Nephrology Cases and Everything in Between

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Disclosures

- Consulting/Advisory Board for Bayer and Boehringer Ingelheim pharmaceuticals

Objectives

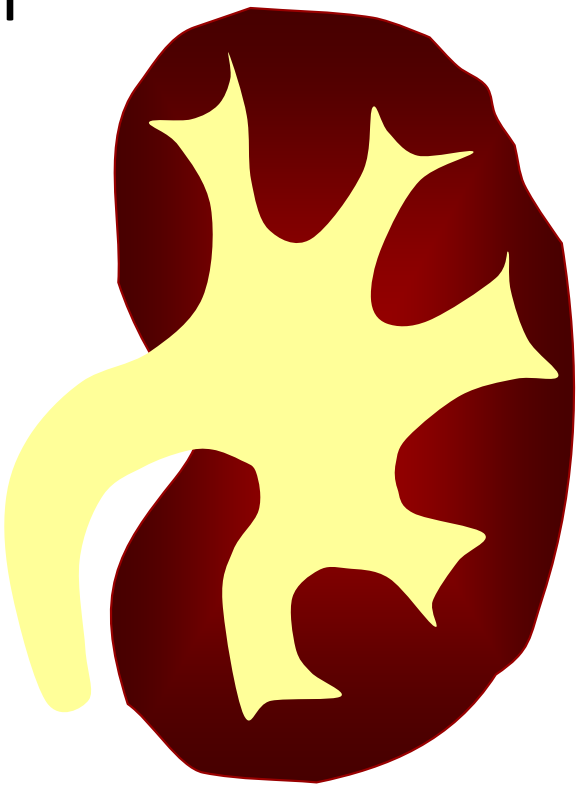
- Differentiate between pre-, intrinsic, and post-renal acute kidney injury (AKI)
- Recognize the differences of presentation between interstitial nephritis (AIN), glomerulonephritis (GN), and nephrotic syndrome
- Interpret the different nephrology lab results that help to guide workup of AKI, ADPKD, ATN, AIN, and GN and electrolyte abnormalities
- Gain confidence in evaluation of altered kidney function

Functions of the kidney

Filtration

Renin-angiotensin system

Erythropoietin production



1,25OH-Vit D production

Free water homeostasis

Acid-base balance

Excretion of uremic toxics

Solute balance

Steps to success in nephrology

1. What is the kidney function? Acute vs chronic
2. What do you see in the urine analysis?
3. How much proteinuria?
4. What do you see on kidney ultrasound?

Urine = success in nephrology

1. IF kidney, look at the urine
2. IF kidney, look at the urine
3. IF kidney, look at the urine

Evaluating kidney function

BUN

- Blood urea nitrogen
- Waste product of protein catabolism
- Normal units 6-20mg/dL
- High BUN found in:
  - high protein diet
  - CKD
- Hypovolemia:
  - CHF, GI hemorrhage, hemorrhage
- Fever
  - Inc catabolism

SCr

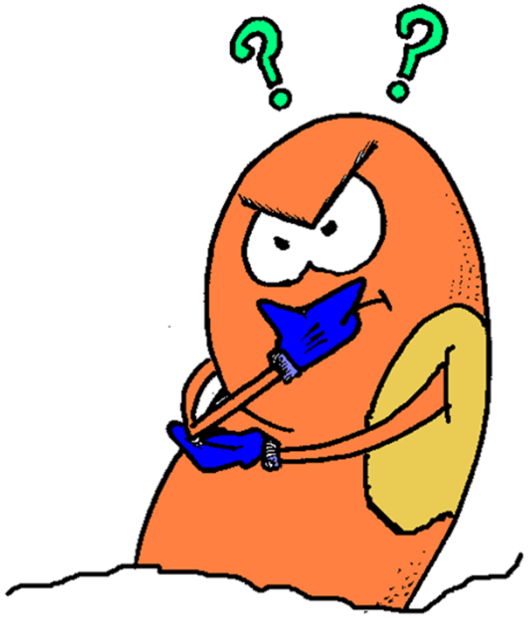
- Serum Creatinine
- Breakdown of creatine phosphate in muscle
- Normal units 0.5-1.2mg/dL
- Dependent on muscle mass

  higher muscle mass = higher SCr
- Higher levels in males
- **Can be late marker of kidney function**
- Logarithmic scale

What is the eGFR?

35 y/o male
eGFR 62
Stage 2

45 y/o female
eGFR 43
Stage 3b



70 y/o male
eGFR 50
Stage 3a

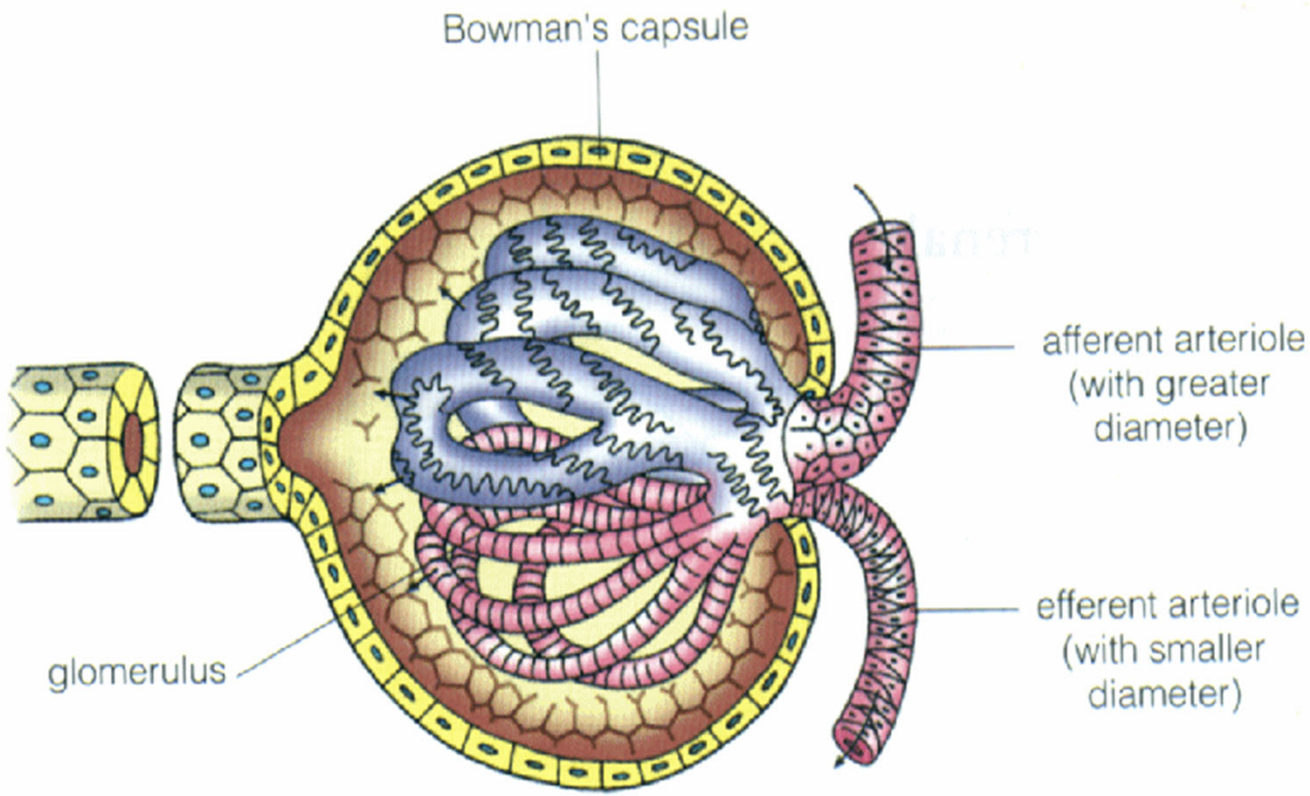
80 y/o female
eGFR 35
Stage 3b

Hold SCr stable at 1.5

Fun with Kidneys

Evaluating kidney function
GFR

- GFR measures amount of plasma filtered across glomerular capillaries (nl >90ml/min)



Fun with Kidneys

Evaluating kidney function
ESTIMATES of GFR

MDRD vs CrCl vs CKD-EPI vs CG

eGFR = % of remaining kidney function

- Cr Cl = 24 hour urine collection = clearance of kidneys = estimate of GFR CrCl = often used in FDA inserts, interchangeable with GFR,
- Cockcroft-Gault (CG) = FDA/pharmacy uses CG for med renal dosing = estimate of CrCl
- MDRD = eGFR = based upon age, sex and SCR. NOT accurate when eGFR >60ml/min
- CKD-EPI = lastest eGFR calculation. More accurate when eGFR >60ml/min
- GFR requires stable function, not useful in AKI
- An increase in SCr from **0.6 to 1.2 indicates a 50% loss of kidney function**

George

80 y/o male
PMH: HDL, HTN, BPH, CAD, former smoker
Meds: atorvastatin, chlorthalidone, amlodipine, tamsulosin, ASA
Retired military who still works full time @ golf shop
Presents to ED with gross hematuria x 1 week. Denies dysuria, fever/chills, penile discharge, LE edema, or changes in urinary habits

Which SCr (mg/dl) change represents most significant deterioration of George's kidney function?

A. 0.6→1.4?
B. 1.0→1.5?
C. 1.5→2.0?
D. 2.0→2.5?

Fun with Kidneys

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Presents to **your office** with gross hematuria x 1 week. Denies dysuria, fever/chills, penile discharge, LE edema, or changes in urinary habits

Which SCr (mg/dl) and eGFR (ml/min) change represent most significant deterioration of George's kidney function?

A.	0.6→1.4?	GFR 95→47
B.	1.0→1.6?	GFR 71→40
C.	1.7→2.8?	GFR 37→20
D.	3.0→6.0?	GFR 19→8

Fun with Kidneys

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Meds: atorvastatin, chlorthalidone, amlodipine, tamsulosin, ASA
Retired military who still works full time @ golf shop

IF his baseline renal function was SCr of 0.6 and eGFR of 95 and today the SCr and GFR are 1.4 and 47, what is the likely cause of kidney dysfunction?

A. Acute kidney injury (AKI)
B. AKI on chronic kidney disease (CKD)
C. CKD

Fun with Kidneys

Criteria for CKD

1. Decreased GFR ≤ 60ml/min for > 3 months

OR

2. Markers of Kidney Damage for > 3 months
   - Albuminuria ≥ 30mg/g
   - Urinary sediment abnormalities

     Ex: microhematuria
   - Electrolyte and other abnormalities due to tubular disorders
   - Structural abnormalities detected by imaging

     Ex: ADPKD (polycystic kidney disease)
   - History of kidney transplantation

George

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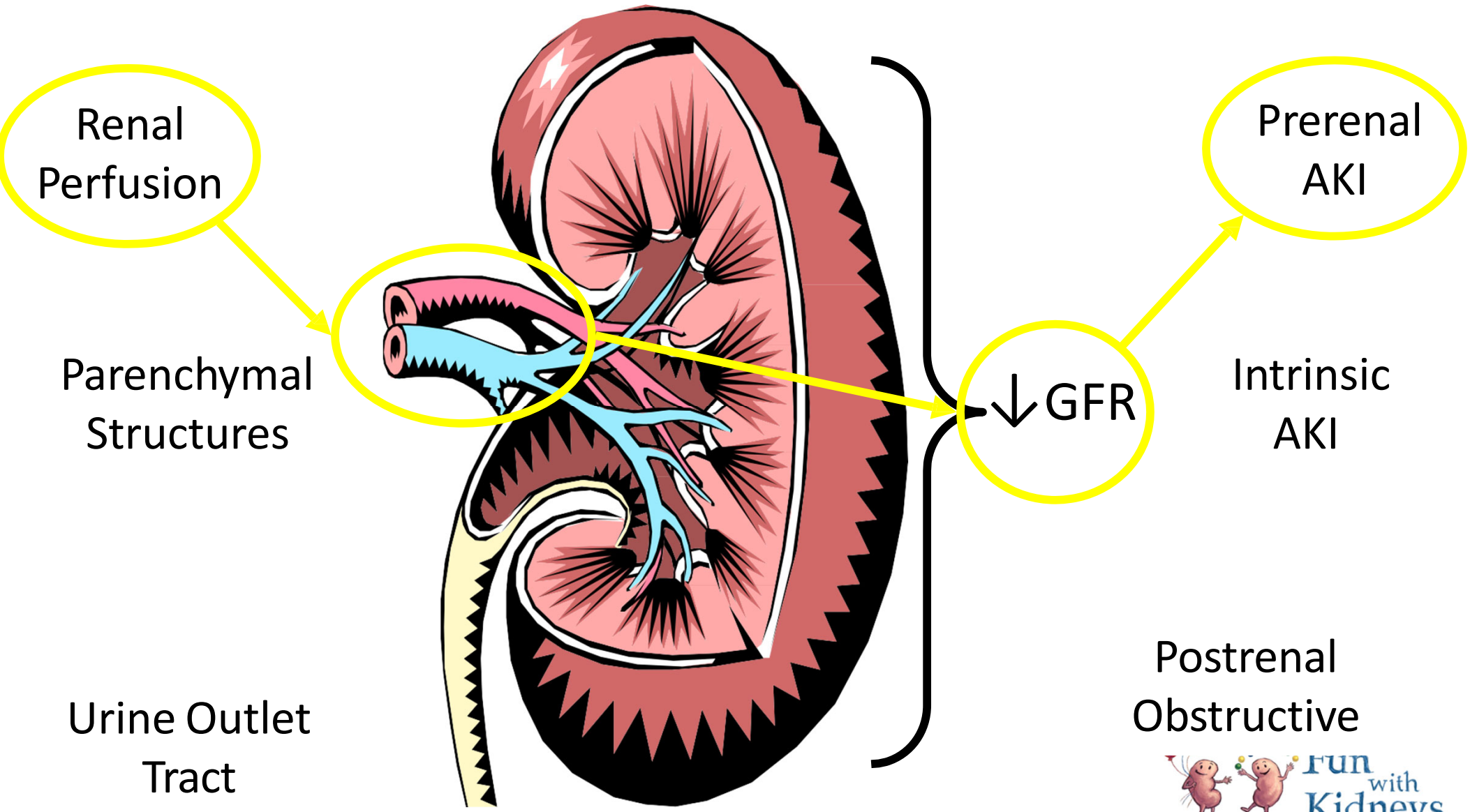
Fun with Kidneys

Syndromes of Acute Kidney Injury

Factors that Affect:	Induce:	Syndrome:
Renal Perfusion	↓GFR	Prerenal AKI
Parenchymal Structures	↓GFR	Intrinsic AKI
Urine Outlet Tract	↓GFR	Postrenal Obstructive



Fun with Kidneys

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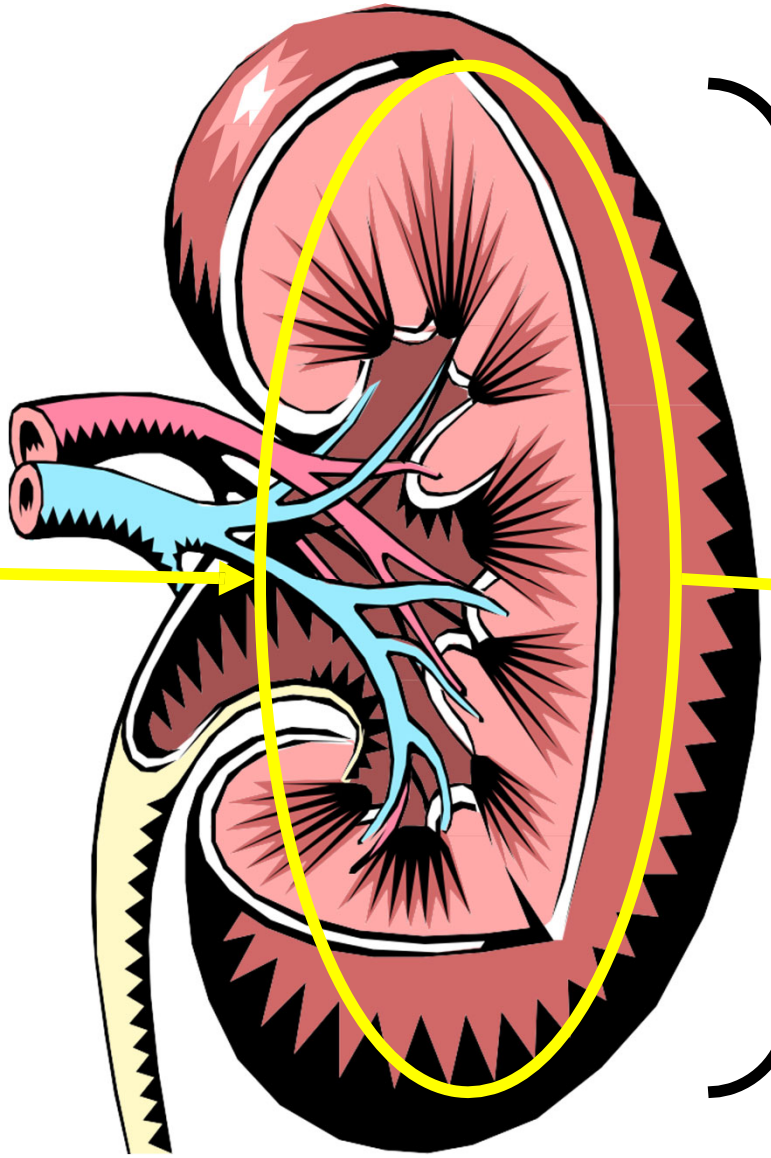

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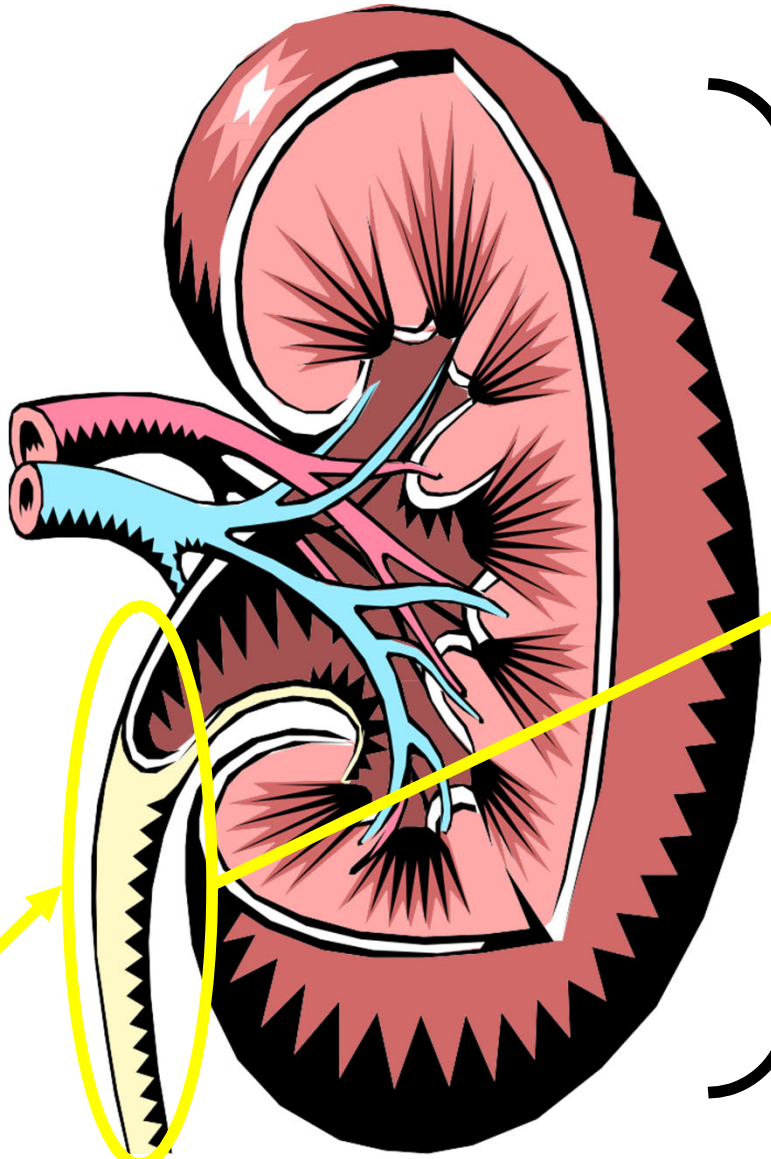


Acute Kidney Injury

Prerenal AKI	Intrinsic AKI	Postrenal AKI
↓ **Intravascular Volume** Dehydration / Hemorrhage GI, Cutaneous or Renal losses Third Spacing ↓ **Effective Blood Volume** CHF Cirrhosis Nephrotic Syndrome Sepsis Anesthesia **Altered Renal Hemodynamics** Preglomerular Constriction Postglomerular Vasodilation Medications: ACEI, NSAIDS, CSA Hepatorenal syndrome, Surgery **Renal Vascular Obstruction** **Abdom. Compartment Synd.**	**Acute Tubular Necrosis** Ischemic: Sepsis Hypotension Nephrotoxic: Drugs Pigments **Acute Interstitial Nephritis** Drug-induced Infection-related Systemic Diseases Malignancy **Acute Glomerulonephritis** **Acute Vascular Syndrome** Renal artery dissection Renal artery Throm-Emb Renal vein thrombosis Atheroembolic disease	**Upper Tract Obstruction** Intrinsic Stone Papillary Necrosis Blood Clot TCC Extrinsic Retroperit. Fibrosis Malignancy Ligation Pelvic Mass **Lower Tract Obstruction** Urethral Stricture BPH Prostate Cancer TCC of the bladder Stones: bladder Neurogenic bladder Malpositioned Foley Cath

George

80 y/o male
PMH: HDL, HTN, BPH, CAD, former smoker
Meds: atorvastatin, chlorthalidone, amlodipine, tamsulosin, ASA
Retired military who still works full time @ golf shop

IF his baseline kidney function was SCr of 0.6 and eGFR of 95 and today the SCr and eGFR are 1.4 and 47, what is the cause of kidney dysfunction?

A. Acute kidney injury (AKI). Because GFR of <60 at 47 has been present X1 not for >3 months. So WHAT TYPE of AKI???

~~B. AKI on chronic kidney disease (CKD)~~

~~C. CKD~~

Fun with Kidneys

George

80 y/o male with HDL, HTN, BPH, CAD, former smoker
Meds: atorvastatin, chlorthalidone, amlodipine, tamsulosin, ASA
Retired military who still works full time @ golf shop
Presents to **your office** with gross hematuria x 1 week.
Denies dysuria, fever/chills, penile discharge, LE edema, or changes in urinary habits
UA: + heme, negative protein, 3-10 RBC, negative WBC, 25-100 hyaline casts
UACR: (urine albumin/creatinine ratio) <30 WNL

What is George's AKI etiology/diagnosis?

A. Nephrotic syndrome
B. Acute interstitial nephritis (AIN)
C. Acute glomerulonephritis AKI
D. Post- renal AKI
E. Acute tubular necrosis (ATN)

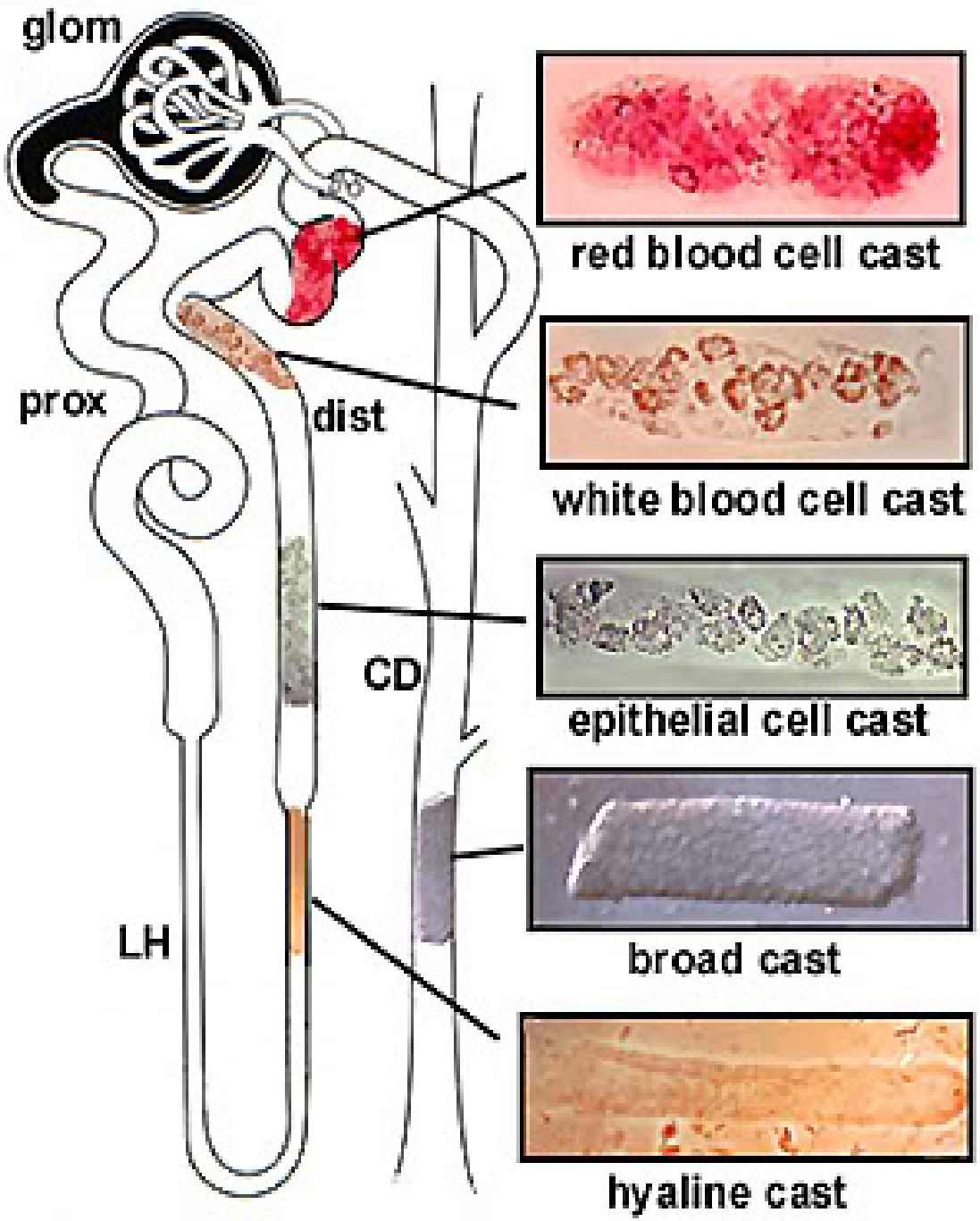
Fun with Kidneys

Steps to success in nephrology

1. What is the kidney function? Acute vs chronic
2. What do you see in the urine analysis?
3. How much proteinuria?
4. What do you see on kidney ultrasound?

Fun with Kidneys

Urinary casts



Named based upon shape and origin

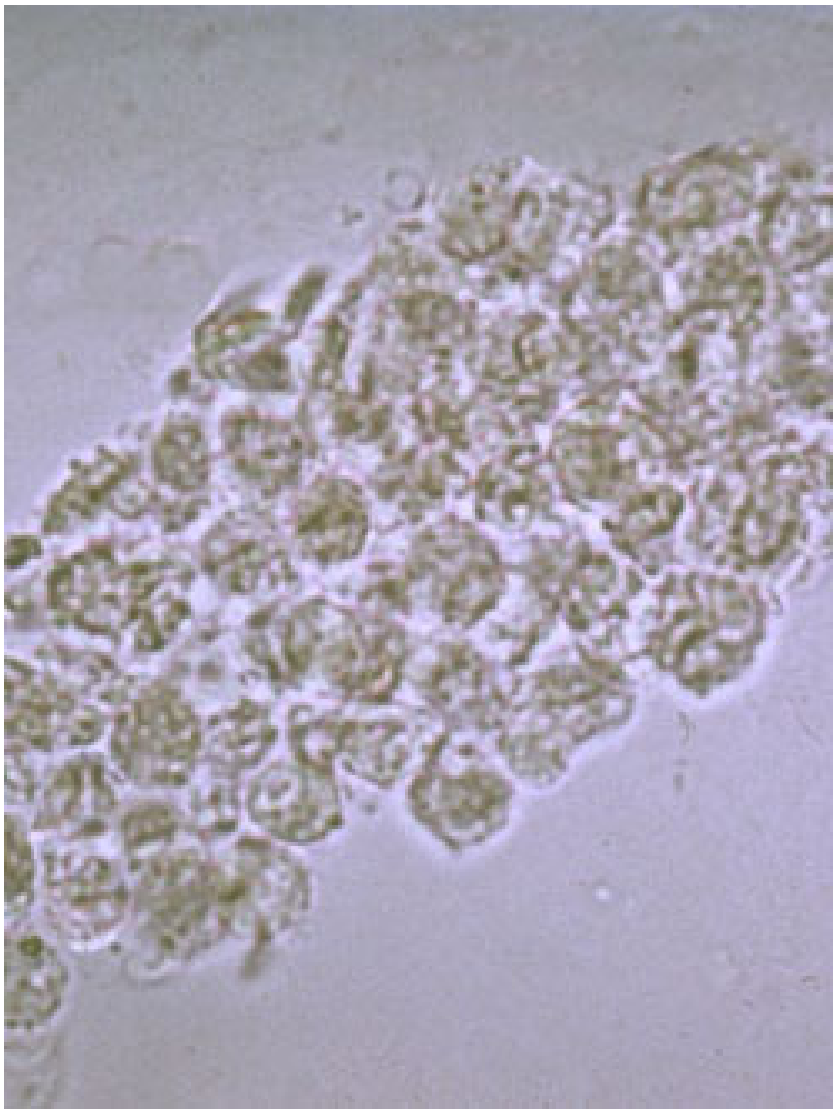
1. Hyaline
2. Granular
3. Waxy/Broad
4. RBC
5. WBC
6. Tubular

Fun with Kidneys

RBC Cast

THINK

GLOMERULONEPHRITIS



WBC Cast

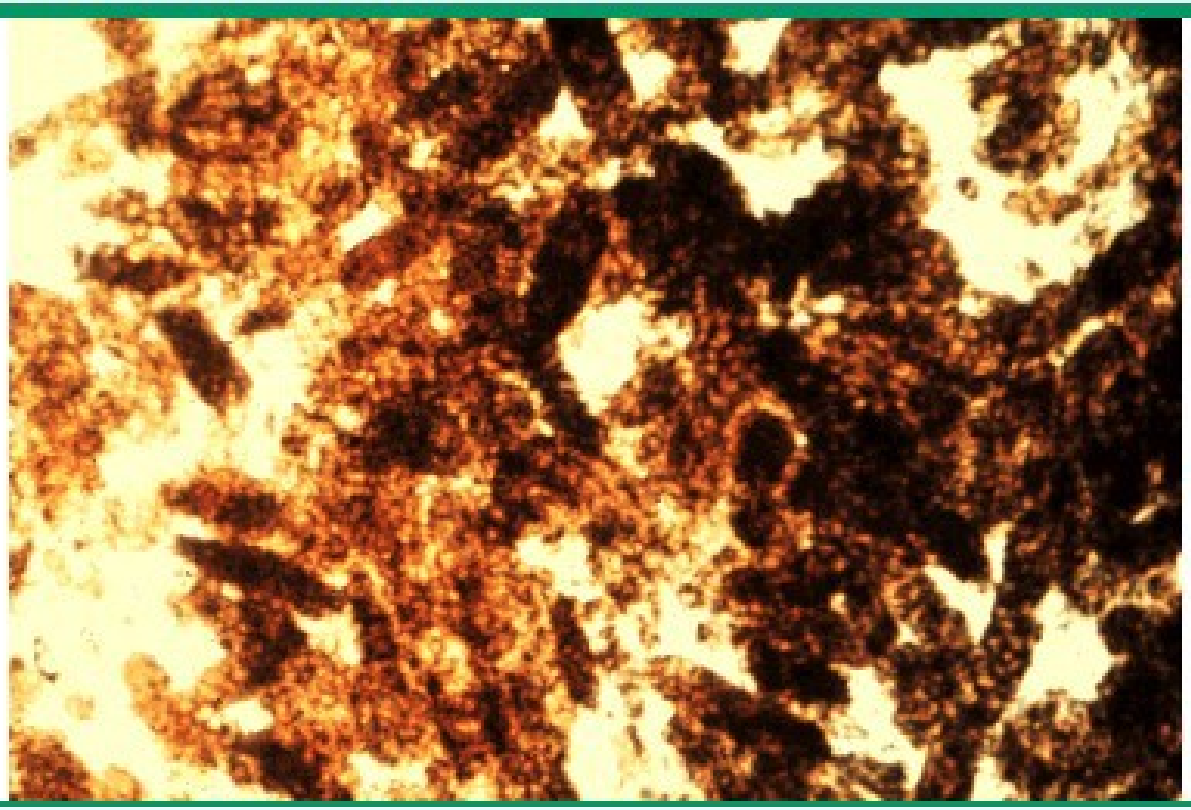
THINK

INTERSTITIAL NEPHRITIS

Fun with Kidneys

Muddy/Granular Brown Casts = ATN

Photomicrograph showing urine sediment with muddy brown granular casts



Pathognomonic for ATN

Fun with Kidneys

Hyaline Casts = Hell, if I know NOTHING

Hyaline cast

Not pathognomonic for anything…..

Fun with Kidneys

Urine cheat sheet for intrinsic kidney injury

	Cystitis	Pyelonephritis	Acute Allergic Interstitial Nephritis	Acute Glomerulonephritis	Nephrotic Syndrome	Ischemic Tubular Necrosis
Protein	0	0	0	++	++++	0
RBCs	0	0	+	+++	0	0
WBCs	++++	++++	++++	+	0	0
RBC Casts	0	0	0	++++	0	0
WBC Casts	0	+++	+++	0	0	0
Granular Casts	0	+	+	+	0	++++

George

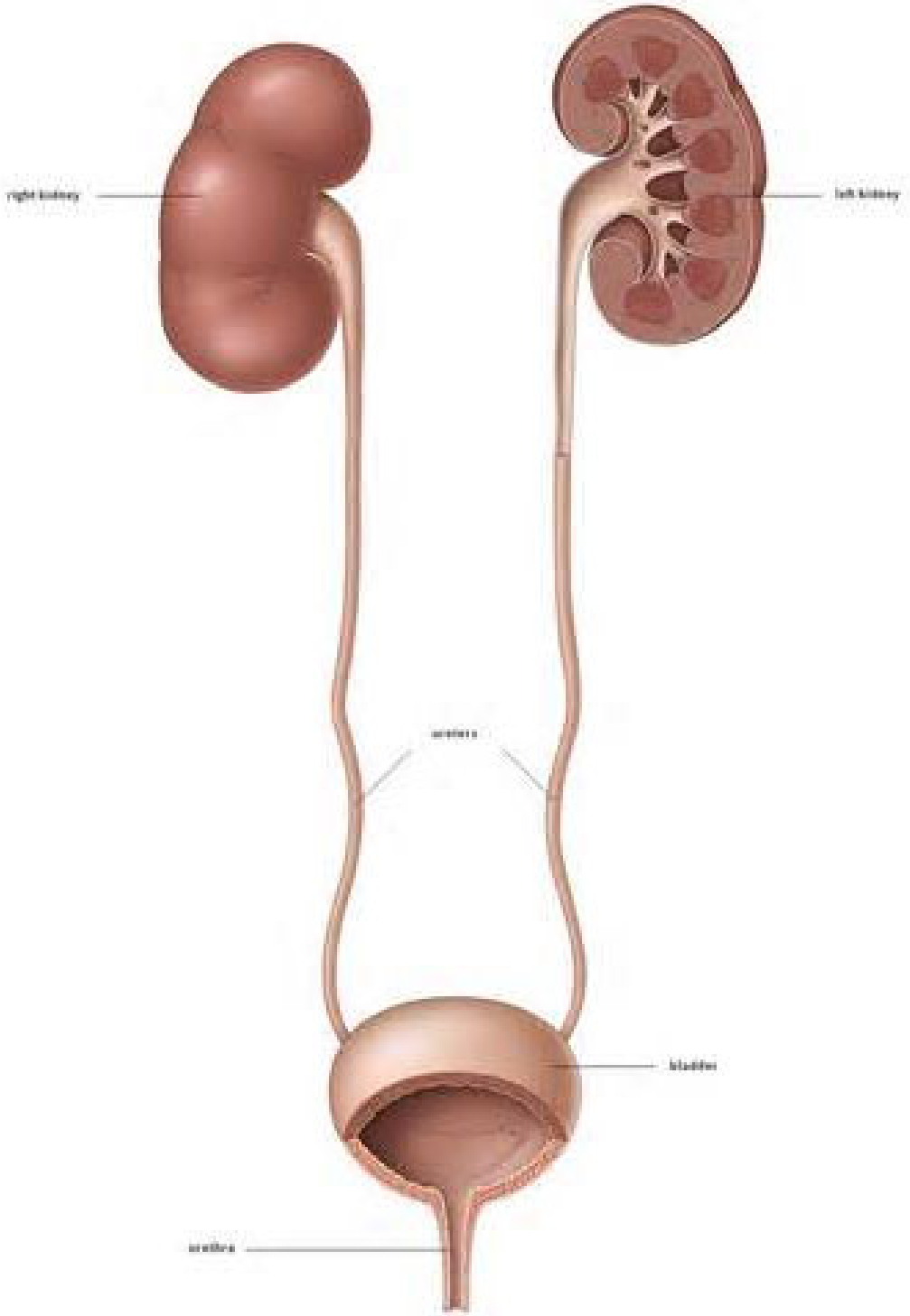
80 y/o male with HDL, HTN, BPH, CAD, former smoker
Meds: atorvastatin, chlorthalidone, amlodipine, tamsulosin, ASA
Retired military who still works full time @ golf shop
Presents to **your office** with gross hematuria x 1 week. Denies dysuria, fever/chills, penile discharge, LE edema, or changes in urinary habits

UA: + heme, negative protein, 3-10 RBC, negative WBC, 25-100 hyaline casts
UACR (urine alb/cr ratio) <30 WNL

What is George's diagnosis?

~~A. Nephrotic pattern~~
~~B. Acute interstitial nephritis (AIN)~~
C. Acute glomerulonephritis AKI
D. Post- renal AKI
~~E. Acute tubular necrosis (ATN)~~

Fun with Kidneys



Where is the origin of the hematuria?

Fun with Kidneys

Causes of hematuria

1. Renal: renal mass, glomerular pathologies, structural disease, pyelonephritis, malignant HTN, renal vein thrombosis, AV malformation, papillary necrosis(sickle cell)
2. Ureter: malignancy, stone, stricture, fibroepithelial polyp
3. Bladder: malignancy, radiation, cystitis
4. Prostate/urethra: BPH, malignancy, prostatic procedures, traumatic catheterizations, urethritis, urethral diverticulum

Steps to success in nephrology

1. What is the kidney function?
2. What do you see in the urine analysis?
3. How much proteinuria?
4. What do you see on kidney ultrasound?

Fun with Kidneys

George

What is George's diagnosis?

~~A. Nephrotic pattern~~

~~B. Acute interstitial nephritis (AIN)~~

~~C. Acute glomerulonephritis AKI~~

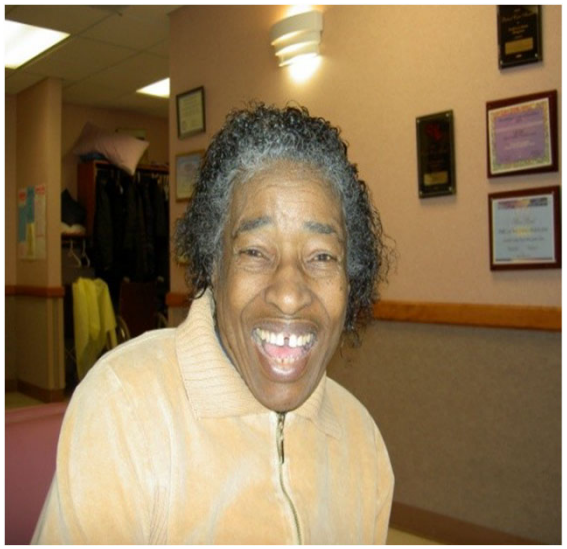
D. Post- renal AKI

~~E. Acute tubular necrosis (ATN)~~

Kidney sonogram demonstrated moderate B/L hydronephrosis. No calculi or renal masses. Noted to have large mass noted in urinary bladder.

Fun with Kidneys

Sally



78 y/o presents ED with nausea & vomiting for 2 days. Unable to keep food down
No available PMH
PE: 110/60 HR 80 sitting
80/55, HR 100 standing
Labs: BUN 45mg/dL, SCr 1.5mg/dL, FeNa 0.3%
UA: neg heme/protein, 0-1 RBC, neg WBC
25-100 hyaline casts. UACR <30mg/g

What is Sally's diagnosis?

A. UTI
B. Acute interstitial nephritis (AIN)
C. Pre-renal AKI
D. Post- renal AKI
E. Acute tubular necrosis (ATN)

Fun with Kidneys

Steps to success in nephrology

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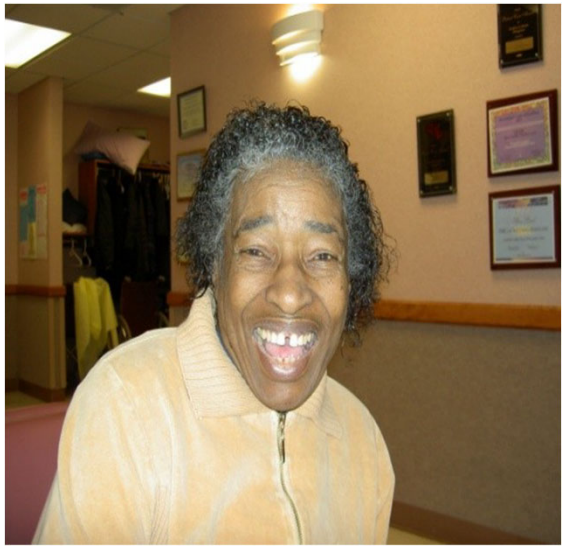

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78 y/o presents ED nausea and vomiting for 2 days. Unable to keep food down

No available PMH

PE: 110/60 HR 80 sitting

80/55, HR 100 standing

Labs: BUN 45mg/dL, SCr 1.5mg/dL.

Review of EMR shows SCr 0.9mg/dl in 2018 FeNa 0.3% UA: neg heme/protein, 0-1 RBC, neg WBC, 25-100 hyaline casts. UACR <30mg/g

What is Sally's diagnosis?

A. UTI

B. Acute interstitial nephritis (AIN)

C. Pre-renal AKI

D. Post- renal AKI

E. Acute tubular necrosis (ATN)

Fun with Kidneys

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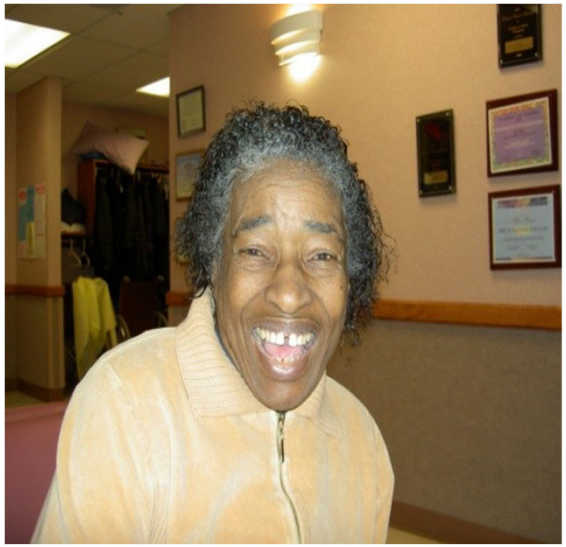
Fun with Kidneys



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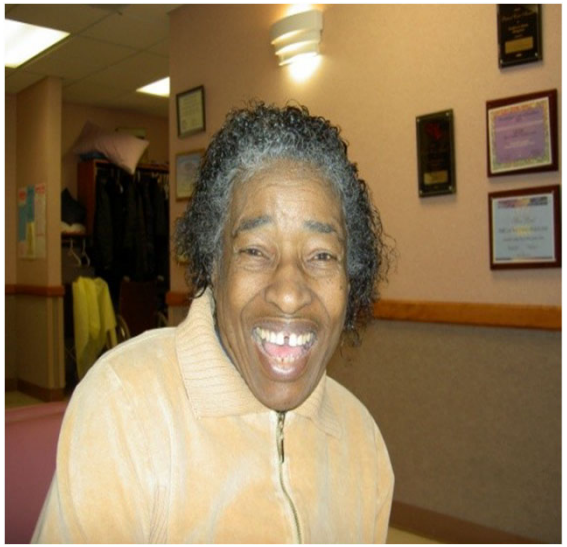
Fun with Kidneys

Sally



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Fun with Kidneys

FeNa (Fractional Excretion of Na)

Remember FeNa is a urine test

	Pre Renal	Intrinsic Renal	
FENa	**<1%**	**>1%**	

Used to help differentiate between intra-renal process or extra-renal

FeNa < 1% ~ prerenal cause, volume depletion

Kidney corrects for low fluid state by reabsorbing Na, therefore functional kidney

FeNa > 1% ~ ATN

Failing kidney…cannot compensate and leaking sodium thus indicates kidney diagnosis

- **Prerenal**: Decreases Kidney Perfusion: Hypovolemia, CHF, Renal Artery Stenosis, Sepsis, etc
- Remember, contrast-induced nephropathy will often look pre-renal!
- **Intrinsic Renal**: ATN

Steps to success in nephrology

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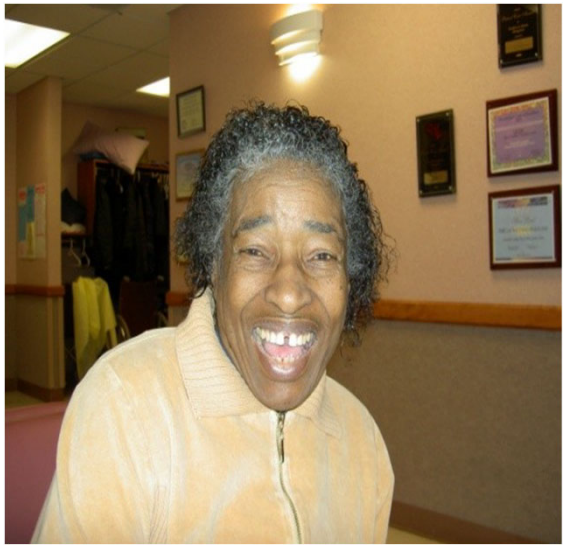
Fun with Kidneys



Sally

78 y/o presents ED nausea and vomiting for 2 days. Unable to keep food down

No available PMH

PE: 110/60 HR 80 sitting

80/55, HR 100 standing

Renal sonogram was unremarkable without hydronephrosis

What is Sally's diagnosis?

~~A. UTI~~

~~B. Acute interstitial nephritis (AIN)~~

C. Pre-renal AKI

D. Post- renal AKI

~~E. Acute tubular necrosis (ATN)~~

Fun with Kidneys

Carrie

85yo with advanced CKD stage 4 (eGFR 28), HTN & uncontrolled type 2 DM with retinopathy who presents to your office with fever, dysuria, malaise and lower abdominal pain x2 days.
BP 125/50, P 105, T 101F
Labs: eGFR 20, SCr 2.5mg/dl, BUN 30mg/dl
UA was negative for leukocyte esterase and positive for nitrite, and positive for glycosuria. 0-2RBC, 25 WBC, 10 WBC casts, UACR <30mg/g

What is Carrie's diagnosis?

A. Post-renal AKI on CKD
B. Pre-renal AKI on CKD
C. Acute tubular necrosis (ATN)
D. Acute Interstitial nephritis (AIN) on CKD
E. Acute Interstitial nephritis (AIN)

Fun with Kidneys

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BP 125/50, P 105, T 101F
Labs: eGFR 20, SCr 2.5mg/dl, BUN 30mg/dL

2 months ago, eGFR was 28,
SCr 2.0, BUN 25mg/dl→AKI on CKD

What is Carrie's diagnosis?

A. Post-renal AKI on CKD
B. Pre-renal AKI on CKD
C. ~~Acute tubular necrosis (ATN~~)
D. Acute Interstitial nephritis (AIN) on CKD
~~E. Acute Interstitial nephritis (AIN~~)

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Fun with Kidneys

Urine cheat sheet for intrinsic kidney injury

	Cystitis	Pyelonephritis	Acute Allergic Interstitial Nephritis	Acute Glomerulonephritis	Nephrotic Syndrome	Ischemic Tubular Necrosis
Protein	0	0	0	++	++++	0
RBCs	0	0	+	+++	0	0
WBCs	++++	++++	++++	+	0	0
RBC Casts	0	0	0	++++	0	0
WBC Casts	0	+++	+++	0	0	0
Granular Casts	0	+	+	+	0	++++

Steps to success in nephrology

1. What is the kidney function?
2. What do you see in the urine analysis?
3. How much proteinuria?
4. What do you see on kidney ultrasound?

Carrie

85yo with advanced CKD stage 4 (eGFR 28), HTN & uncontrolled type 2 DM with retinopathy who presents to your office with fever, dysuria, malaise and lower abdominal pain x2 days. Pyelonephritis

Sonogram showed isoechoic kidneys R and L measuring 8.5cm & 8.3cm with evidence of medical renal disease. No hydronephrosis

What is Carrie's diagnosis?

~~A. Post-renal AKI on CKD~~

~~B. Pre-renal AKI on CKD~~

~~C. Acute tubular necrosis (ATN)~~

D. Acute Interstitial nephritis (AIN) on CKD

~~E. Acute Interstitial nephritis (AIN)~~

Fun with Kidneys

Mickey

52 y/o male with history of HTN since mid 20s.
No family history, he was adopted
Meds: chlorthalidone and prn ibuprofen
Presents to your office with complaints of intermittent sharp pains in left lower flank and back for past few months. Denies nausea, vomiting, diarrhea, gross hematuria, dysuria, fever/chills.
PE: BP 150/92, P 85. Unremarkable
Labs: Na^+ 138, K^+ 5.8, SCr 1.3, BUN 18, eGFR 66
UA: negative heme/protein, negative RBC/WBC, no casts
UACR (urine albumin/creatinine ratio) 200mg/g

What is causing Mickey's kidney dysfunction?

A. AKI
B. CKD
C. AKI on CKD

Fun with Kidneys

Steps to success in nephrology

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2. What do you see in the urine analysis?
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Trending of kidney function
Differentiating acute vs chronic

Mickey's renal function

SCr	eGFR	UACR	Year
0.77	124	<30	1999
0.99	96	50	2010
1.2	75	70	2012
1.3	66	200	2019

Mickey

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UA: negative heme/protein, negative RBC/WBC, no casts
UACR (urine albumin/creatinine ratio) 200mg/g

What is causing Mickey's kidney dysfunction?

~~**A. AKI**~~

B. CKD

~~**C. AKI on CKD**~~

Fun with Kidneys

Criteria for CKD

1. Decreased GFR ≤ 60ml/min for > 3 months

OR

2. Markers of Kidney Damage for > 3 months
   - Albuminuria ≥ 30mg/g
   - Urinary sediment abnormalities

     Ex: microhematuria
   - Electrolyte and other abnormalities due to tubular disorders
   - Structural abnormalities detected by imaging

     Ex: ADPKD (polycystic kidney disease)
   - History of kidney transplantation

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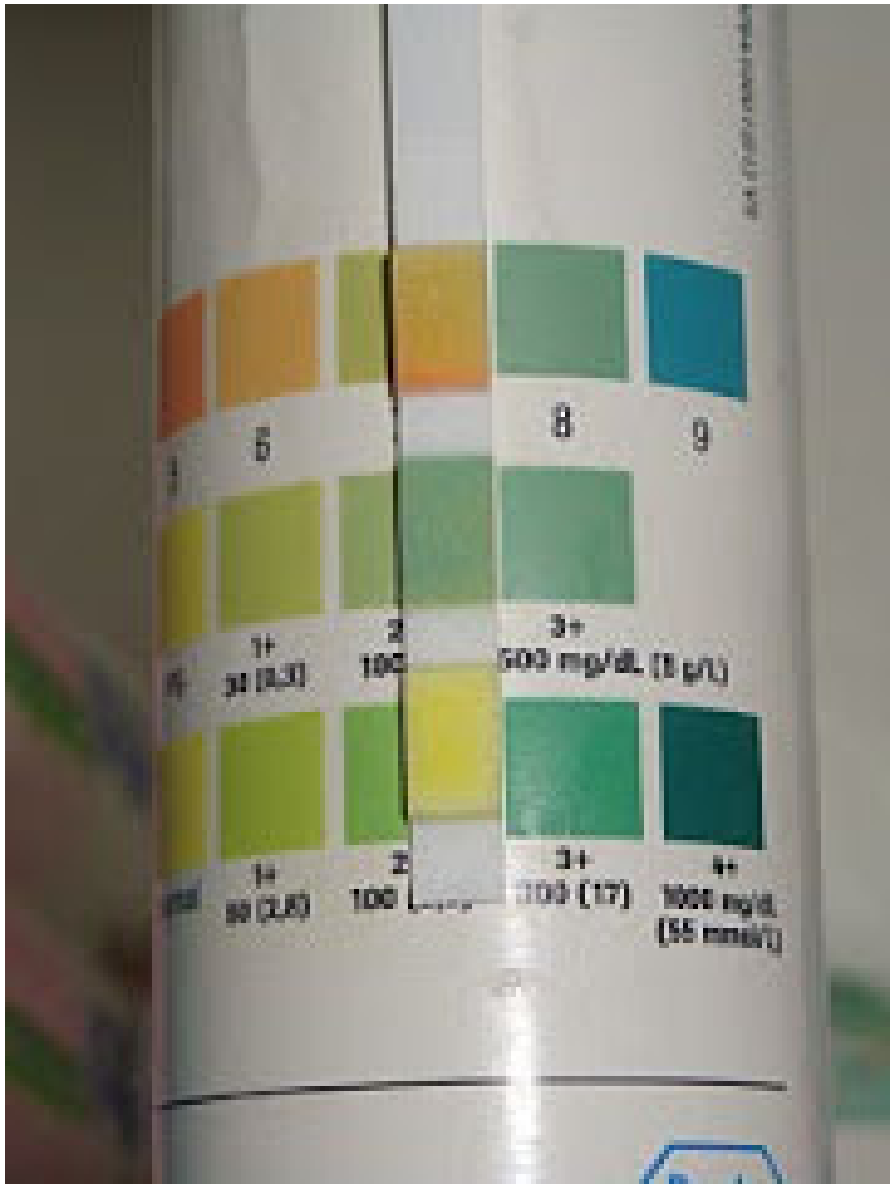
Fun with Kidneys

Proteinuria???



negative	0 mg/dL
trace	15-30 mg/dL
1+	30-100 mg/dL
2+	100-300 mg/dL
3+	300-1000 mg/dL
4+	>1000 mg/dL

Quantification of Proteinuria

1. 24 hour total urinary protein <150mg is NORMAL

OR

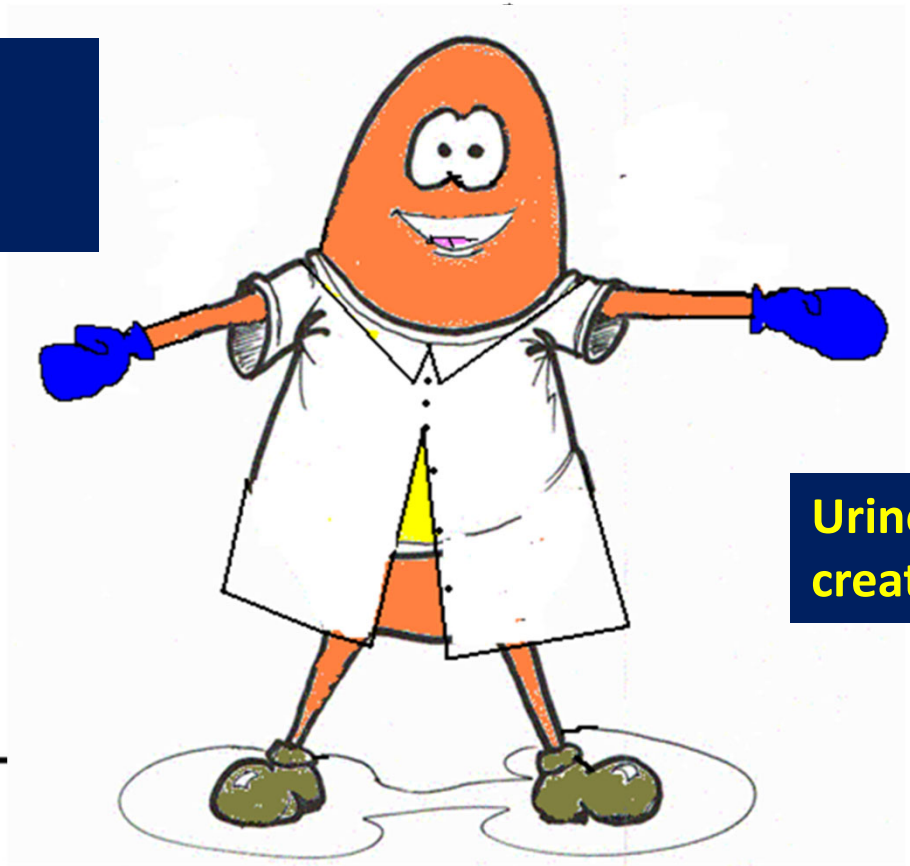
2. Random spot

    UPCR: protein/Cr <150mg/g is WNL
    UACR: albumin/Cr <30mg/g is WNL

Adjustment for urinary concentration is made by relating the urine protein concentration to the urine creatinine concentration

Quantifying ALBUMINURIA: Where is the UA dipstick?

Urine protein to creatinine ratio (UPCR)



Urine albumin to creatinine ratio (UACR)

Special Thanks to Scott and White of Temple TX for use of their kidney comic

Fun with Kidneys

Nephrotic vs Non-nephrotic

- **Nephrotic >3 grams of protein in 24hrs**
- Syndrome associated with

1. Edema
2. HTN
3. Rapid decline in kidney function
4. Oval Fat bodies
5. Hypercoag state
6. Hypertriglyceridema

- ALL PROTEINURIA is TOXIC to the kidney
- ALL PRTOTEINURIA has bad prognosis
- More PROTEINURIA worse prognosis
- PROTEINURIA is not just marker of kidney disease

IT IS TOXIC to KIDNEY

Fun with Kidneys

Albuminuria Necessary to Stage CKD AND Determine Prognosis

CKD classified based on:

- GFR (G)
- **Albuminuria (A)**

KDIGO 2012

GFR categories (ml/min/1.73 m^2) Description and range				Albuminuria categories Description and range		
				A1	**A2**	**A3**
				Normal to mildly increased	Moderately increased	Severely increased
				<30 mg/g <3 mg/mmol	30-299 mg/g 3-29 mg/mmol	≥300 mg/g ≥30 mg/mmol
	G1	Normal or high	≥90	Monitor 1	Monitor 1	Refer* 2
	G2	Mildly decreased	60-90	Monitor 1	Monitor 1	Refer* 2
	G3a	Mildly to moderately decreased	45-59	Monitor 1	Monitor 2	Refer 3
	G3b	Moderately to severely decreased	30-44	Monitor 2	Monitor 3	Refer 3
	G4	Severely decreased	15-29	Refer* 3	Refer* 3	Refer 4+
	G5	Kidney failure	<15	Refer 4+	Refer 4+	Refer 4+

Fun with Kidneys

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A. Nephrolithiasis
B. Pyelonephritis
C. Chlorthalidone + ibuprofen
D. ADPKD, autosomal dominant polycystic kidney dz

Fun with Kidneys

Steps to success in nephrology

1. What is the kidney function? Acute vs chronic
2. What do you see in the urine analysis?
3. How much proteinuria?
4. What do you see on kidney ultrasound?

Fun with Kidneys

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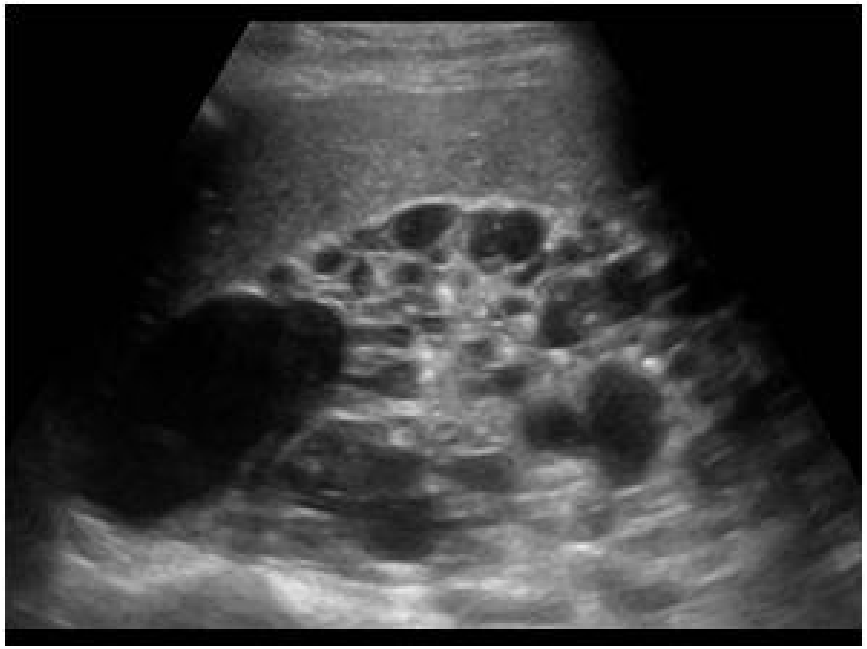
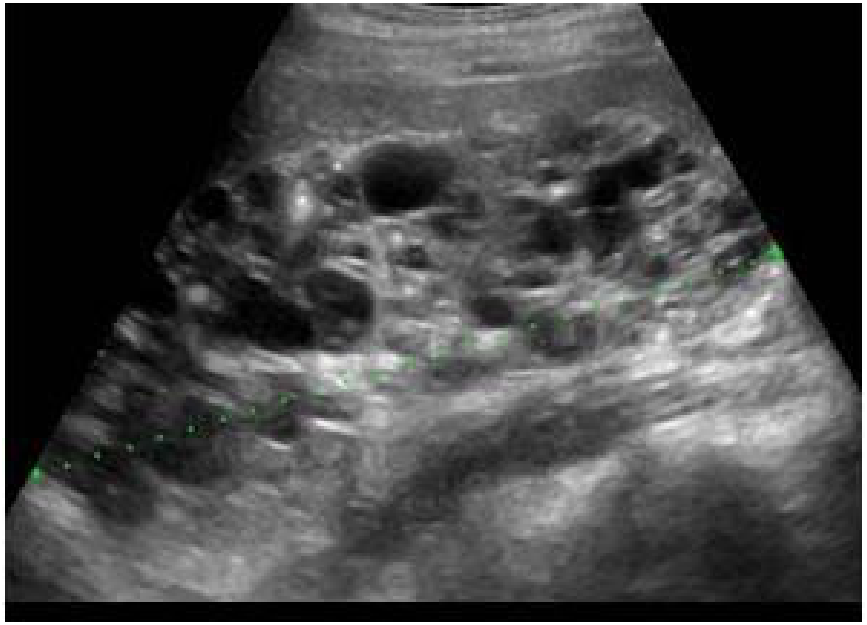
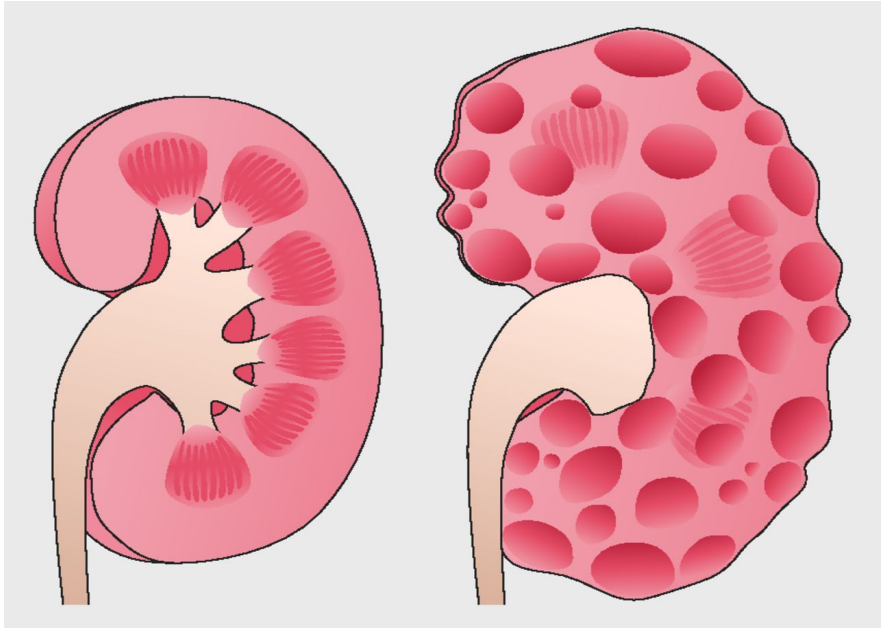
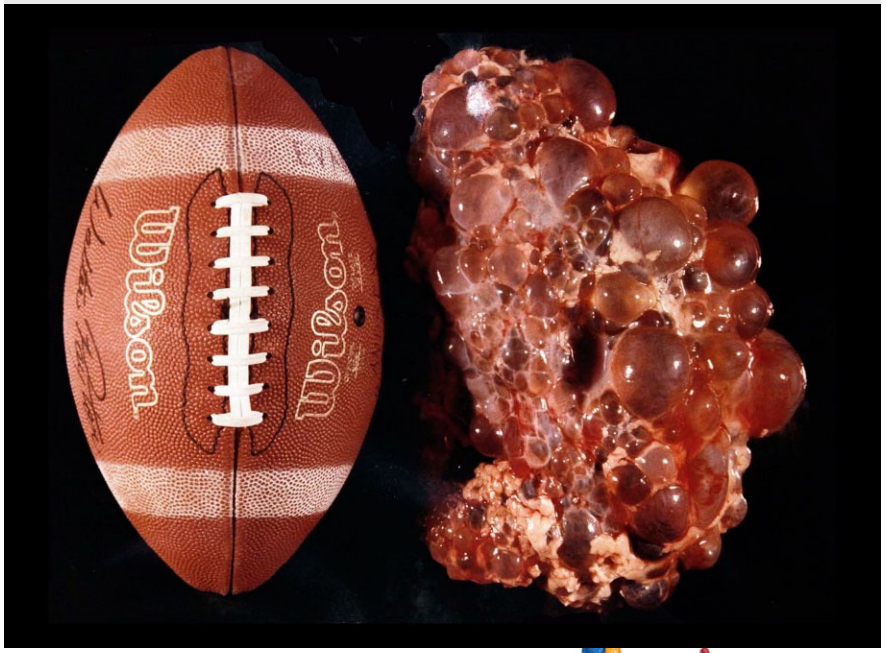
Fun with Kidneys









Fun with Kidneys

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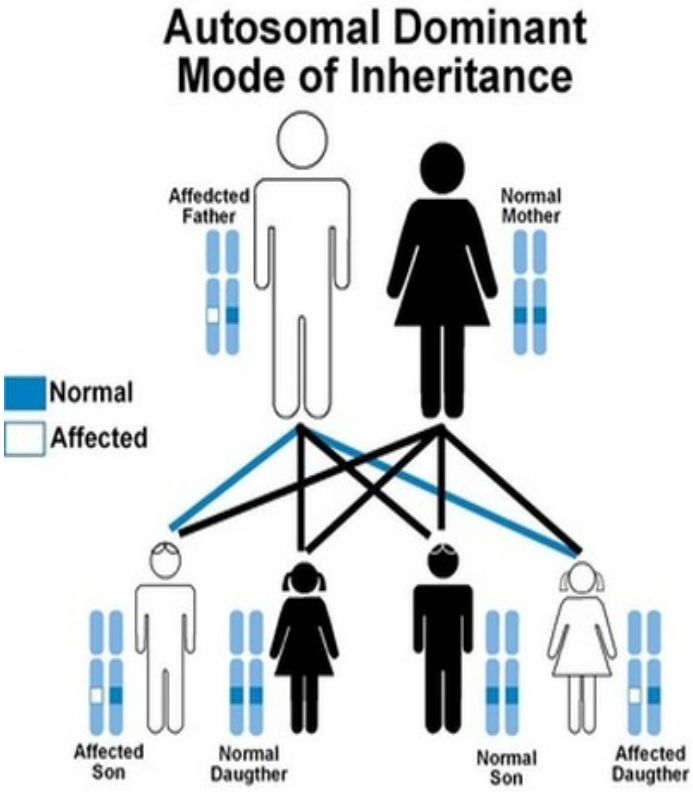
No family history, he was adopted

IF we knew his family history, this would have been an easy diagnosis

PE: BP 150/92, P 85.



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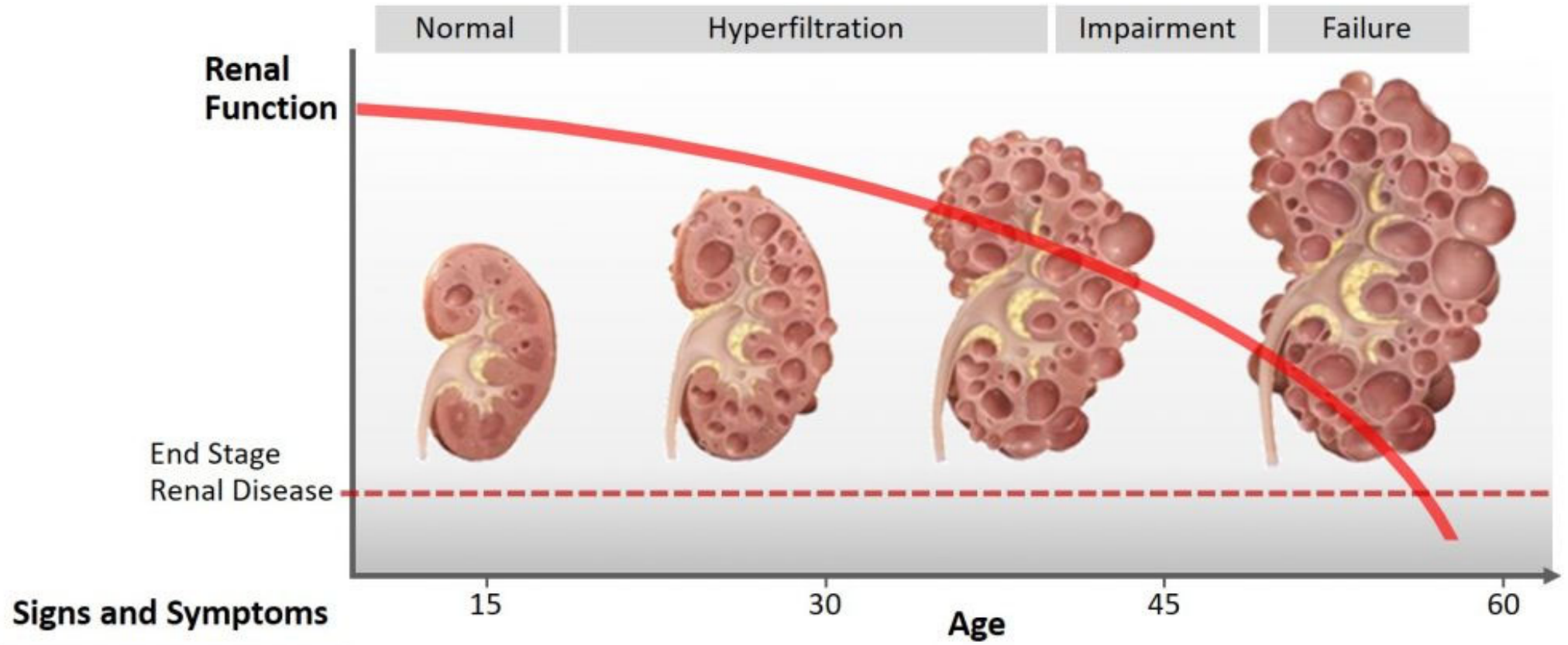
Fun with Kidneys

Typical Disease Progression in ADPKD



Signs and Symptoms

Chronic
- Hypertension
- Dull Pain
- Proteinuria

Acute
- Pain
- Hematuria
- Urinary Tract Infection
- Cyst Rupture
- Cyst Infection
- Kidney Stones

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What is the cause(s) for Mickey's hyperkalemia?

A. **ACEi usage**
B. **Salt substitute**
C. **Chlorthalidone**
D. **Ibuprofen**
E. **CKD**

Fun with Kidneys

Drug-Induced Hyperkalemia

Mechanisms	Drugs
Impaired RAS function	ACEi/ ARBs, β-blockers Heparin NSAIDs, COX-2 inhibitors
Altered K^+ distribution	Insulin antagonists Hypertonic solutions Digoxin, β-blockers
Increased K^+ load	Salt substitutes, K^+ or herbal supplements PRBC infusions
Reduced K^+ excretion	K^+ sparing diuretics (MRAs) Calcineurin inhibitors TMP-SMX (Bactrim), pentamidine

K/DOQI Guidelines on Hypertension and Antihypertensive Agents in CKD

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D. Ibuprofen

E. CKD

Fun with Kidneys

Screening for kidney disease in DM

PMH: Type 2 DM x 15 yrs with retinopathy, obesity, CKD stage 2A3, smoker
Meds: metformin 500mg daily, carvedilol 6.25mg BID
LABS: SCr 1.3mg/dl, eGFR 63ml/min, sK+ 4.0mmol/L, A1C 9.2%, UACR 1500mg/g
PE: BP 145/90, P 80, weight 255lbs, BMI 33, +trace LE edema

Presents for 6 month follow up on DM management.

How would you screen for kidney disease in DM?

1. **Evaluate kidney function by looking at eGFR**
2. **Evaluate kidney function by looking at SCr**
3. **Quantitate albuminuria by ordering urine albumin/creatinine (UACR)**
4. **Check urine dipstick for evidence of albuminuria**
5. **Combination of answers**

Fun with Kidneys

Screening for CKD in DM
ADA recommendation

- Screen for presence of kidney disease in ALL patients with type 2 diabetes and in type 1 with duration of >5 years
- Annual basis

1. eGFR = CKD if <60ml/min for > 3 month
2. UACR = CKD if >30mg/g for > 3 month

- If UACR >300mg/g, then check UACR 2x/year to GUIDE THERAPY?

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First steps in treatment of CKD in DM

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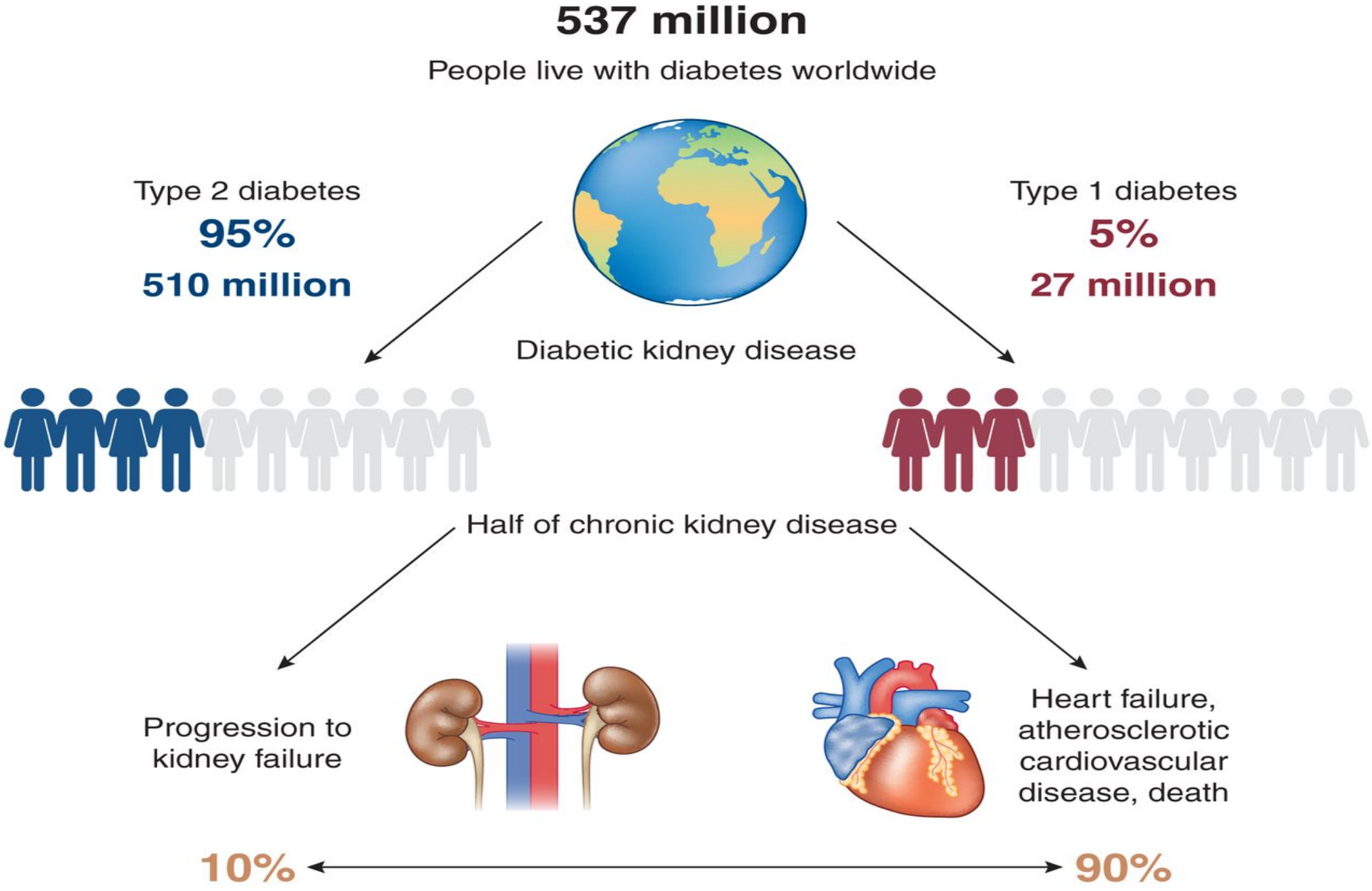
First step(s) in treatment of CKD in DM?

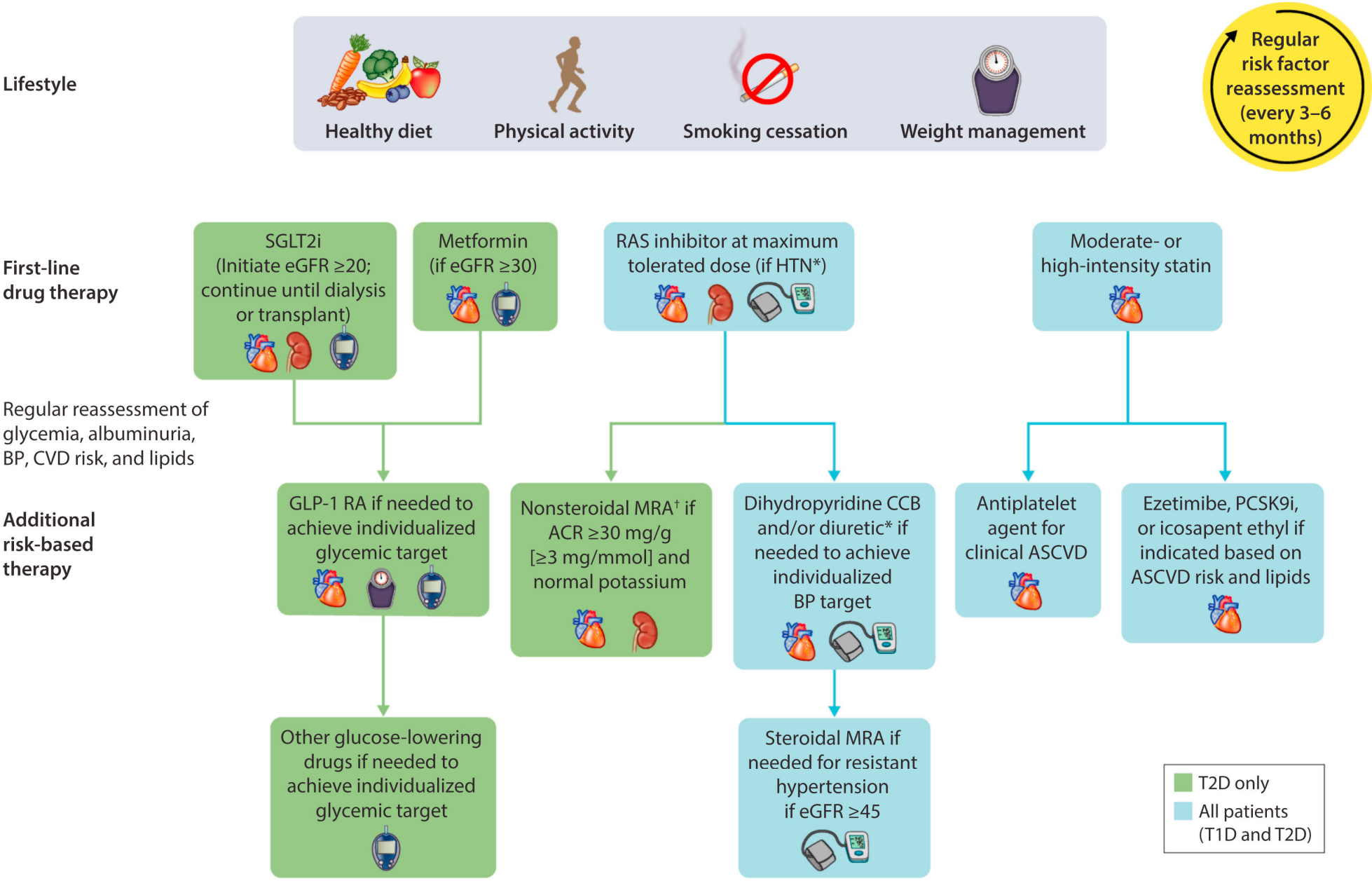
1. Refer to dietician for DM education
2. Address lifestyle changes
3. Refer to weight management specialist
4. Address smoking cessation
5. All of the above

Fun with Kidneys

Diabetic kidney disease risk



Management of DKD



Kidney International 2022 102990-999DOI: (10.1016/j.kint.2022.06.013)

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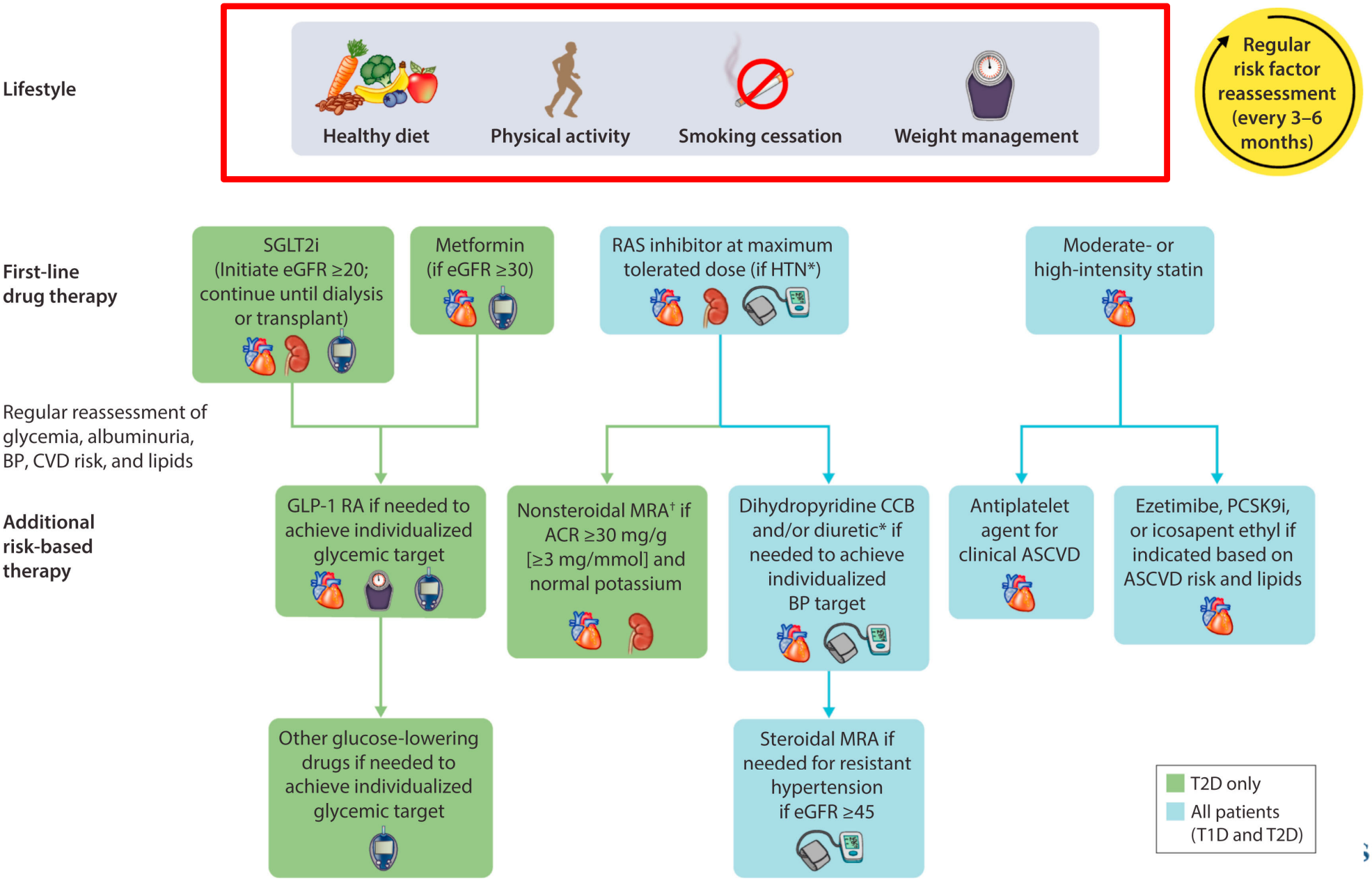

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Treatment of CKD in DM

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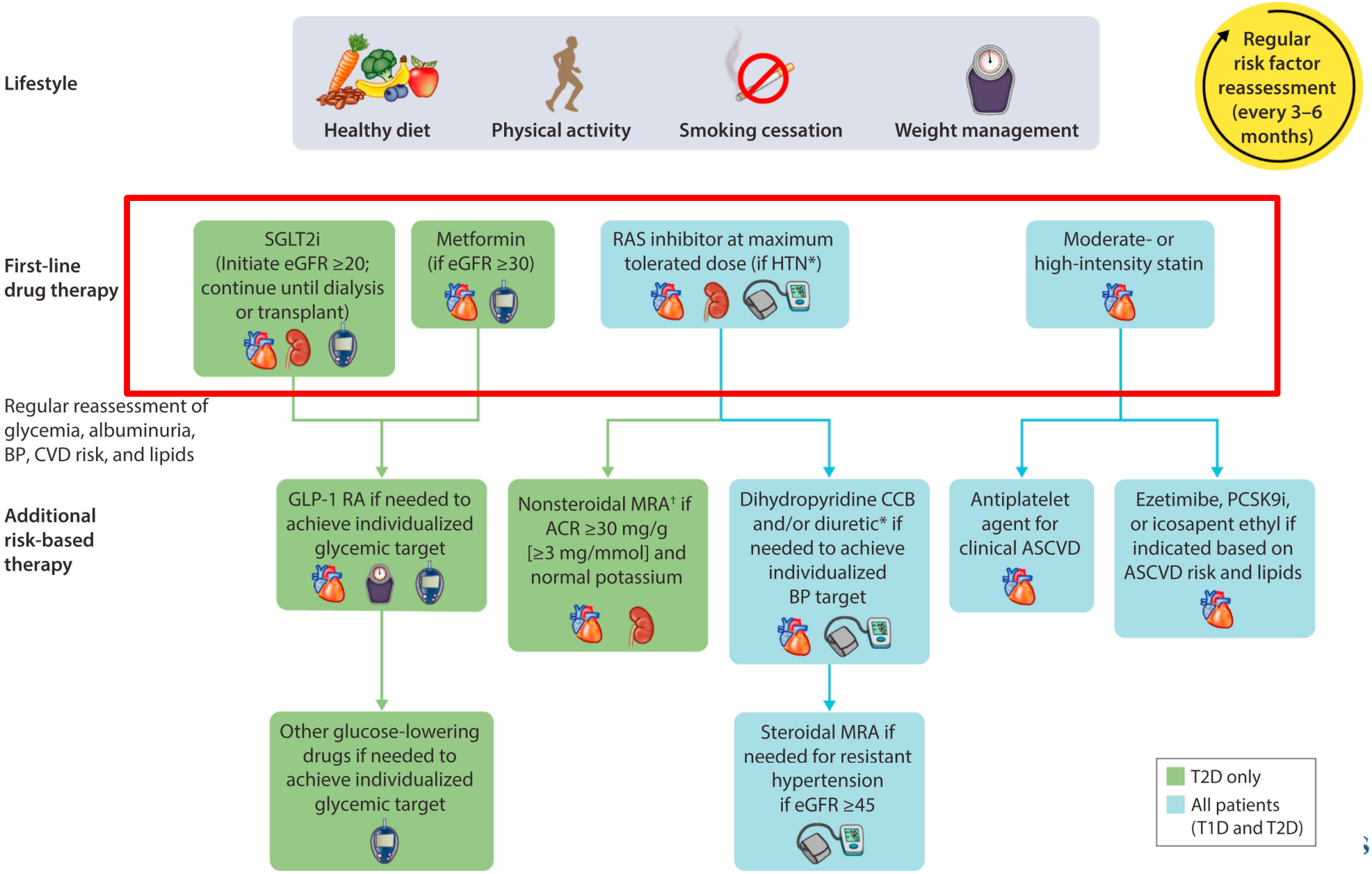
What change would you make for Tx of CKD in DM?

1. Start dapagliflozin 10mg daily
2. Order cholesterol profile
3. Start losartan 25mg daily
4. Consider increasing metformin
5. A combination of multiple answers and if so which answers?

Fun with Kidneys

Management of DKD



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Treatment of CKD in DM

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Permissive "hypercreatininemia"

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LABS: **Increase in SCr 1.3→1.6mg/dl**, **eGFR 49ml/min,** sK+ 5.0 mmol/L, A1C 8.2%, **UACR 1500→800mg/g**

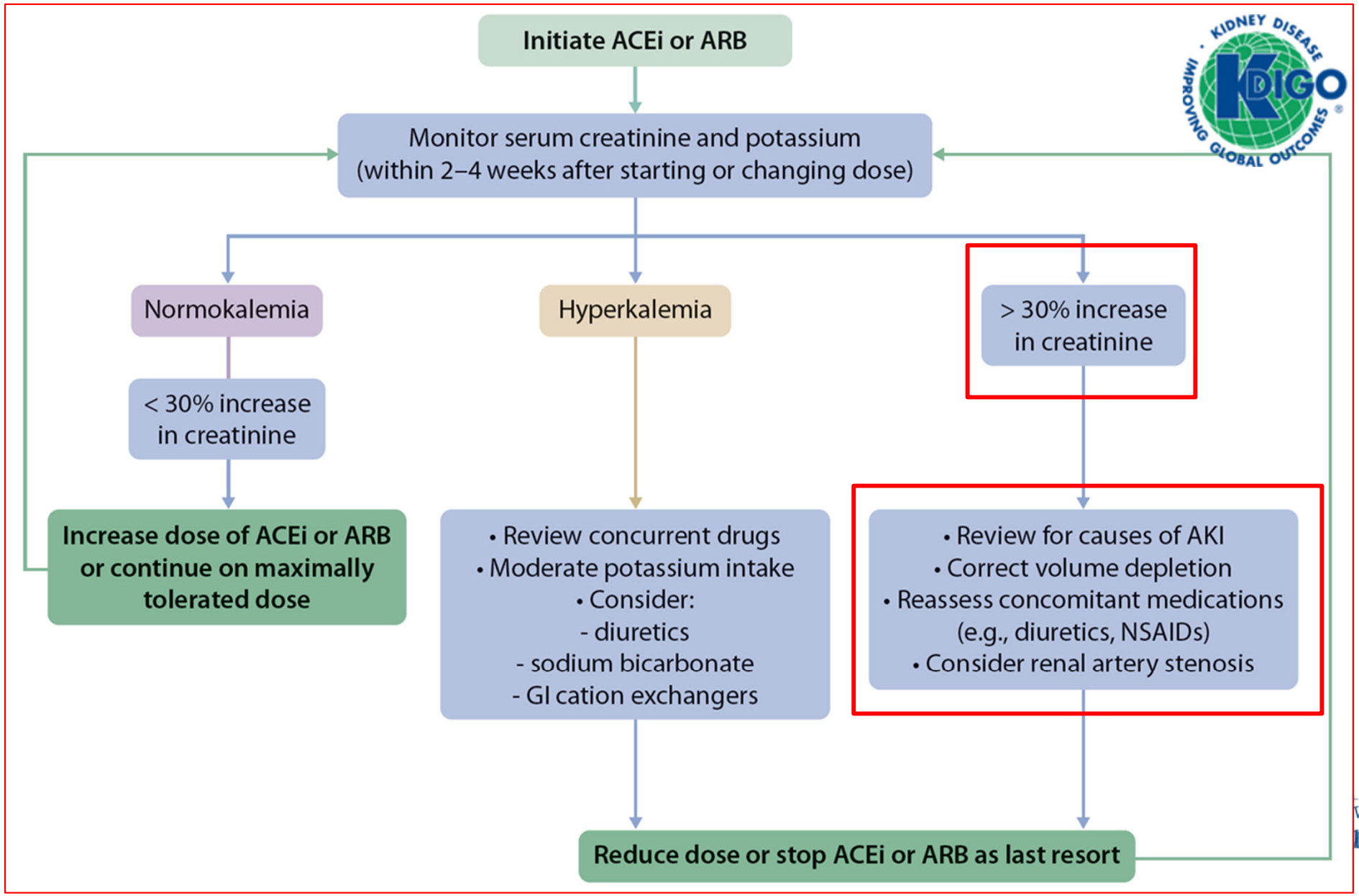
PE: BP 138/85

What would you do next?

1. Look for evidence of pre-renal AKI. Hypotension? Usage of NSAIDs? Vomiting/diarrhea?
2. Decrease losartan to 12.5mg and dapagliflozin to 5mg daily
3. Order renal sonogram with dopplers to ensure no renal artery stenosis
4. Repeat SCr and eGFR in 2 weeks and if stable, continue losartan and dapagliflozin
5. Combination of answers

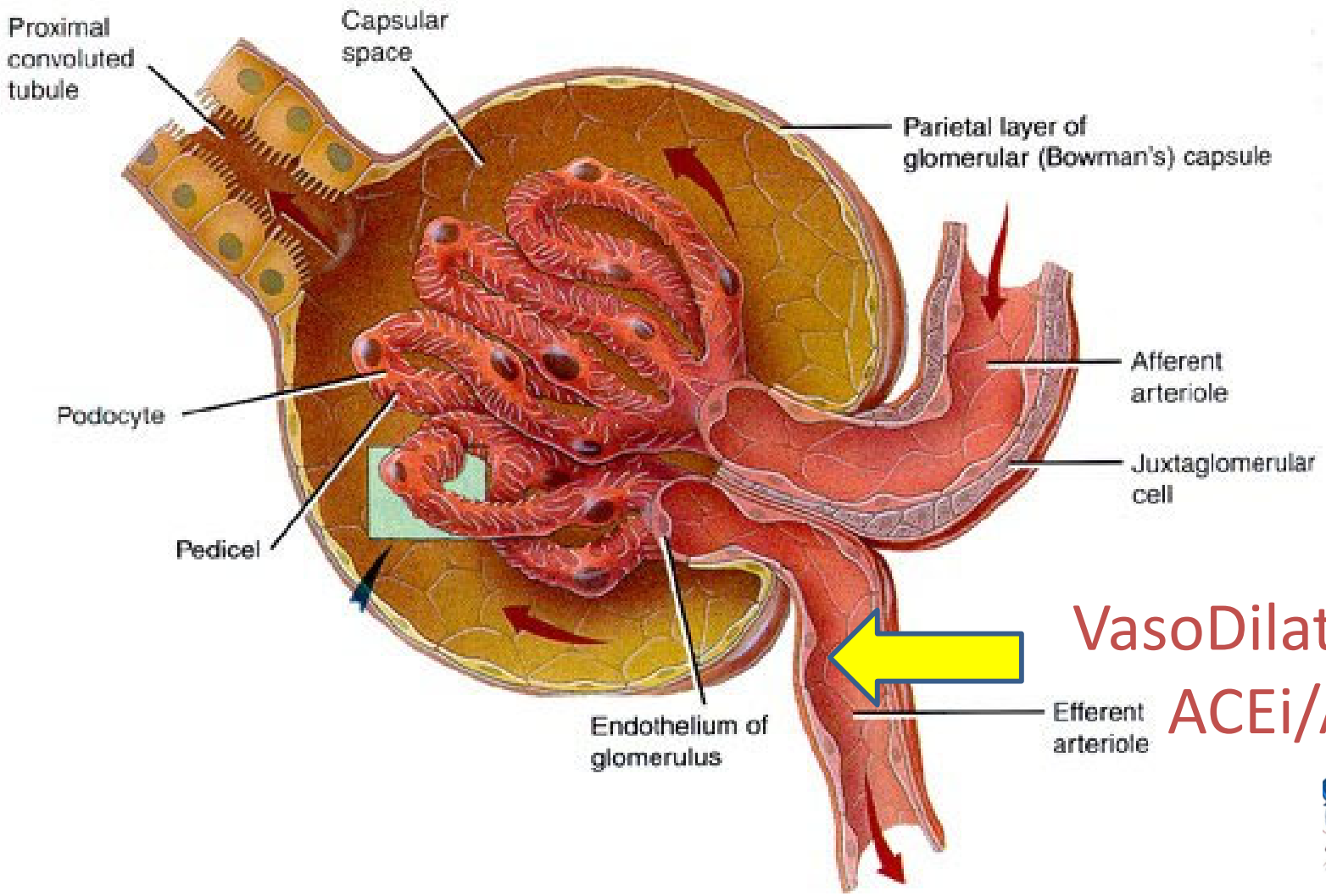
Fun with Kidneys

RAS blockade with albuminuria



Vaso-dilation efferent arteriole=

↓ GFR + ↓ albuminuria

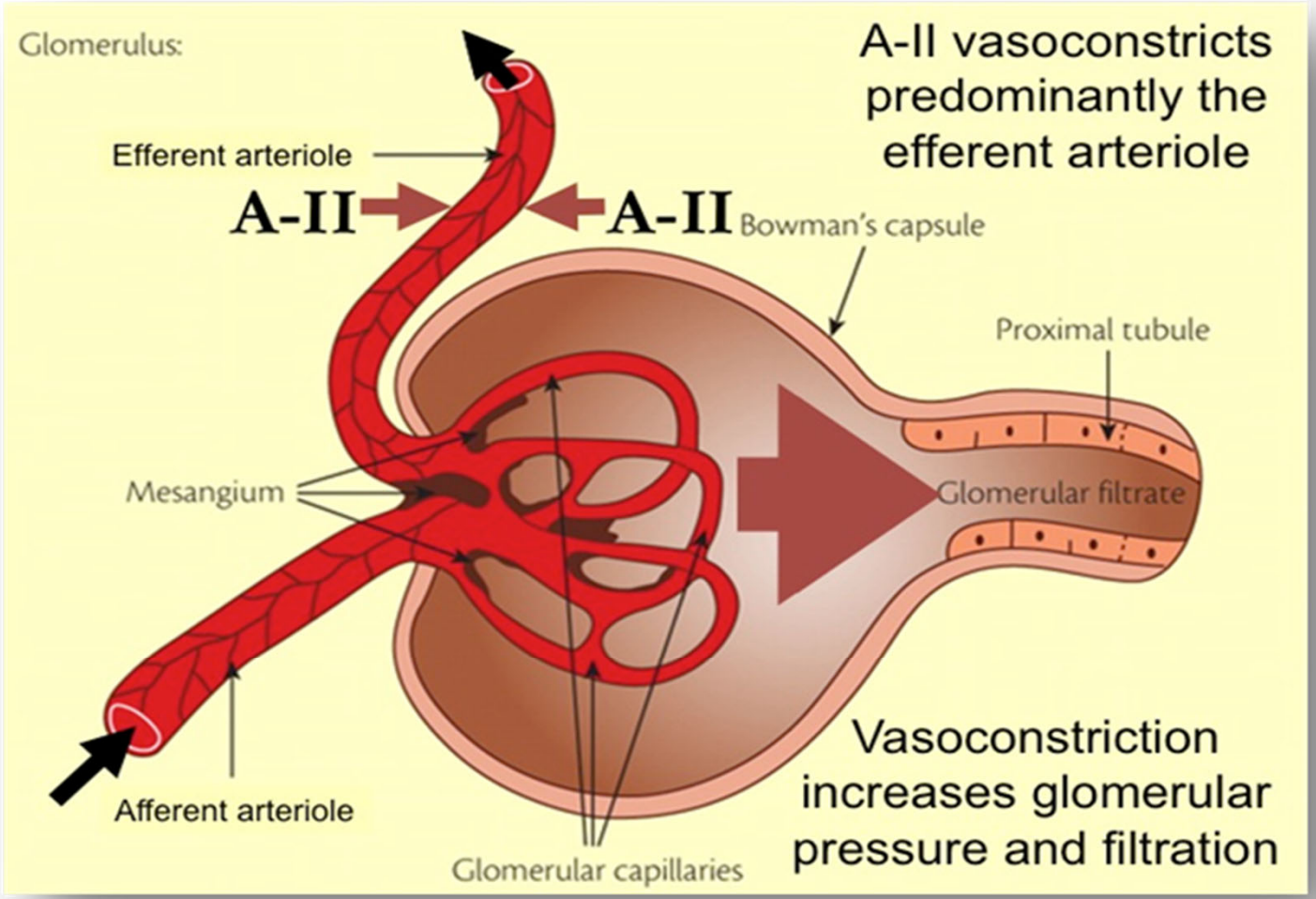


VasoDilation via ACEi/ARBs

Fun with Kidneys

ACEi or ARBs even with advanced CKD

"Permissive hypercreatinemia"

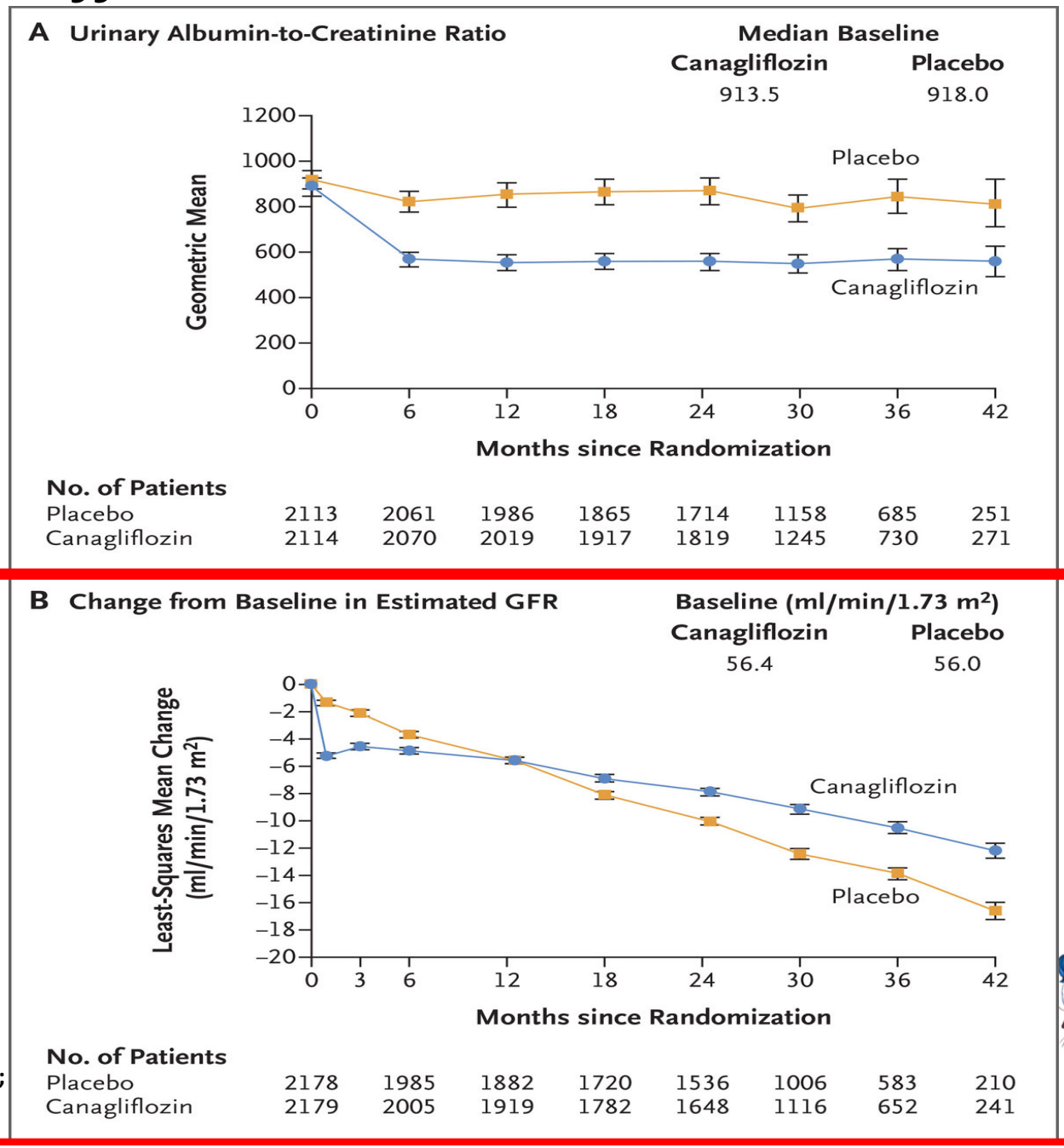


20-30%→40% bump in SCr is normal. This should be expected. Repeat labs in 2 weeks

Fun with Kidneys

CREDENCE- SGLT2i

Effects on GFR and albuminuria



V Perkovic et al. N Engl J Med 20 9; 380:2295-2306.

SGLT2 Inhibitors

Outcome trials in type 2 DM

- Reduce risk of major adverse CVD Events
  - 3-point MACE (myocardial infarction, stroke, CVD death)
  - Heart failure (empagliflozin, canagliflozin, dapagliflozin)
  - CVD death (empagliflozin, dapagliflozin)
- Decrease severe albuminuria, decline in eGFR, and ESKD. SGLT2i enhance natriuresis, cause intravascular volume contraction and alter intra-renal hemodynamics, which probably contribute to beneficial effects on blood pressure, body weight and albuminuria

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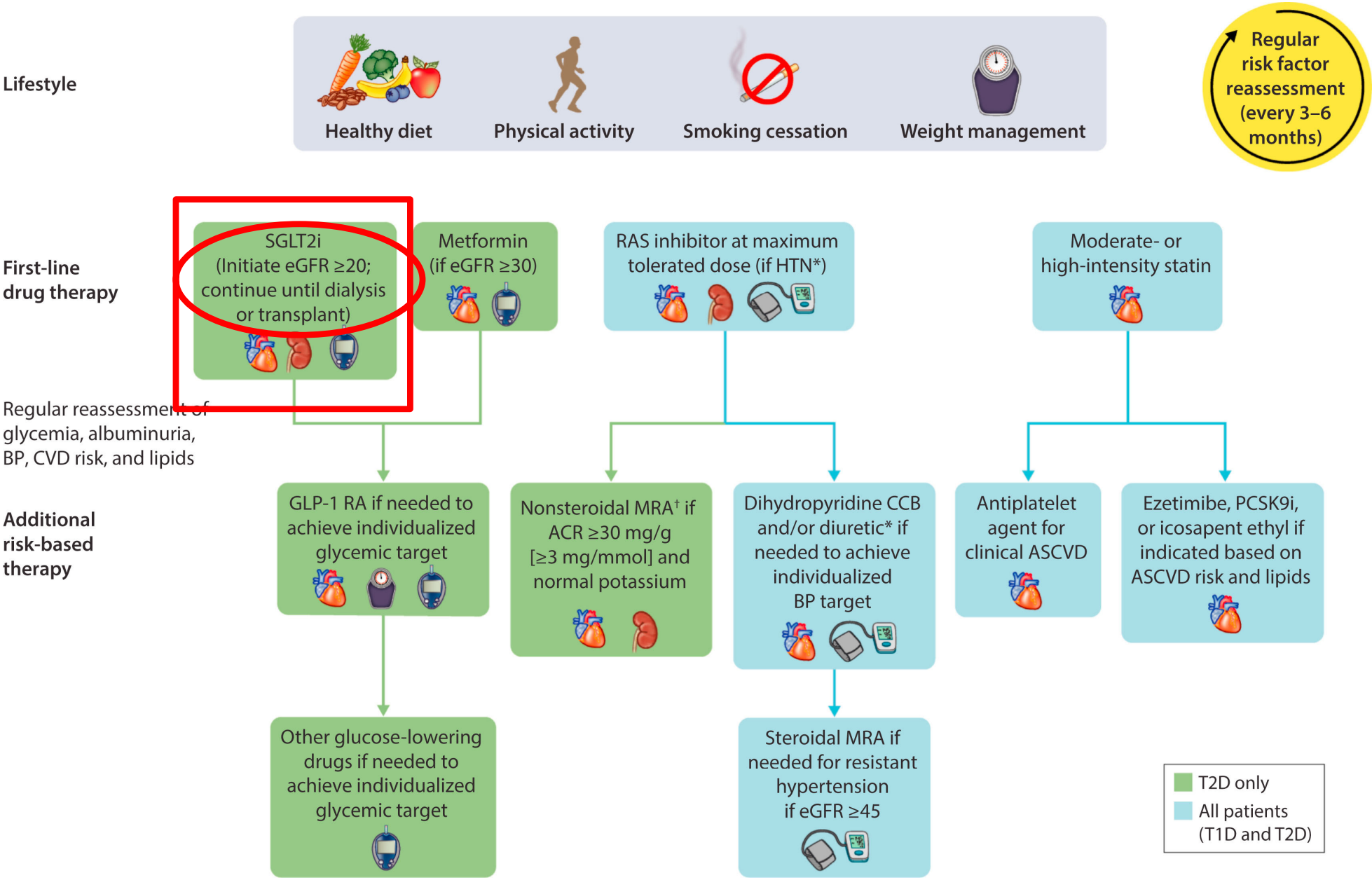
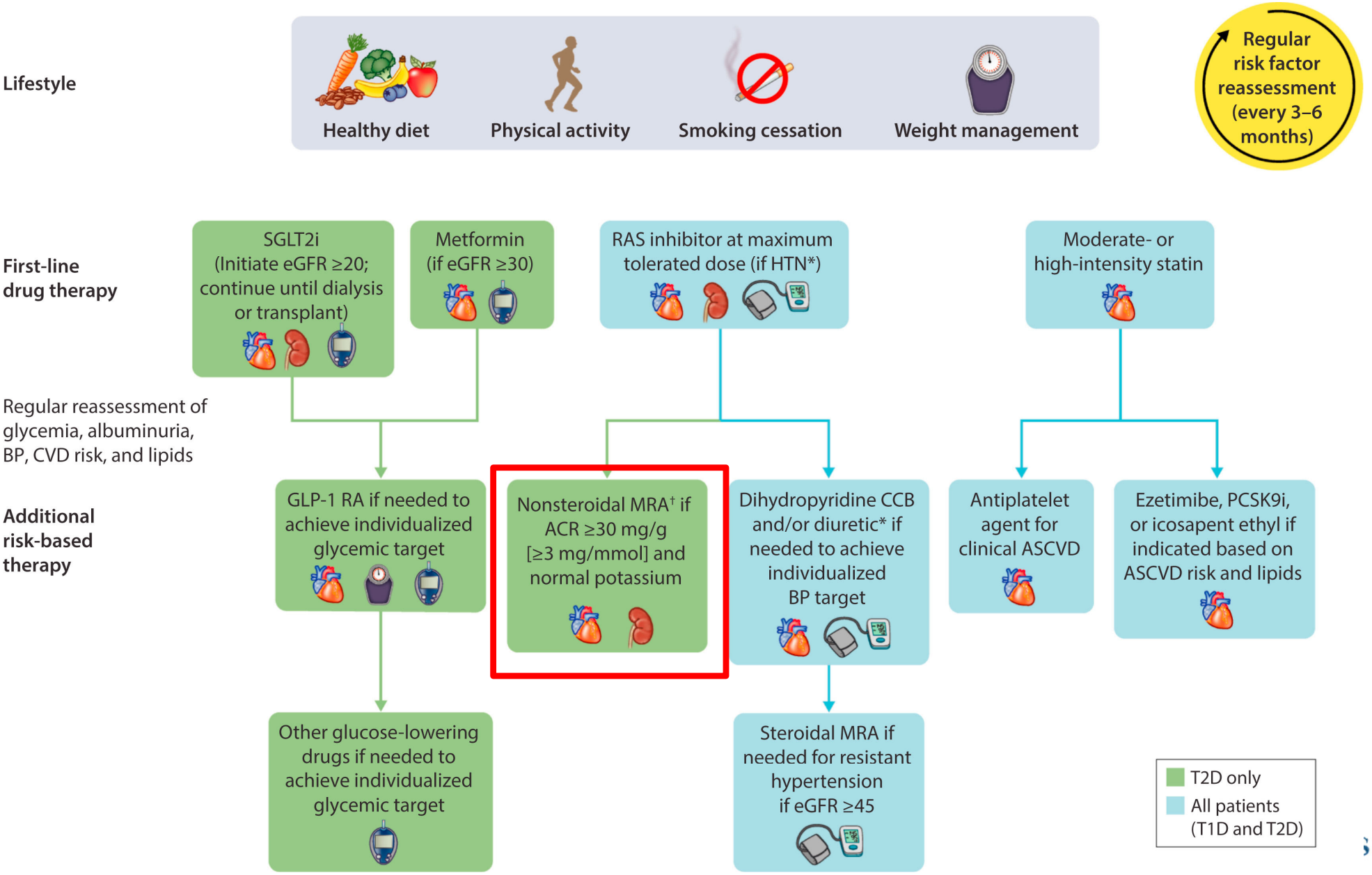
Management of DKD



Kidney International 2022 102990-999DOI: (10.1016/j.kint.2022.06.013)

Management of DKD



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Questions?

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