Renal Response Team: Managing Patients with Kidney Disease

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Disclosures

- No relevant commercial relationships to disclose

Educational Objectives

At the conclusion of this session, participants should be able to:

- ✓ Understand the epidemiology and common causes of hospitalizations in patients with kidney disease
- ✓ Be familiar with the evaluation and management of unique complications in the hospitalized dialysis patient
- ✓ Recognize the different types of binding resins used for treatment of hyperkalemia
- ✓ Understand what to use and what not to use for pain medications in dialysis patients

How many of you have taken care of patients with abnormal kidney function?

How many of you have taken care of dialysis patients in the hospital?

What is chronic kidney disease (CKD)?

- Gradual loss of kidney function over time
- kidney damage **or** decreased kidney function **for three or more months**, irrespective of the cause
- Stage III (most common)
  - GFR: 30-59ml/min
- Stage IV
  - GFR: 15-29ml/min
- Stage V
  - GFR < 15ml/min

End stage renal disease (ESRD)

- Defined as GFR<15ml/min
- Marks the beginning of the end (time to start dialysis)
  - Varies between patients (typically GFR<8 ml/min)
- Associated with progressive metabolic and clinical complications of renal failure

Your kidney is pretty important

EPO production

Anemia

Sodium excretion

HTN, edema

Phosphorus excretion

Vascular calcification

Vitamin D activation

Vitamin D deficiency

Potassium excretion

Hyperkalemia

Fluid balance: aquaporins

Hyponatremia

Acid excretion

Acidemia, bone disease, inflammation

Signs/symptoms of kidney failure

- Hypertension (>95%)
- Insomnia (20-70%)
- Pruritus (25-44%)
- Restless leg syndrome (12-25%)
- Peripheral and pulmonary edema

Why should we care?

- *Increased prevalence* of kidney disease in the United States
- *Up to 17-fold increase in hospitalizations* among kidney disease patients compared to general population
- The *more severe the kidney disease* the more common the hospitalizations

Mix, CH. Am J Kid Dis. 2003; 42(5):972-981

Ilimuro and CKD-JAC Investigators. Clin Exp Nephrol 2019; 23(7):956-968

Shah S. PLoS One. 2019; 16:14

- Highest rates of hospitalization occur in the *3 months before and the 3 months* after starting dialysis
- Hospitalization before dialysis *increases mortality* on dialysis
- Rate of *readmission* within 30 days is as high as *35%* among new dialysis patients
  - Usually in the first 5-10 days after discharge

Shah S. PLoS One. 2019; 16:14

Hickson, LJ. Nephron. 2018; 139(1):1-12

What is the most common cause of hospitalization for kidney disease patients?

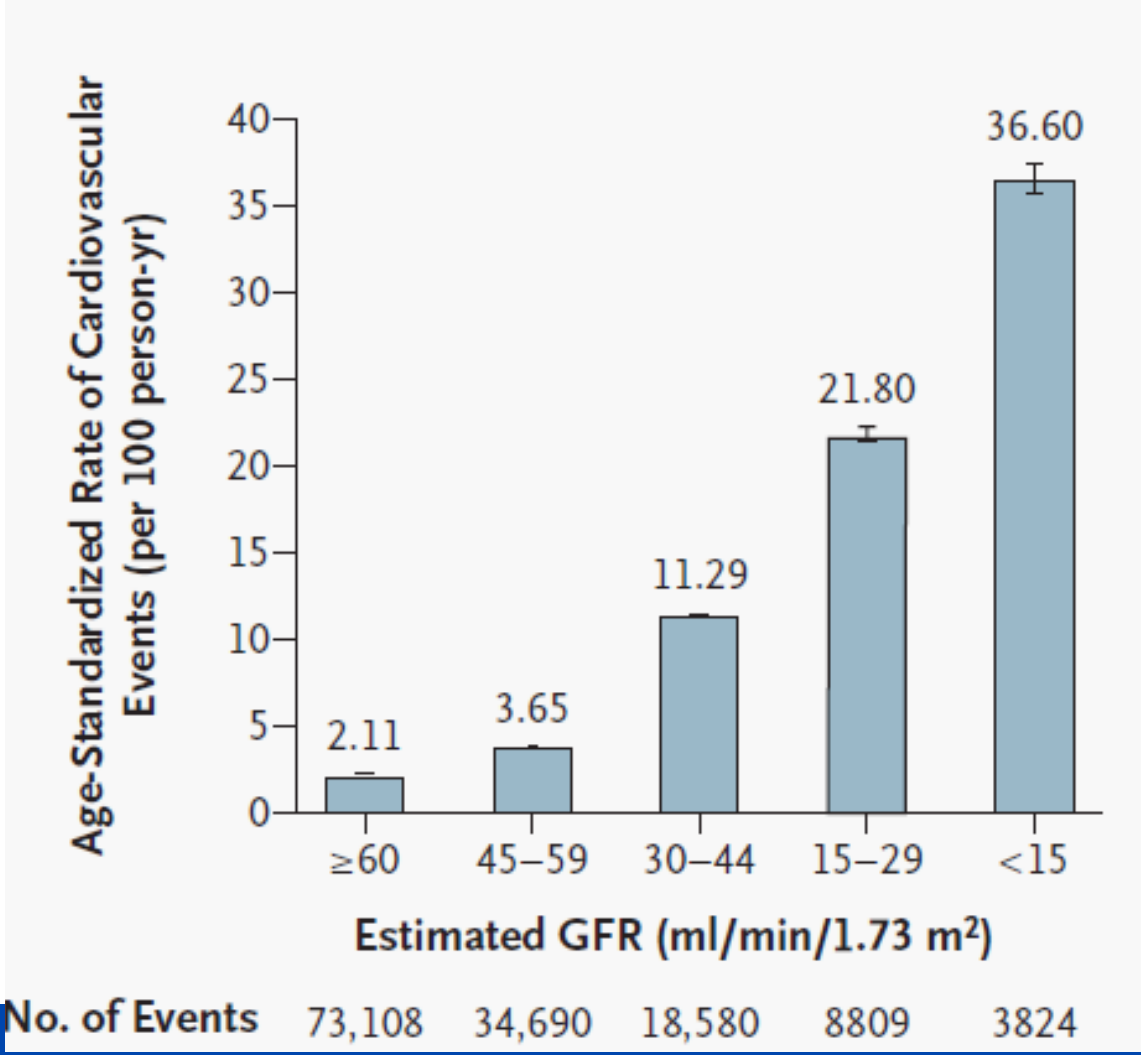
a. Cardiovascular complications
b. Infections
c. Hyperglycemia
d. Fractures
e. Malignancy

The most common cause of hospitalization and the most common complication and co-morbidity of kidney disease is…..

1. ***Cardiovascular***
2. ***Cardiovascular***
3. ***Cardiovascular***

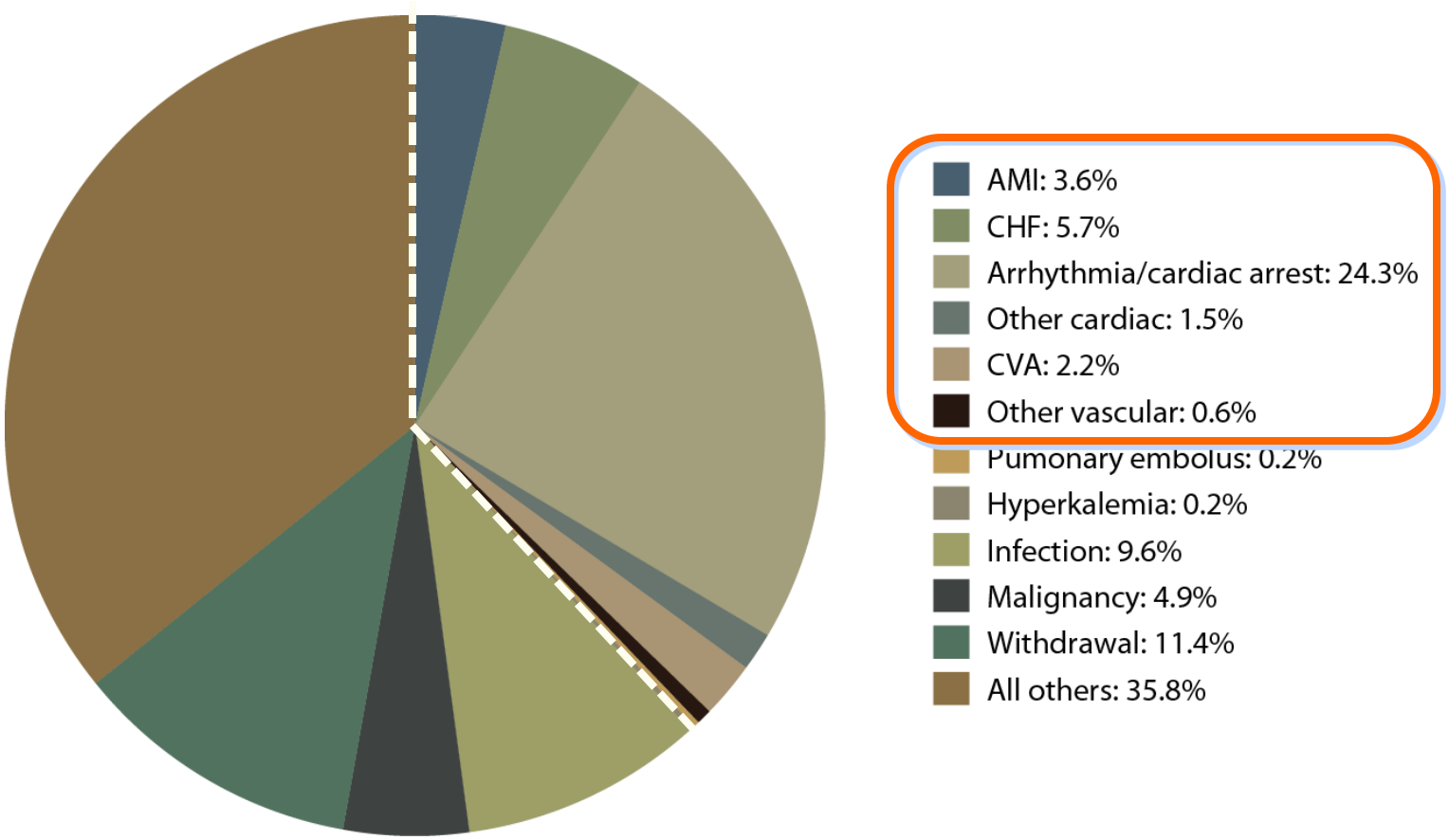
Arrhythmia, hypertension, syncope, heart failure, myocardial infarction, peripheral vascular disease, stroke

Graded association between low eGFR and cardiovascular events (CVE)



Go. NEJM 351:1296-1305, 2004

Causes of death in incident dialysis patients, first 180 days



Incident & prevalent dialysis patients, 2009–2011.USRDS [illegible] 13

Other causes for hospitalizations in kidney disease include:

- ***Infections***: sepsis, pneumonia, skin & urinary tract infections
- ***Gastrointestinal***: infections, liver disease, gastrointestinal bleeding
- ***Endocrine***: glycemic control, electrolyte disorders

Shah S. PLoS One. 2019; 16:14

Hickson, LJ. Nephron. 2018; 139(1):1-12

Key points

- **Kidney disease** patients have **more hospitalizations** than the general population
- The more severe the kidney disease the **more the hospitalizations** and **higher readmission** rates
- **Cardiovascular causes** are the most common reason for hospitalization

Objectives

By the end of this session, the attendee will be able to:

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- ✓ Understand what to use and what not to use for pain medications in dialysis patients

Management of dialysis patients in common clinical scenarios

- Diabetic ketoacidosis treatment
- Infection evaluation and management
- Pain management
- Post-operative care

Let’s take it to the bedside…

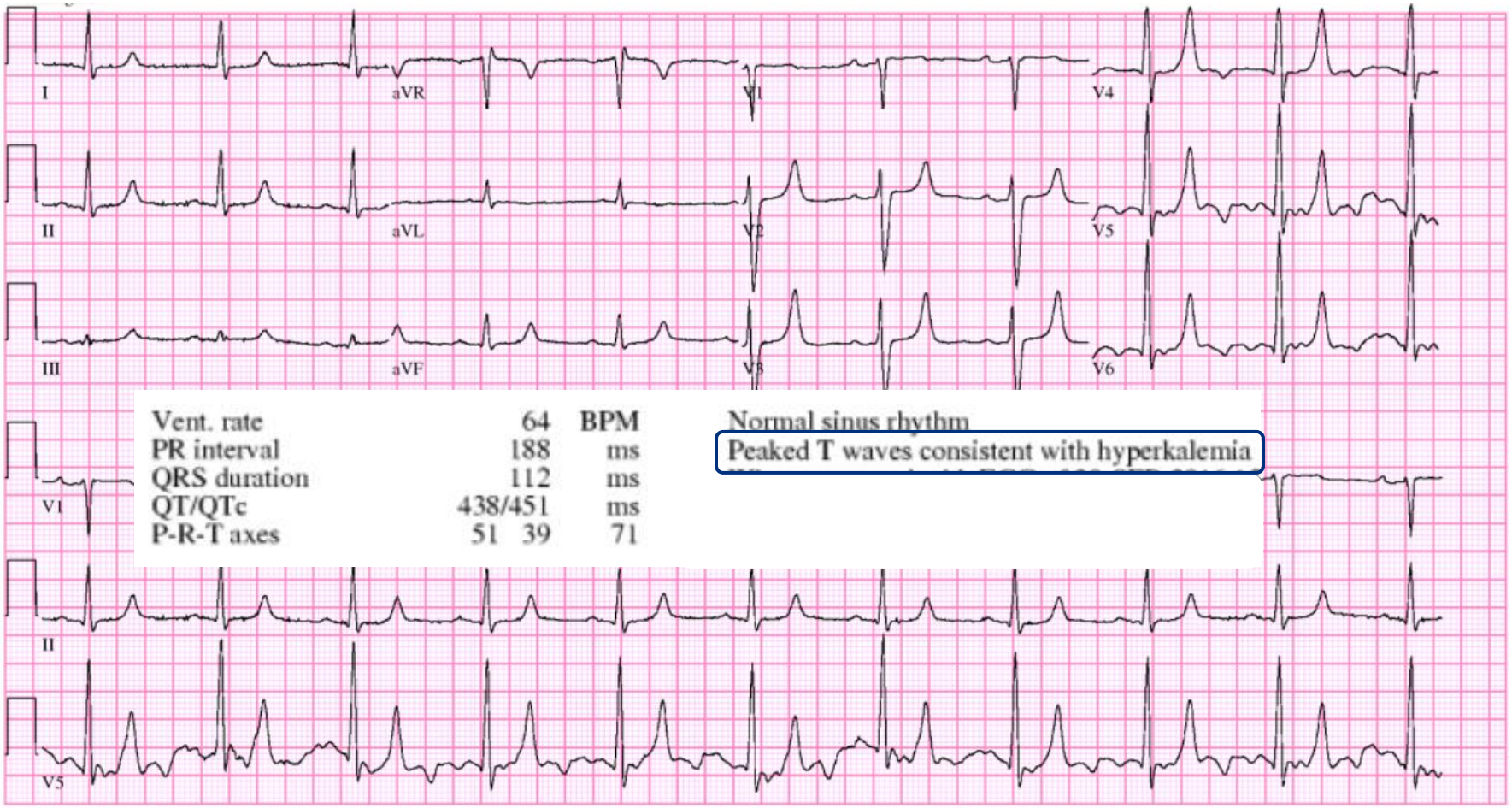
Case 1

- Mr. DD is a 59 year old man with ESRD due to DM2 on hemodialysis since 2013
- Other co-morbidities include CAD s/p CABGx3, HLD, HTN
- Presented to the hospital on Sunday morning for fatigue, malaise, nausea, vomiting x 3 days
- Last dialysis was a week ago
- He was dismissed from his dialysis unit due to behavioral dyscontrol
- He does not make any urine

Case 1

- Home meds include: amlodipine, aspirin, metoprolol, atorvastatin, sevelamer, sertraline, clonidine patch, hydralazine, lanthanum
- Exam: BP 187/76, HR 68bpm, saturating 83% on room air
- Bibasilar inspiratory crackles, 3+ pitting edema

Na	144
K	7.1 (!)
Cl	100
TCO2	14 (L)
Anion Gap	30 (H)
Ca	8.9
Ionized Ca	
Phos	11.3 (H)
TP	
Albumin	
Glucose	125 (H)
Bili Total	
Bili Direct	
Creat	13.8 (!)
Estimated GFR	3.6 * (L)
BUN	129.6 (H)
Creat-CT,IVP,MRI,Hem	
Special Chemistry	
Mg	2.9 (H)


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5
Vent. rate 64 BPM
PR interval 188 ms
QRS duration 112 ms
QT/QTc 438/451 ms
P-R-T axes 51 39 71
Normal sinus rhythm
Peaked T waves consistent with hyperkalemia

In addition to administering calcium gluconate or chloride, what is the most important step in the treatment of this patient?

Na	144
K	7.1 (!)
Cl	100
TCO2	14 (L)
Anion Gap	30 (H)
Ca	8.9
Ionized Ca	
Phos	11.3 (H)
TP	
Albumin	
Glucose	125 (H)
Bili Total	
Bili Direct	
Creat	13.8 (!)
Estimated GFR	3.6 * (L)
BUN	129.6 (H)
Creat-CT,IVP,MRI,Hem	
Special Chemistry	
Mg	2.9 (H)

1. Kayexalate
2. Patiromer
3. Sodium zirconium cyclosilicate
4. Call your friendly nephrologist for emergent dialysis

Hyperkalemia in dialysis patients: what you need to know

- ***Common*** cause of hospitalizations
- Major cause of ***arrhythmia*** and ***sudden death***
- Liberal use of IV calcium → ***vascular calcifications***
- ***Do not use sodium bicarbonate***

Hyperkalemia treatment options in dialysis patients

- DIALYSIS DIALYSIS DIALYSIS

- Consider binding resins

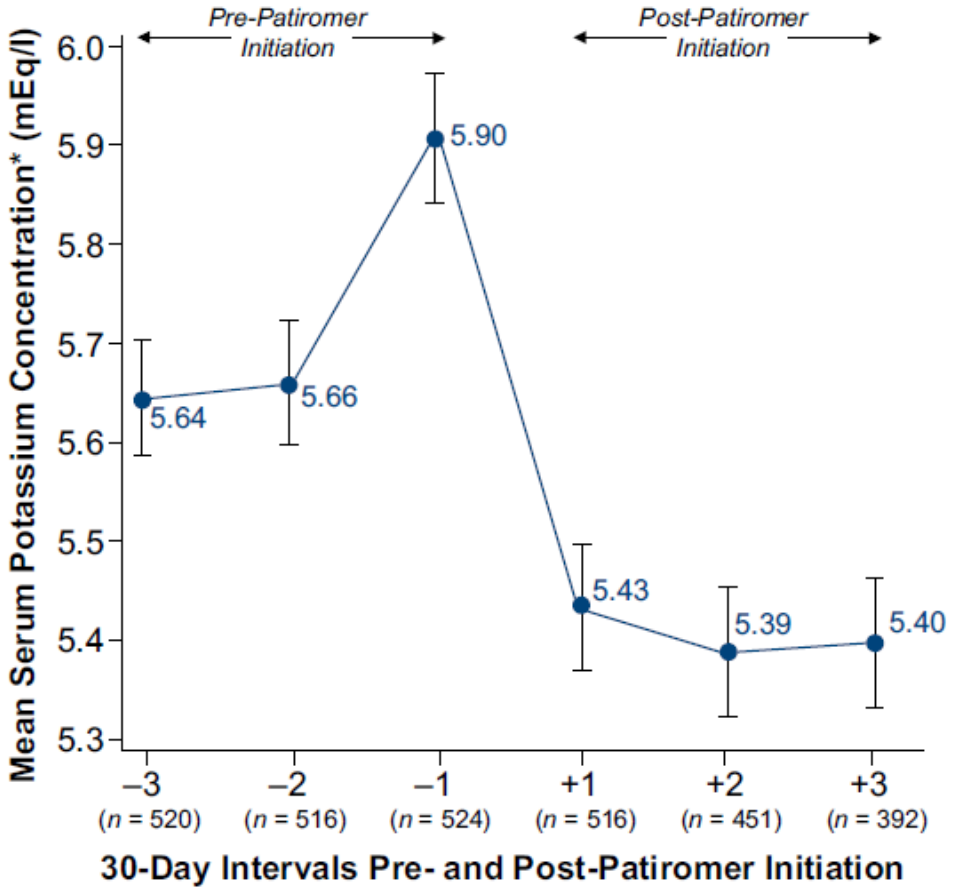
Sodium Polystyrene

- Ion exchange binding resin (exchanges K for Na)
- Effect is delayed for at least 2 hours
  - 0.7-1.1mEq/L
- FDA warning 2009 for colonic necrosis with powder form with sorbitol
- **Avoid in patients with recent surgery, h/o ischemic bowel, intestinal dysfunction**
- Never studied in dialysis patients
- Not well tolerated by patients
- Side effects: nausea, diarrhea

Patiromer (Veltassa) Approved 2015

- Ion exchange binding resin (exchanges K for Calcium)
- Mean decrease in K was 0.5-1mEq/L
  - Over 52 week treatment period
- Side effects: constipation, hypomagnesemia, nausea
- Must space it out from other meds by at least 3 hours
- Approved for use in dialysis and non-dialysis CKD patients

Chronic maintenance use of patiromer can lower serum potassium



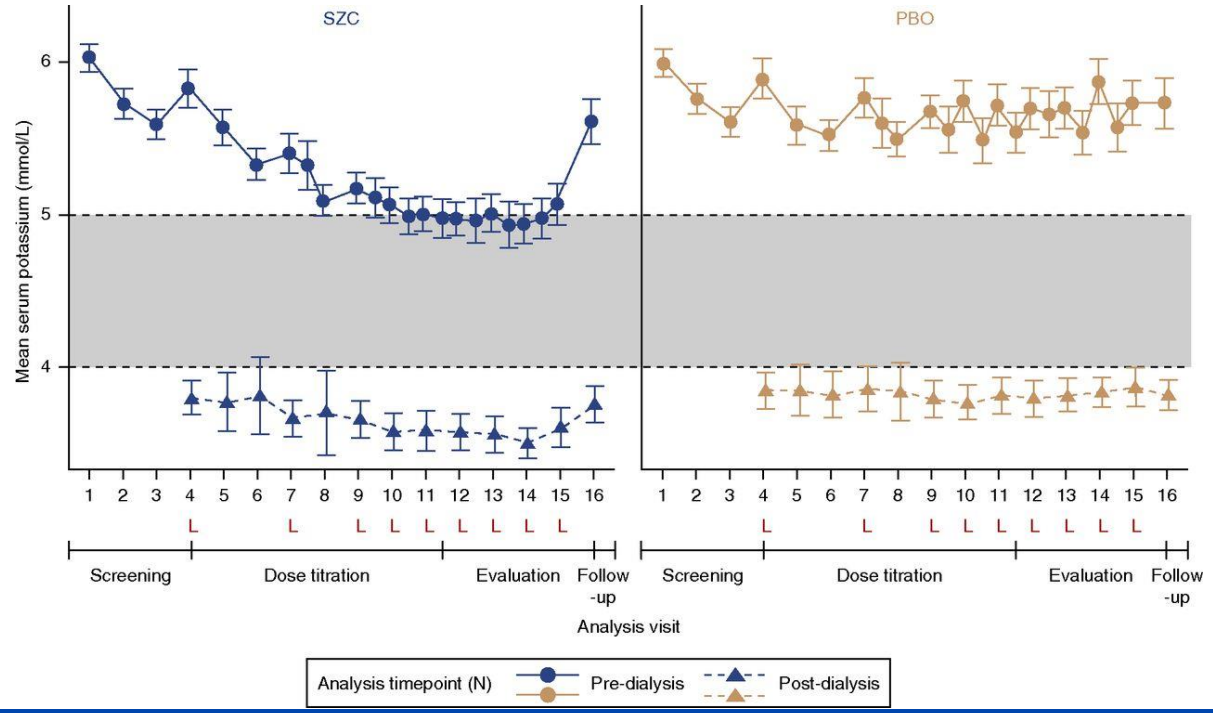
Kovesdy CP Kidney Int Rep (2019) 4, 301-309

ZS-9 (Lokelma)- Approved 2018

- Ion exchange binding resin (exchanges K for Na and H+)
- Mean decrease in K 0.5-1.0 mEq/L (dose dependent)
  - Over 28 day treatment period
- Side effects: edema, hypokalemia

Sodium zirconium cyclosilicate (SZC)

- Randomized double blind study comparing SZC to placebo → effectively lowered potassium when used over 4 week period



Fishbane S. JASN 2019. 30 (9): 1723-1733

Summary of binding resins in dialysis patients

SPS	Patiromer	ZSC
Variable time of onset 2-6 hours	7-48 hours	1-6 hours
Duration of effect: 6-24 hours	12-24 hours	4-12 hours
Not recommended for acute hyperkalemia management	Not recommended for acute hyperkalemia management	May be used for acute hyperkalemia

Beccari MV. Core Evid 2017:12:11-24

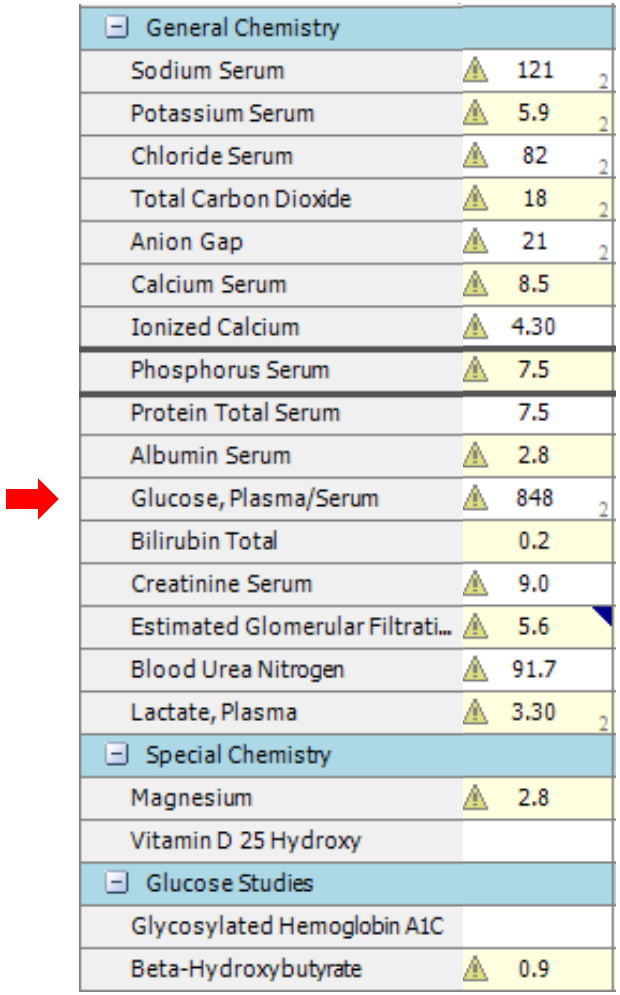
Key points

- Hyperkalemia is common and associated with arrhythmia and sudden death
- Treatment of choice is EMERGENT HEMODIALYSIS
- Use intravenous calcium judiciously and avoid the use of sodium bicarbonate
- Consider Patiromer and ZSC for chronic management

Case 2

- Ms. DC is a 50 year old with type 1 DM s/p pancreas and kidney transplant both of which failed in 2013 now with ESRD on hemodialysis on Tues/Thurs/Sat schedule
- Presented to the ED after missing three dialysis sessions due to nausea and weakness
- On exam: BP 154/87, HR 83 bpm, afebrile, 10kg above usual dry weight
    - Distant heart sounds, decreased BS at lung bases
    - 3+ pitting edema

Patient is diagnosed with DKA. What is the best treatment approach for this patient?



General Chemistry		
Sodium Serum	⚠	121
Potassium Serum	⚠	5.9
Chloride Serum	⚠	82
Total Carbon Dioxide	⚠	18
Anion Gap	⚠	21
Calcium Serum	⚠	8.5
Ionized Calcium	⚠	4.30
Phosphorus Serum	⚠	7.5
Protein Total Serum		7.5
Albumin Serum	⚠	2.8
Glucose, Plasma/Serum	⚠	848
Bilirubin Total		0.2
Creatinine Serum	⚠	9.0
Estimated Glomerular Filtrati...	⚠	5.6
Blood Urea Nitrogen	⚠	91.7
Lactate, Plasma	⚠	3.30
Special Chemistry		
Magnesium	⚠	2.8
Vitamin D 25 Hydroxy		
Glucose Studies		
Glycosylated Hemoglobin A1C		
Beta-Hydroxybutyrate	⚠	0.9

1. Insulin drip + dialysis
2. Insulin drip + dialysis + 1L of normal saline
3. Insulin drip + dialysis + 1L of 0.45% normal saline
4. Insulin drip + dialysis + 1L of normal saline + K replacement

Unique aspects of DKA in dialysis patient

- DKA in dialysis is very rare
  - Reduced insulin clearance (renal)
  - Improved insulin sensitivity with dialysis
  - Decreased renal gluconeogenesis
- Volume depletion is uncommon
  - No osmotic diuresis
  - Extracellular volume expansion more common
- High potassium balance
  - No GFR + low insulin state + hypertonicity

Gosmanov AR et al. Diabetes Metab Syndr Obes. 7:255-264, 2014

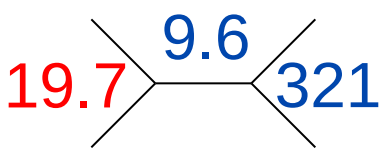
Key points

- Key aspects of management of DKA in a dialysis patient is INSULIN
- Fluids and potassium replacement not necessary and can be harmful
- Be careful not to apply hospital DKA care sets to dialysis patients

Case 3

- Ms. NC is a 29 year old female with DM1 complicated by retinopathy, neuropathy and ESRD on home hemodialysis (5x/week) for last 5 months via tunneled dialysis catheter who was called to the hospital to receive a combined kidney-pancreas transplant
- ROS: tired with chills last two dialysis sessions, new onset left shoulder pain x 2 weeks, chronic dry cough x 4 weeks
- On exam temp 38.6, BP 183/99, HR 98bpm, saturating 83% on RA
  - Significant left shoulder pain with passive movement

Labs



Ca	8.5
Phos	9.7
Alb	3.2

ESR	94
CRP	>300

How would you work up this patient's febrile illness?

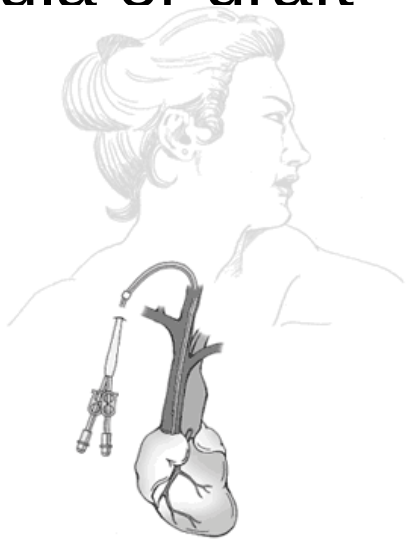
1. Peripheral blood cultures
2. Peripheral blood cultures + chest x-ray
3. Peripheral blood cultures + chest x-ray + shoulder x-ray
4. Peripheral blood cultures + culture from each port of the dialysis line + chest x-ray + shoulder x-ray

What is the most likely cause of this patient's fever?

1. Pneumonia
2. Tunneled dialysis catheter infection
3. Septic arthritis
4. Bacteremia
5. Endocarditis
6. Any of the above

Tunneled dialysis catheter

- Easiest & fastest access
- 80% of patients starting dialysis use catheter
- Associated with highest risk of infection (10x) and mortality compared to AV fistula or graft
- Two main complications:
  - Catheter malfunction
  - Catheter infection
    - Exit site
    - Systemic bacteremia



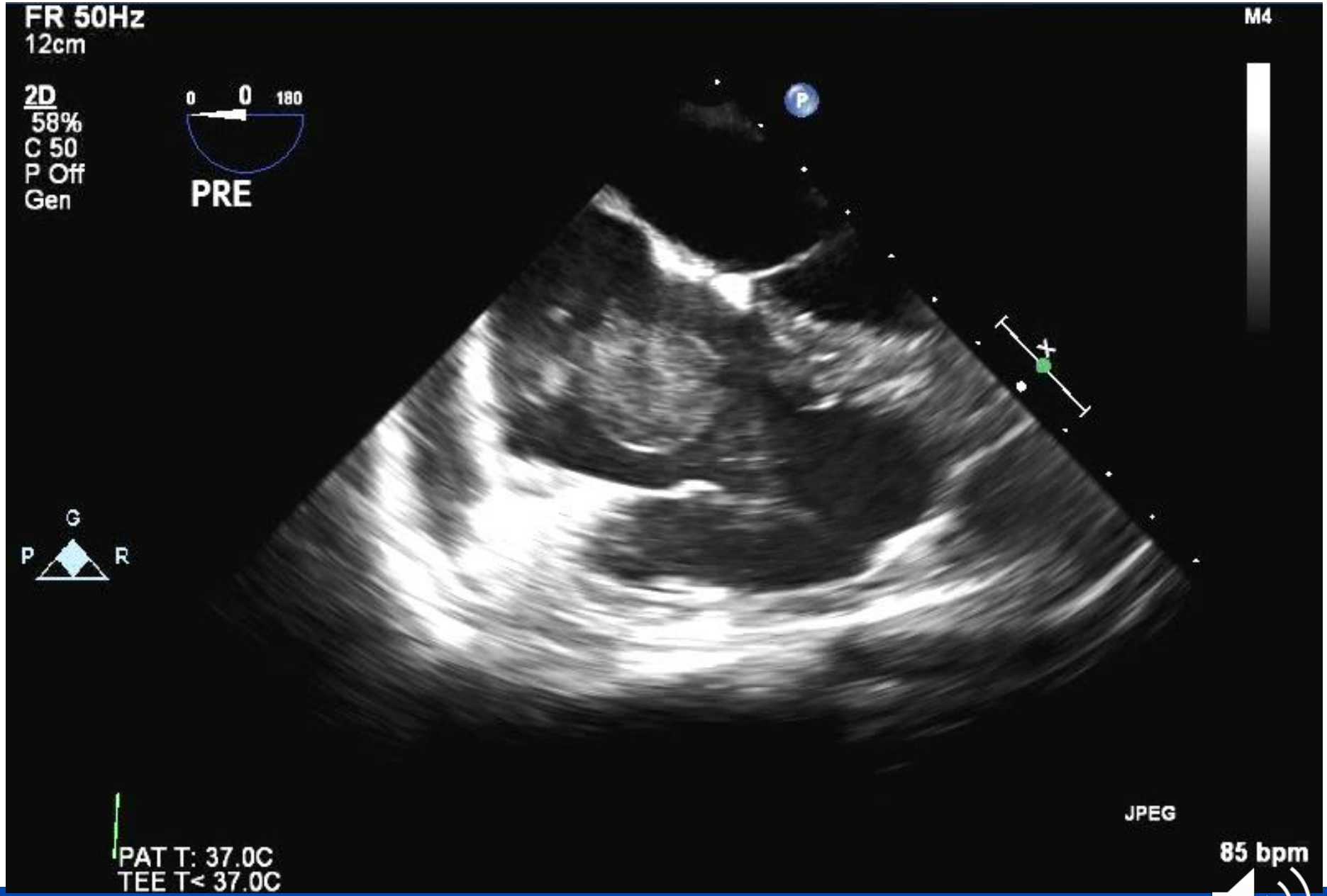
Tunneled dialysis catheter related infection

- 35-54% rate of catheter associated bacteremia within 3-6 months of insertion
- 5-10% rate of metastatic infectious complications
  - Staph aureus → up to 40%
- Skin flora: staph and Strep are most common organisms

Back to our patient

- Transplant was cancelled and she was transitioned to general medicine service for further workup
- CXR → pulmonary edema/ no pneumonia
- Shoulder x-ray → normal
- Peripheral and dialysis catheter blood cultures:
  - Coag negative staphylococcus
    - staph Lugdunensis
- Left shoulder synovial fluid aspirate
  - staph Lugdunensis
- Persistent bacteremia despite 3 days of vancomycin

→Echocardiogram


FR 50Hz
12cm
M4
2D
58%
C 50
P Off
Gen
0 0 180
PRE
G
P
R
JPEG
PAT T: 37.0C
TEE T< 37.0C
85 bpm

Back to our patient

- Right atrial ’thrombus’ enlarged despite adequate anticoagulation and antibiotic therapy
- Operative removal of the mass
  - ‘a multi-lobed gelatinous collection with the bulk of the tumor being the consistency of an egg yolk with a thin layer of film of outer consolidation and a near-liquid cavity’

Key points

- Must obtain blood cultures from each lumen of dialysis catheter AND peripheral in all dialysis patients with suspicion for infection
- Low threshold to check echocardiogram to rule out endocarditis
- Do not let the SUN SET on a dialysis patient presenting with fever!

Case 4

- Ms. CA is a 41 year old female with ESRD due to lupus nephritis on hemodialysis for 9 months via a tunneled dialysis catheter
- Admitted for MRSA dialysis catheter associated bacteremia
- She is about to be discharged from the hospital and requires 2 weeks of intravenous vancomycin with vancomycin trough level monitoring to maintain level between 15-20

What is the best approach for administering intravenous vancomycin in this patient?

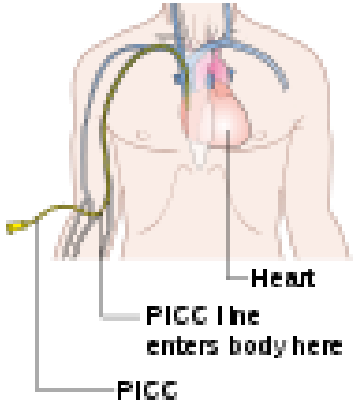
1. Place peripherally inserted central catheter (PICC line) and coordinate with home health administration of vancomycin
2. Coordinate with patient's outpatient dialysis unit to administer vancomycin after dialysis using patient's tunneled dialysis catheter
3. Coordinate with home health administration of vancomycin via small bore cuffed tunneled central catheters (TSB-CVC)

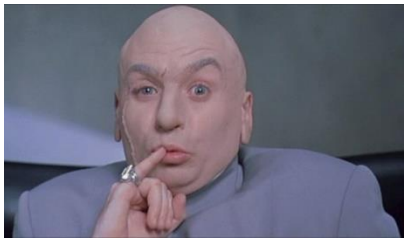
PICC line in dialysis patients

- Associated with delay in establishing a working vascular access (fistula or graft)
- Associated with high likelihood of failed fistula
- Associated with shorter survival on dialysis

McGill RL. et al. Clin J Am Soc Nephrol 11: 1434-144[illegible]016
El Ters M. et al. Am J Kid Dis 60(4): 601-608, 2012

Why are PICC lines evil?





- Create venous injury
- Promote venous thrombosis (as high as 38%)
  - Cephalic and basilic sites
    - Golden veins for fistula creation
- Increase risk of vascular sclerosis → stenosis

What are the alternatives?

- Explore options of antibiotic administration after dialysis using the patient's dialysis access (fistula or catheter)
- Consider small-bore tunneled internal jugular catheter
  - Less risk of venous thrombosis or stenosis
  - Avoid cannulation of cephalic and basilic veins

Key points

- Think twice before ordering PICC on your dialysis patient
- National Kidney Foundation Kidney Disease Outcomes Quality Initiative (NKF-KDOQI) recommends AGAINST the use of PICCs in patients with CKD

Key points

- Talk with your nephrologist and dialysis center first
- Explore use of small-bore tunneled internal jugular catheter if available at your hospital
- Preserve the veins of your dialysis patient!

Case 5

- Ms. NS is a 63 year old female with ESRD due to DM & HTN admitted for leg pain
- Found to have severe anemia due to bilateral iliopsoas hematoma
- Oxycodone was not adequate for pain control
- Morphine 2mg IV pushes q4hr given
- 12 hours later patient became confused and disoriented

What of the following is the best treatment approach for her pain?

1. Tramadol (extended release)
2. Aleve
3. Codeine
4. Hydromorphone
5. High doses of morphine

What NOT TO USE in kidney disease

Medication	Why?	What to do?
Morphine	Accumulation → crosses blood-brain barrier → suppress CNS respiratory center	-Dose reduce in CKD -GFR: 20-50: reduce dose by 50% -GFR: 15-20: reduce dose by 75% -GFR<15: avoid
Codeine and hydrocodone	Accumulation and prolonged half life → nausea, vomiting, hypotension, respiratory arrest	Avoid use in ESRD Use lowest doses for CKD
Extended release Tramadol	Has not been studied in patients with CKD	Use short acting Tramadol instead

Koncicki HM et al. Am J Kid Dis Nov 2[illegible]016

Dean M. J Pain Symptom Manage 28:497-504, 2004

Medications to use in ESRD

Medication	Pain severity	Dose
Acetaminophen	Mild	650mg q6hr as needed
Oxycodone	Moderate	5mg q4-6hr as needed
Tramadol (short acting)	Moderate	50mg q12hr dose after dialysis
Hydromorphone	Severe	1mg q6hr as needed
Fentanyl	Severe	12.5-25μg patch *only use in patients who have been on opioids prior
Methadone	Severe	

Koncicki HM et al. Am J Kid Dis Nov 2[illegible]016

Neuropathic pain management in kidney disease patients

- Duloxetine should not be used for GFR<30ml/min
- Gabapentin:
  - 30-59ml/min → max 1400mg/24hrs
  - 15-29ml/min → max 700mg/24hrs
  - <15ml/min → max 300mg/24hrs
- Pregabalin:
  - 30-59ml/min → max 300mg/24hrs
  - 15-29ml/min → max 150mg/24hrs
  - <15ml/min → 75mg/24hrs

Raouf M et al. J Pain Res. 10:275-27[illegible]017
Raouf Me et al. Kidney Dis. 6:157-167, 2020

Key points

- Avoid MORPHINE and codeine in patients with ESRD
- Remember to check drug-dosing adjustment for your dialysis patient
- Start low and go slow

True or False

Patients on dialysis should avoid the use of NSAIDS and contrast exposure.

1. True
2. False

True

- Maintain and protect residual renal function in dialysis patients
- Residual renal function can improve dialysis patient survival
- Avoid NSAIDS and contrast studies if possible

True or False

Tunneled dialysis catheter in a dialysis patient can be used for maintenance IV fluids and blood draws.

1. True
2. False

False

When to use and who can use dialysis catheter?

- Should only be used by dialysis nurse
- Used for the dialysis procedure, to draw cultures, administer blood transfusions on dialysis, administer antibiotics while on dialysis
- Outside of these scenarios, dialysis catheter should only be accessed during an emergency!

True or False

- Dialysis patients fasting for surgery or procedure should receive maintenance IV fluids to avoid dehydration.

1. True
2. False

False

- Dialysis patients are at increased risk of volume overload

Key points

- Preserve residual renal function in patients who still make urine
- Avoid the use of dialysis catheter outside the dialysis session
- Avoid maintenance IVF in fasting dialysis patients

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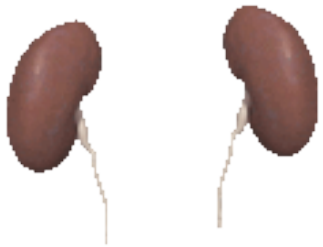
MAYO CLINIC

Questions



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