renal failure
- Pre-dialysis or recently started HD (<8 wk)
- Correlation with ↑ BUN (>60)
- Inflammatory cells do not penetrate myocardium
- *Typical pericarditis EKG changes often absent*
  - Also seen in hypothyroidism pericarditis
- Respond well to initiation or increased dialysis

Dialysis Associated Pericarditis (DAP)

- 13% of patients on maintenance HD (> 8 wk)
- Inadequate dialysis, ↑ catabolic states
- More likely to result in complications, tamponade, harder to treat

Typical pericarditis EKG

- Initially:
  - ↑ ST segments diffusely with upward concavity
  - PR isoelectrical or depressed diffusely, except AVR and V1 (↑ PR – “knuckle sign”)
- Later: pseudonormalization → T waves invert
**Pericarditis - Treatment**
- Begin or intensify dialysis
  - Predictors of poor response to dialysis: fever > 102, WBC > 15, large effusion
  - Risk of heparin use
- If no improvement in 7-14 days → drain
- NSAIDs for pain

**Pericardial effusions**
- 50% uremic or DAP pericarditis
  → pericardial effusion
- Effusions: loculated, bloody, adhesions
- Pericardiocentesisis very risky
- Risk of tamponade: 20%

**Pericardial tamponade**
- Sudden pericardial hemorrhage or compensated pericardial effusion that acutely decompensates
- S&S: ↓BP, ↑HR, muffled heart sounds, ↑JVP, pulsus paradoxus > 10 mm Hg, narrow pulse pressure
- EKG: +electrical alternans, low voltage

**Ultrasound is your friend.**
- 30% HD pts may have chronic pericardial fluid.
- RV collapse on US = cardiac tamponade

**Tamponade treatment**
- Fluids & volume expanders
- Pericardiocentesis: reserve for life-threatening hemodynamic compromise
- Much higher risk of complications: myocardial laceration, cardiac arrest, death
- Definitive treatment: pericardial window or pericardiectomy

**Pericarditis... in a**
- Uremic pericarditis is common in HD pts (20%)
- Pericarditis may indicate inadequate dialysis (dialysis associated pericarditis)
- Uremic pericarditis often lacks usual EKG findings
- Pericardial effusion + RV collapse on US = tamponade
- Avoid doing pericardiocentesis unless absolutely necessary!
**Case #1:**

“My achey breaky heart…”

Mr. Cyrus is a 59 yo M who is BIBA from dialysis where he developed sudden onset of severe SOB, cough, chest pain at the conclusion of dialysis. VS: BP 75/30, HR 150, RR 30, O2 sat 93% NRB.

“Crunching” sound on auscultation.

What should you worry about and what are your next management steps?

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**Air embolism**

- Rare nowadays, more common in subclavian catheters
- Sx vary with position: seated vs recumbent
- Exam: 50 ml air \( \rightarrow \) \( \uparrow \) RR, HR; \( \downarrow \) BP, “mill-wheel murmur” (massive air embolism)
- Treatment:
  - Clamp the venous line, L lateral decub and Trendelenburg, 100% O2.
  - Aspiration of air from RV
  - If arresting, chest compressions
  - Consider HBO

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**Key points: chest pain**

- Take chest pain seriously in a dialysis patient, especially if it’s during dialysis.
- ½ all deaths in ESRD pts are from cardiovascular events.
- Think about pericardial disease and air embolism in the HD patient.
- Ultrasound is your friend.

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**Common ED presentations**

- Chest pain
- Dyspnea
- Altered mental status
- Fever
- Electrolyte/acid-base disturbances
- Vascular access complications

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**Case #2:**

“Take my breath away…”

Ms. Berlin is a 60 yo F BIBA with gradual onset of SOB.

- Vitals: T 36.3  BP 185/122, P 102, RR 30, 91% NRB
- Exam: sitting upright, diaphoretic, distant heart sounds, coarse wheezing & rales diffusely, shunt on L forearm

What diagnosis is most likely and what utility do BNP levels have?
Dyspnea - DDx

Volume Overload
Cardiovascular
• CHF
• Pericarditis/pericardial effusion/tamponade
• ACS
• Arrhythmias
• Hypertensive emergency

Pulmonary
• PTX or HTX
• Pleural effusions due to fluid overload or uremic pleurisy
• Pulmonary Embolism

Infection
Inflammatory
Air embolism

CHF in dialysis patients
• Prevalence of HF – 10-30x higher in dialysis pts than in general population
• Risk factors for CHF: HTN, older age, anemia, heart disease, baseline systolic dysfunction
• CHF+ESRD = bad
  – Independent predictor for mortality – 83% at 3 yrs in dialysis pts with CHF.

BNP utility in ESRD?
• Renal and extra-renal clearance
• Not correlative with volume status
• Baseline BNP, but usually < 300 pg/ml
• Use a higher exclusionary cutoff (NO CHF):
  – Normal: BNP < 100 pg/ml → no CHF
  – Dialysis pts: BNP < 300 pg/ml → no CHF
• YES CHF:
  – Normal: BNP > 500 pg/ml
  – Dialysis pts: BNP > 800 pg/ml

CHF - management
• O2, sitting position, nitrates, ACE-I
• Hemodialysis – fastest method
• NIPPV and endotracheal intubation

If dialysis isn’t available immediately:
• Lasix – pulmonary vasodilation
• Nesiritide 2 mcg/kg bolus, then 0.01 mcg/kg/min gtt
• Phlebotomy 250-500 ml blood
• Sorbitol 70% 50-100 ml doses

High-output HF - AVF
• Occur when AV fistulas have > 20-30% CO
• Blood is being shunted from artery → vein, bypassing the capillary systems
• Heart can’t keep up with ↑blood flow demand
• Clues on exam: warm extremities, wide pulse pressure, bounding pulses, hyperkinetic heart on palpation, systolic flow murmur, Branham’s sign
• Treatment: surgical banding
**KEY points: dyspnea**

- Most common cause: volume overload!
- BNP are useful if negative, and cutoffs are higher in renal patients
- Consider high-output heart failure, air embolism.

**Common ED presentations**

- Chest pain
- Dyspnea
- Altered mental status
- Fever
- Electrolyte/acid-base disturbances
- Vascular access complications

**Case #3:**

**“Dazed and confused”**

Mr. Zeppelin is a 74 yo M BIBA after he was unable to stand at the movie theater. No complaints except feeling weak. Poor historian, seems confused, drowsy. Dstick - 90

PMH: NIDDM, ESRD on HD, COPD, HTN, ischemic CM

Meds: metoprolol, lasix, ASA, amlodipine, quinapril

VS: T 98 HR 40 irreg BP 83/50 RR 16

Exam: R brachiocephalic fistula, o/w unremarkable

**Altered Mental Status - DDx**

- Cerebrovascular accident (particularly hemorrhage)
- Subdural hematoma
- Intracerebral abscess
- Tumor
- Uremia
- Drug effects
- Disequilibrium syndrome
- Meningitis
- Seizures/post-ictal state
- Hypertensive encephalopathy
- Hyper/hyponatremia
- Hypercalcemia
- Hypermagnesemia
- Hypo or severe hyperglycemia
- Hypoxemia
- Dialysis dementia
- Toxins (alcohol)

**Stroke & Bleeds**

- ! relative risk compared to normal subjects
  - Stroke (ischemic & hemorrhagic) – 5.2
  - Cerebral hemorrhage: 10.7
  - SAH: 4.0
- Risks: HTN, cerebral atherosclerosis, heparinization, EPO, uremic platelets
- Tx: IV DDAVP for head bleeds

**EKG**

What is the cause of his weakness and AMS?

Bottom line: have low threshold to CT
**Disequilibrium syndrome**
- Sx occur during or within 12 hrs HD
  - Mild: HA, malaise, muscle cramping, anorexia, blurred vision, asterixis, restlessness, nausea, confusion
  - Severe: stupor, seizures, coma, death
- Cause: rapid osmotic shifts → cerebral edema
- At risk: new to HD, BUN > 175, pre-existing neurologic disorder, pediatric
- Tx: supportive care, self-limiting, consider mannitol or hypertonic saline

**Seizures in HD patient**
- Usual causes: Electrolyte disturbances, hypoglycemia, anatomic lesions, bleeds, infections
  - Special considerations:
    - Uremia
    - Dialysis associated seizures (<10%)
    - Drug toxicity
    - Dialysis disequilibrium syndrome
    - Air embolism
    - EPO therapy (during HD, in pts with HTN)

**Seizure - treatment**
- AEDs: Benzos > phenytoin > phenobarb
- Dialyzable drugs: phenobarbital, gabapentin, primodine.
- Nondialyzable drugs: phenytoin, carbemazepine, valproic acid

**Dialysis dementia**
- Only seen in dialysis patients, > 2 yrs on HD
- Likely due to aluminum accumulation
- Less common nowadays
- Sx: dyscalculia, dyslexia, dyspraxia, dysgraphia, impaired memory, myoclonic jerks, seizures
- Treatment: desferoxamine

**Uremic encephalopathy**
- Diagnosis of exclusion
- Nonspecific central neurologic sx that improve with dialysis
- Objective findings:
  - EEG: slow delta waves on EEG
  - MRI: increased signal intensity bilaterally in cortical or subcortical areas of occipital and parietal lobes

**KEY points: AMS**
- Have a low threshold to do head CT in the altered dialysis patient!
- Don’t forget about IV DDAVP.
- Do not attribute AMS to dialysis disequilibrium syndrome, dialysis dementia, or uremic encephalopathy without ruling out potential badness.
Case #3: “Dazed and Confused”
Mr. Zeppelin is a 74 yo M BIBA after he was unable to stand at the movie theater. No complaints except feeling weak. Poor historian, seems confused and drowsy.
VS: HR 40 irreg  BP 83/50, L arm shunt

Why is this patient altered and weak?
HYPERKALEMIA
K=8.3

EKG isn’t reliable for ↑K+
- EKG’s sensitivity for K>6.5 = 55-62%
- Classic EKG changes may be absent even with profound hyperkalemia (K>8)
  - Especially in renal patients - cardiac tolerance for ↑K+? or ↑Ca?
  - STD, axis shifting, BBB, exit blocks, arrhythmias

Hyperkalemia
- Seldom in the well-dialyzed patient
- Dietary indiscretions or missed dialysis
- May be from rhabdo, sepsis, severe acidosis
- Meds: potassium PCN’s (Pen V K, ticarcillin-clavulanic acid, pen G), digitalis, β-blockers, succinylcholine, ACE-I
- Many HD patients tolerate K+ 6-7 meq/L without problems, but still potentially dangerous

Common ED presentations
- Chest pain
- Dyspnea
- Altered mental status
- Fever
- Electrolyte/acid-base disturbances
- Vascular access complications

Objectives
- What unique disease processes should you consider in dialysis patients presenting with chest pain, dyspnea, altered mental status?
2. What potential high-risk vascular access complications can present to the ED and how do you treat them?
Types of hemodialysis access

- Arteriovenous (AV) fistula
- Synthetic graft
- Tunneled double-lumen catheter

AV fistula

- Access of choice
- Anastomosis of native artery ➔ native vein
- Nondominant arm
- Maturation: 1-4 months
- Long lifespan
- Least complications

Synthetic graft

- 80% permanent access
- Graft vs fistula on exam?
- Adv: easier to create, shorter maturation time
- Disadv: more complications, shorter lifespan (~2 yrs)
- Polytetrafluoroethylene (Gore-Tex)

Tunneled catheters

- Bridge catheter
- Double lumen, large French, tunneled
- Cuffed ➔ NEVER PULL
- Disadv: most prone to thrombosis and infection, central venous stenosis, far shorter life span

Rules of Engagement

ACCESS = LIFELINE

- DO:
  - Document thrill/bruit
- DON’T:
  - DON’T measure BP’s on access arm
  - DON’T do IV sticks proximal to the access
  - DON’T use HD access unless pt is coding
  - DON’T place central lines in the subclavian vein

Access of Evil

- Thrombosis
- Infection
- Bleeding
Complication #1: THROMBOSIS

Thrombosis

- Loss of thrill/bruit
- 80% access failures
- Causes: stenosis, trauma, hypercoagulability, hypotension
- Grafts > fistulae

**NOT** a true emergency

Thrombosis - Rx

- Nephrology
- IR
  - Localized thrombolysis (tPA), mechanical thrombectomy, PTCA
- Vascular
  - thrombectomy, graft revision

Case #4: “The thrill is gone!”

ID: Mr. B.B. King – 82 yo M
Exam: no thrill or bruit, even with bedside doppler.

**Critical actions in the management of this patient include**
- Consulting nephrology.
- Ordering a formal upper extremity ultrasound.
- Trying to flush the fistula.
- Ordering an angiogram and giving IV heparin.

Complication #2: INFECTION

Infection

- Vascular access = #1 source infx and bacteremia
- May lack usual local or systemic findings
- Catheter > graft > fistula
- Fever + absent thrill/bruit → clot infection
- *S. aureus* (esp MRSA) > *S. epidermidis* > Gram neg organisms
**Infection - Management**

**Treat access infections aggressively!**

- Cultures (peripheral, access, purulent drainage)
- **ABX:**
  - vancomycin PLUS
  - aminoglycoside or 3rd generation cephalosporin
- Not septic -- IV abx, f/u within 24 hr
- Septic – admit, remove access
- Consult nephrology

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**Case #5:**

**“Gimme fever!”**

ID: Ms. Peggy Lee - 75 yo F  
CC: 1 day h/o temp 102 °F (38.9°C).  
ROS: Otherwise feels well. Anuric.  
Exam: VSS. AV graft: no erythema/tenderness, +bruit  
Labs: WBC 14 K.

**What is your BEST management option?**

- Culture and discharge her with close f/u.  
- Culture, IV cefazolin, and d/c with close f/u.  
- Culture, IV vancomycin + gentamicin, d/c with close f/u.  
- Admit for IV antibiotics.

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**Complication #3: BLEEDING**

- **Reasons:**
  - Heparin  
  - Thrombocytopenia  
  - Bleeding diathesis  
  - Thrombosis or stenosis  
  - Aneurysm  
  - Pseudoaneurysms  
- Synthetic grafts: not self-sealing  

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**Bleeding - Management**

- Firm, gentle pressure: 10-15 min  
- Topical gel foam with thrombin powder  
- IV desmopressin (DDAVP) 0.3 µg/kg  
- IV conjugated estrogen  
- FFP or IV protamine if ↑PTT  
- If life threatening → tourniquet, vascular consult  
- Once stopped, observe in ED for 1-2 hrs for rebleed; check for early thrombosis

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**Case #6: “Let it bleed!”**

ID: Mr. Mick Jagger - 64 yo M  
CC: persistent, brisk bleeding from AV graft site 4 hrs after dialysis, despite 10-15 min pressure  
Exam: Vitals stable. No palpable thrill or bruit

**How should you treat this patient?**

- Apply a small dissolvable suture.  
- Use a tourniquet.  
- Place gelfoam with thrombin powder over the site.  
- Administer IV DDAVP.  
- Consult nephrology/IR.
**Take Home PEARLS**

- **Chest pain:**
  - CP during dialysis = ischemia
- **Dyspnea:**
  - Volume overload - most common cause
- **AMS:**
  - ↑ risk of CVA, bleed – low threshold to CT
- **Hyperkalemia**
  - May have a normal EKG in HD pts

**Take Home PEARLS**

- **Vascular Access:**
  - Thrombosis – no bruit/thrill; not emergency!
  - Infection – any febrile HD pt gets empiric abx!
  - Bleeding – pressure, topical, IV agents