U&Es, Kidneys, and Ultrasound.

What does your clinician want to know?

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Learning Objectives

- Glean the Clinical Perspective
- Basics of renal Physiology
- What & Why of U & E’s
- Case Scenarios
- Building an Imaging approach to abnormal U&E’S

Renal Medicine

- Prevention, diagnosis and treatment of kidney disease.
- Management of
  - acute kidney injury(AKI)
  - chronic kidney disease(CKD)
- Institution of renal replacement therapy – Dialysis /Transplant

https://gettingitrightfirsttime.co.uk/medical_specialties/renal-medicine/

Problem Statement

- 1 in 5 emergency admissions affected by AKI
- *Can be a CAUSE or CONSEQUENCE*
- Moderate to severe CKD (stages 3-5) : 2.6 million people (6% of UK s adult population)
- 56,200 i.e 1227/million population currently receive RRT

TYPES OF KIDNEY DISEASE

AKI

- Kidneys lose function ABRUPTLY
  - over hours to days
- REVERSIBLE
  - in most cases

CKD

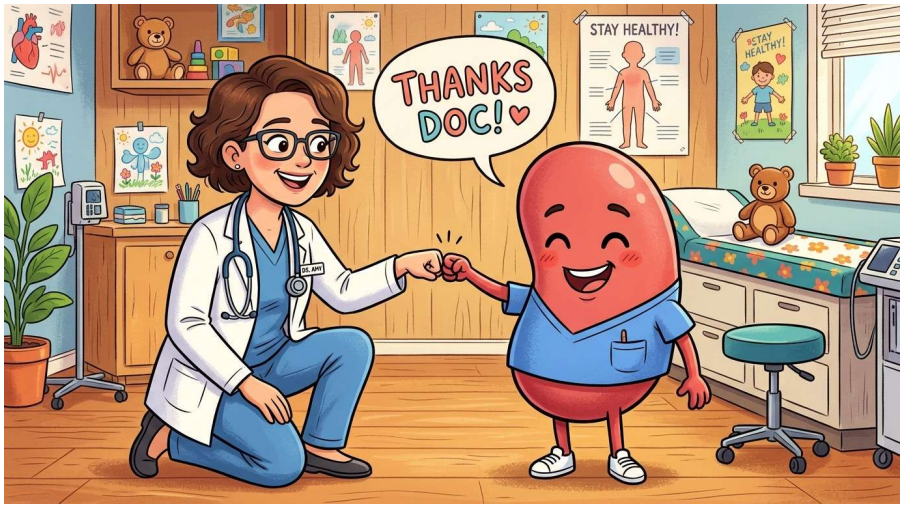
- Slow & progressive damage
  - typically 3 months
- Partially reversible
  - In early and moderate stages
  - Eventually progresses to ESRD

CKD HEAT MAP


uACR Nu
Lower than 30
A 1
eGFR number
CKD Stage
90 or higher
G 1
60-89
G 2
45-59
G 3 a
30-44
G 3 b
15-29
G 4
15 or lower
G 5

TREATMENT GOALS

AKI



Complete recovery

CKD

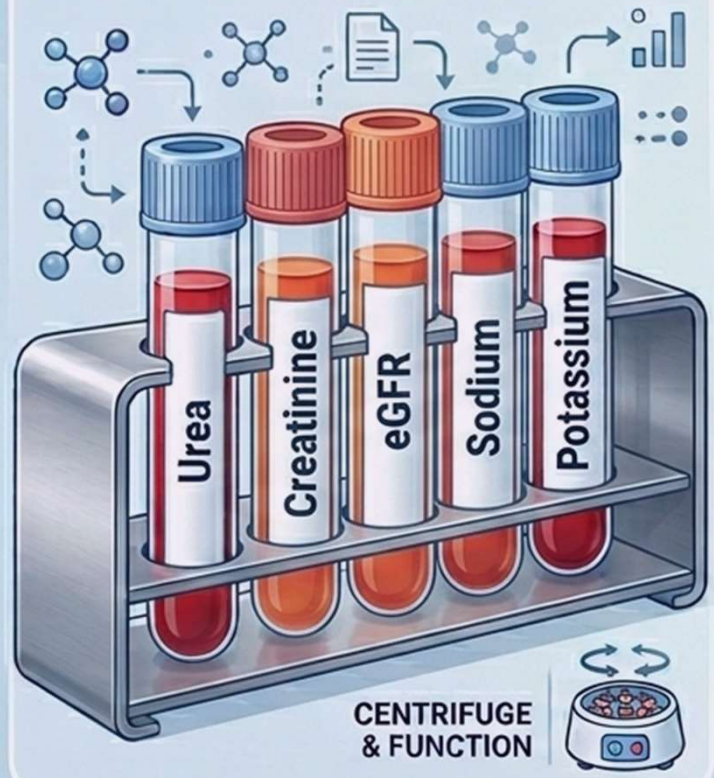
Delay progression

You cannot defeat your enemies until you know who they are.

Anthony Horowitz

NEPHROLOGY DIAGNOSTIC ARMAMENTARIUM

U&E



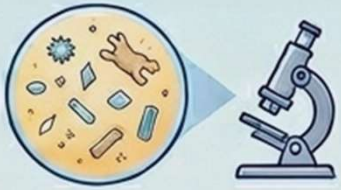
Urine Tests

URINALYSIS (Protein, Glucose, Blood, pH)

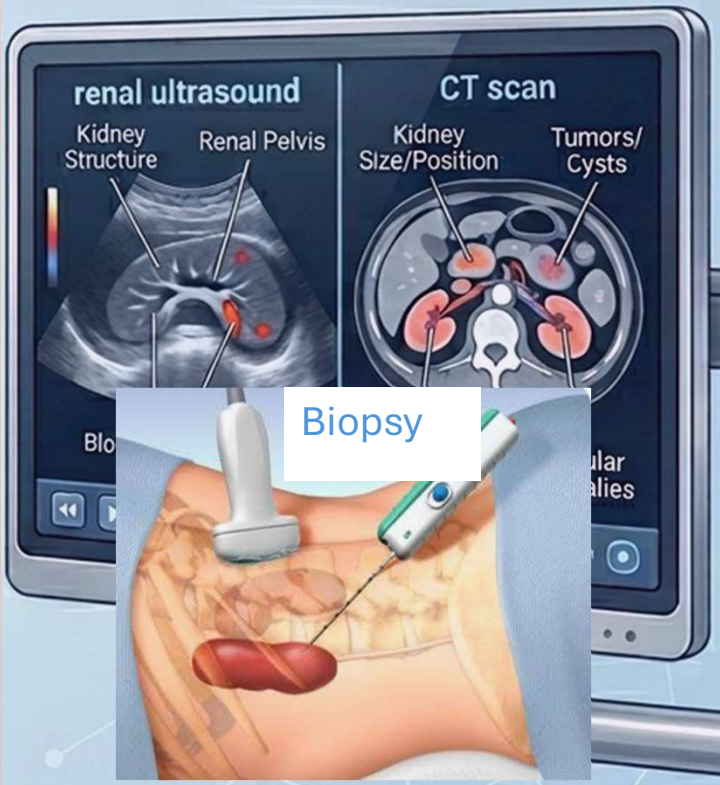
24-HOUR URINE COLLECTION

URINE ALBUMIN/CREATININE RATIO (ACR)

URINE SEDIMENT & CASTS



Imaging (US, CT)

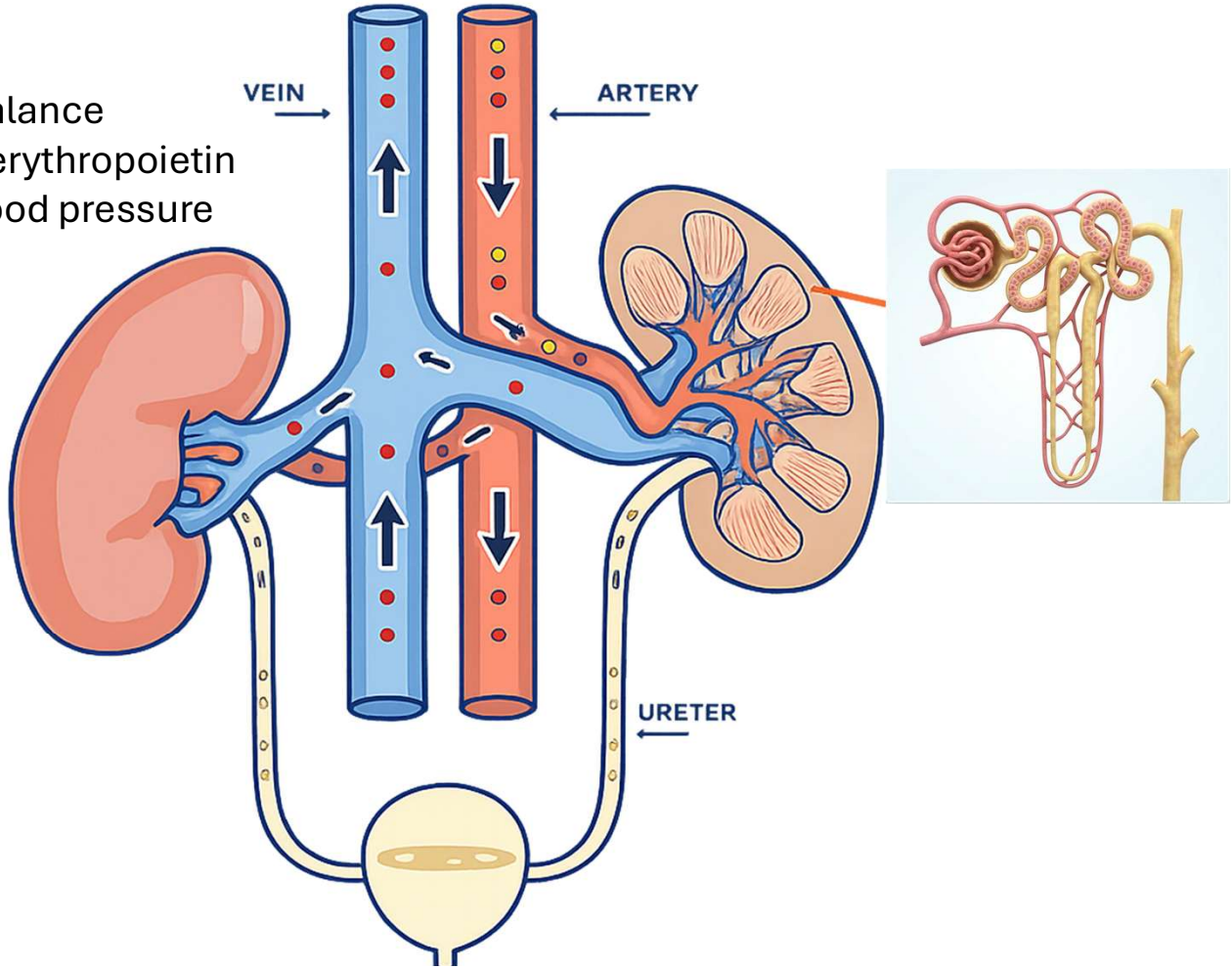


COMPREHENSIVE KIDNEY HEALTH ASSESSMENT

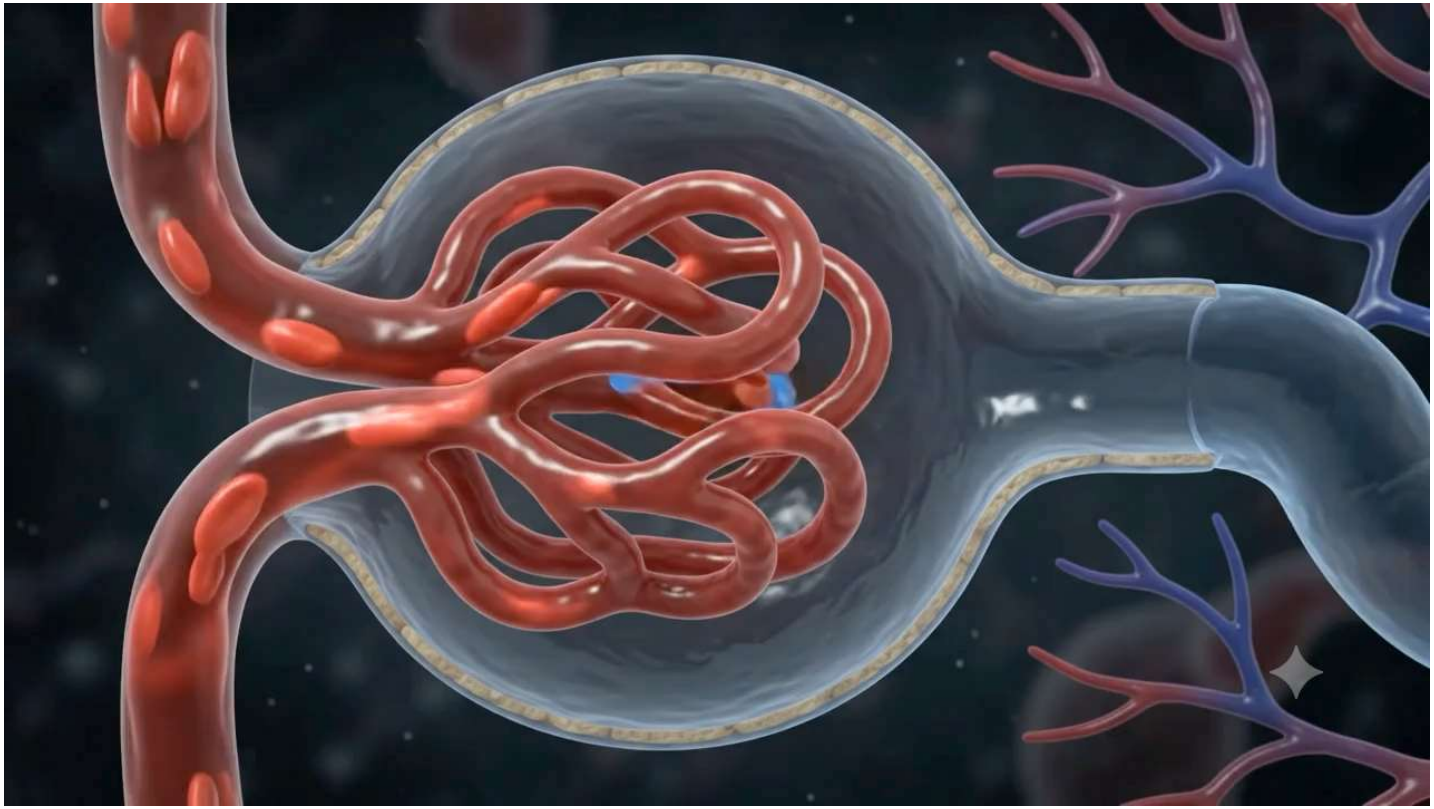
KIDNEY DISEASE STAGING & MONITORING

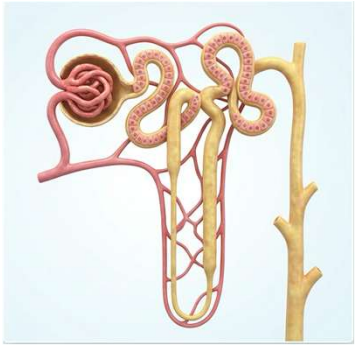
RENAL FUNCTIONS

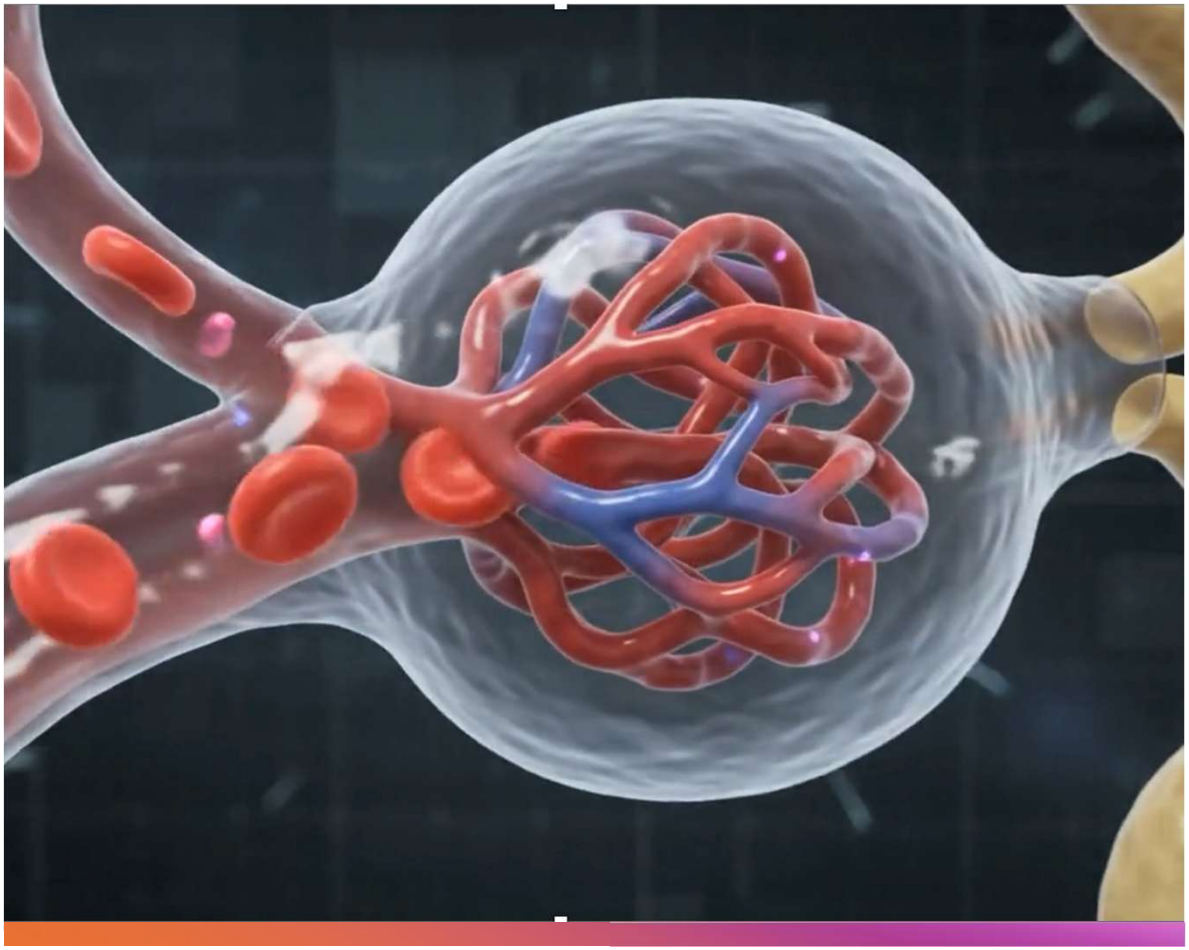
1. Filtration
2. Electrolyte balance
3. Synthesis of erythropoietin
4. Regulates blood pressure



FILTRATION - REABSORPTION = EXCRETION

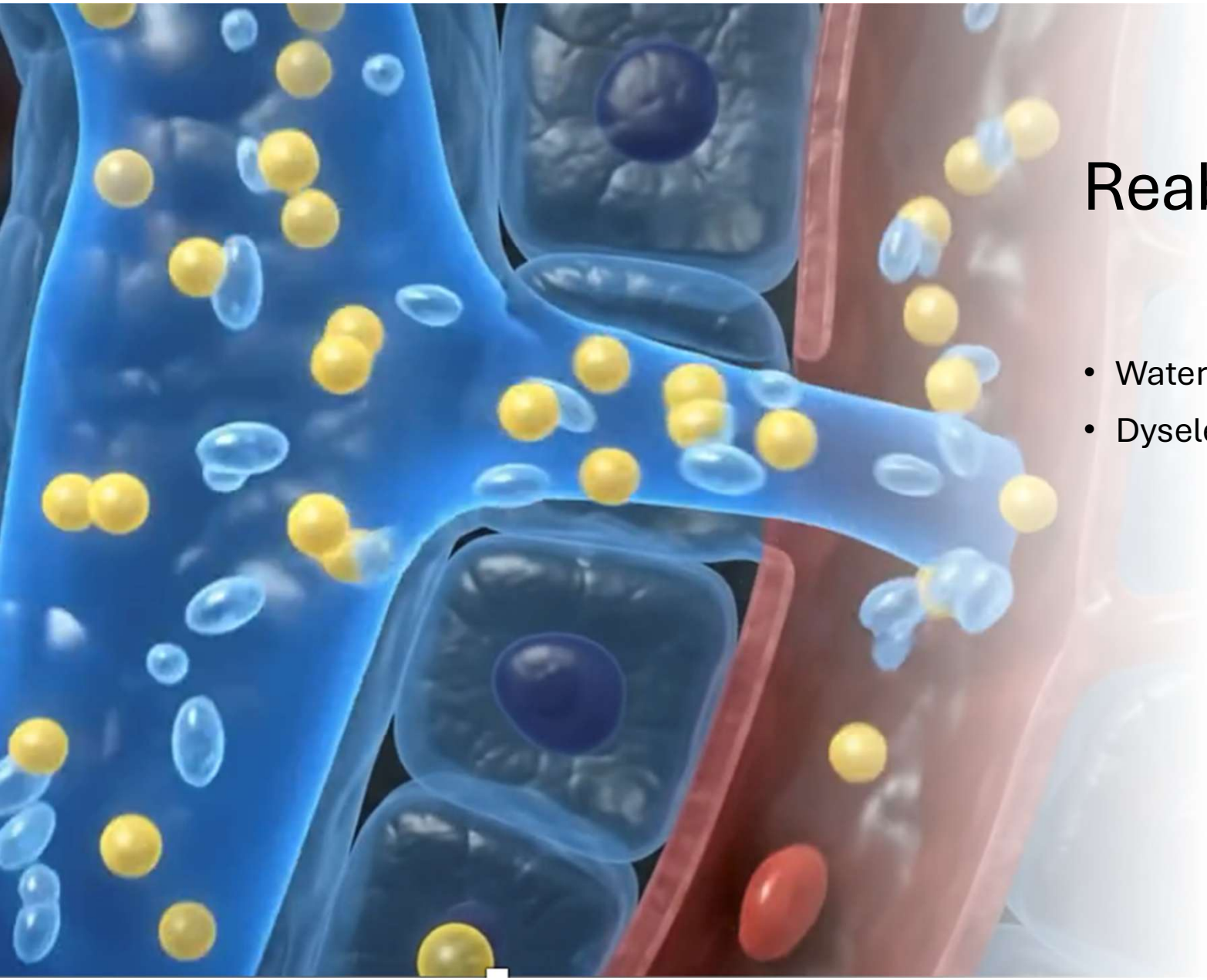






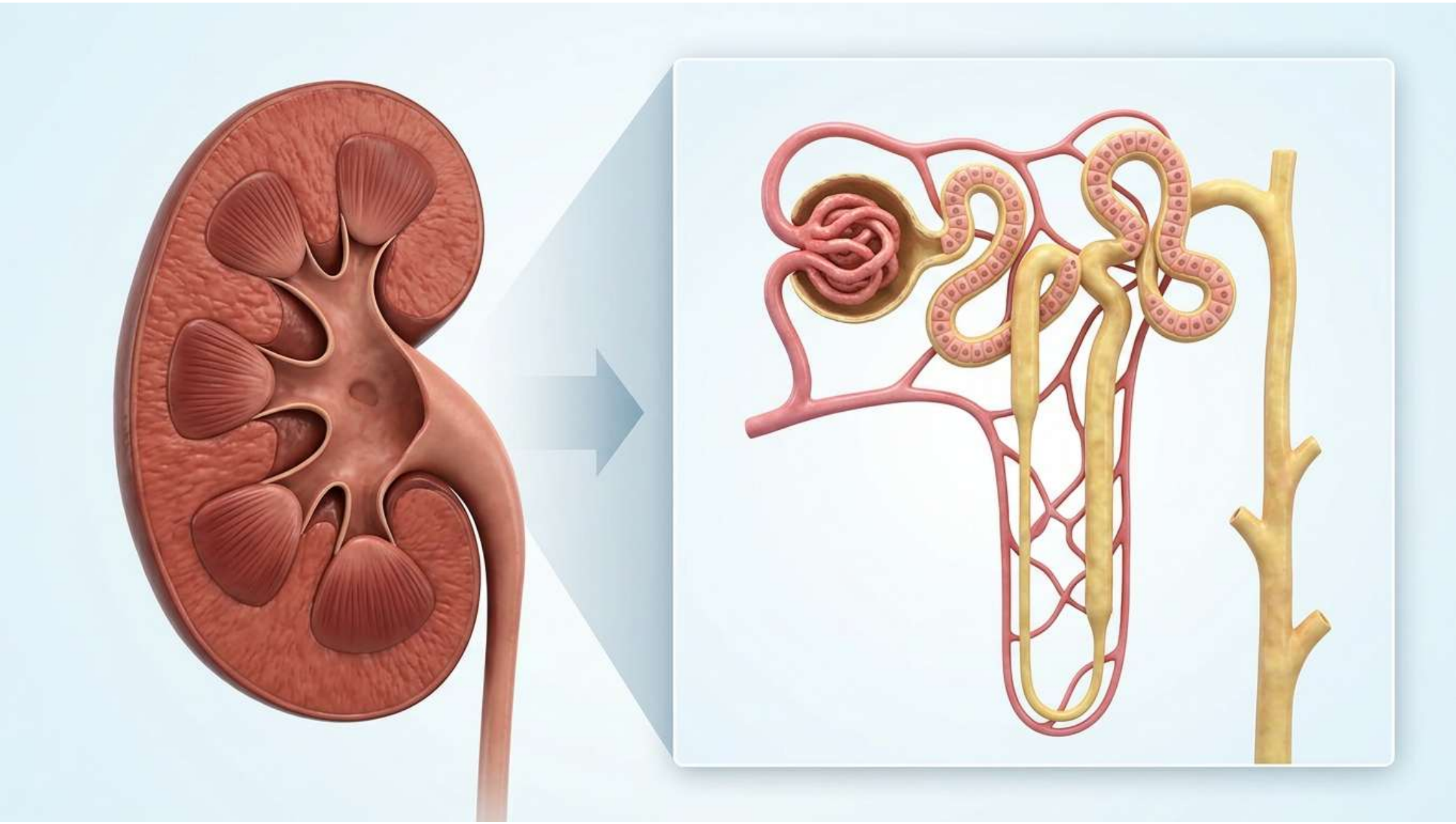
Filtration - Glomerulus

- Urea & Creatinine levels go up in blood
- Protein and blood cells leak, levels go up in urine



Reabsorption

- Water
- Dyselectolytemia



like the NHS, CKD copes remarkably well...
right up until the walls start falling down

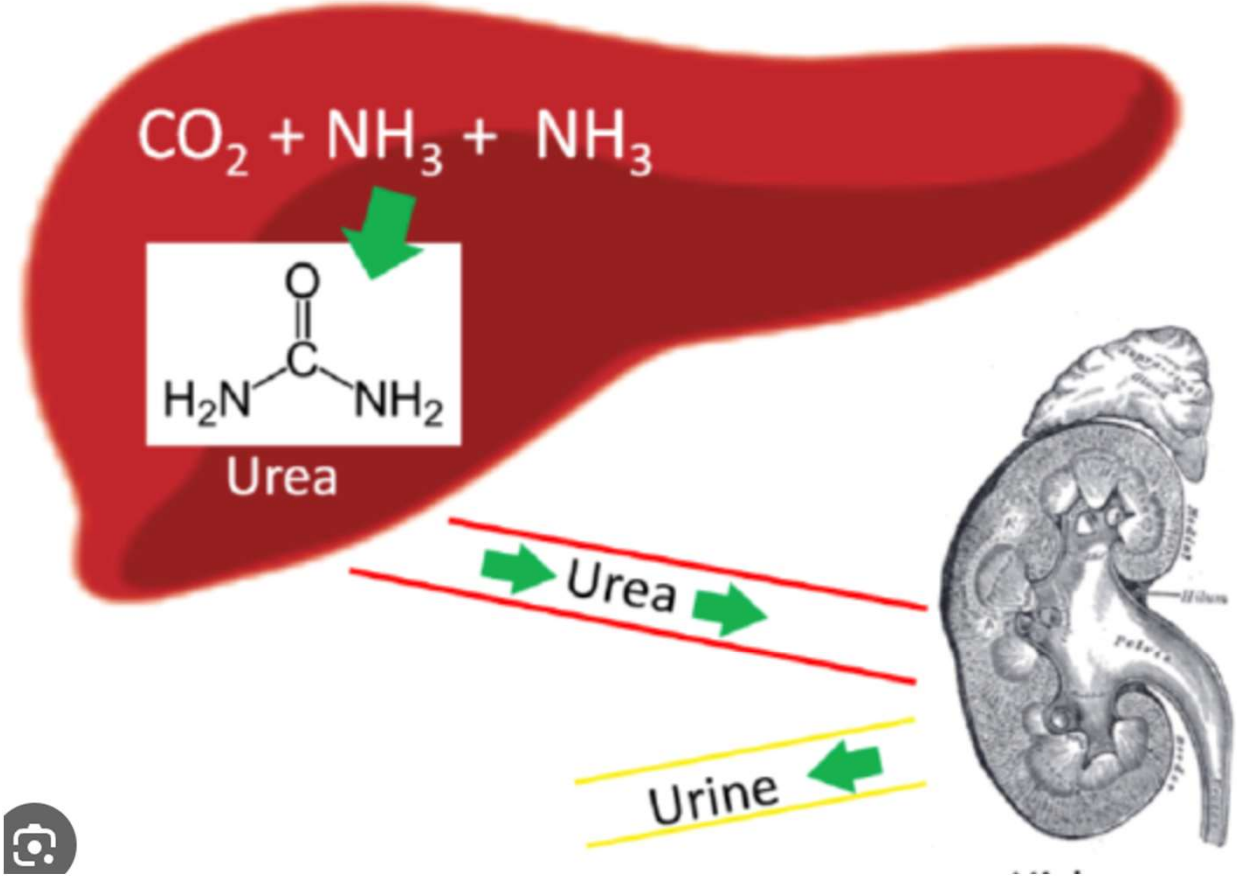
WHY do U & E s ?

- Assess renal function
- Monitor chronic kidney disease
- Safe drug use and dosage adjustment
- Investigative – confusion, abnormal ECG s, Fatigue

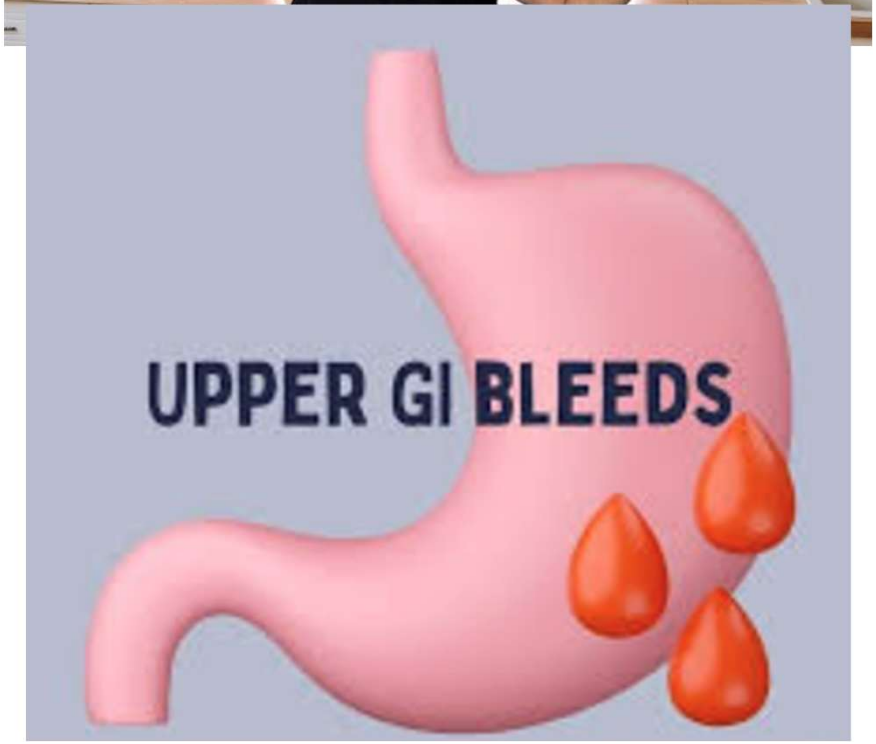
WHAT is included in U & E ‘ s?

- Urea
- Creatinine
- Sodium (Na+)
- Potassium (K+)
- eGFR (estimated Glomerular Filtration Rate)

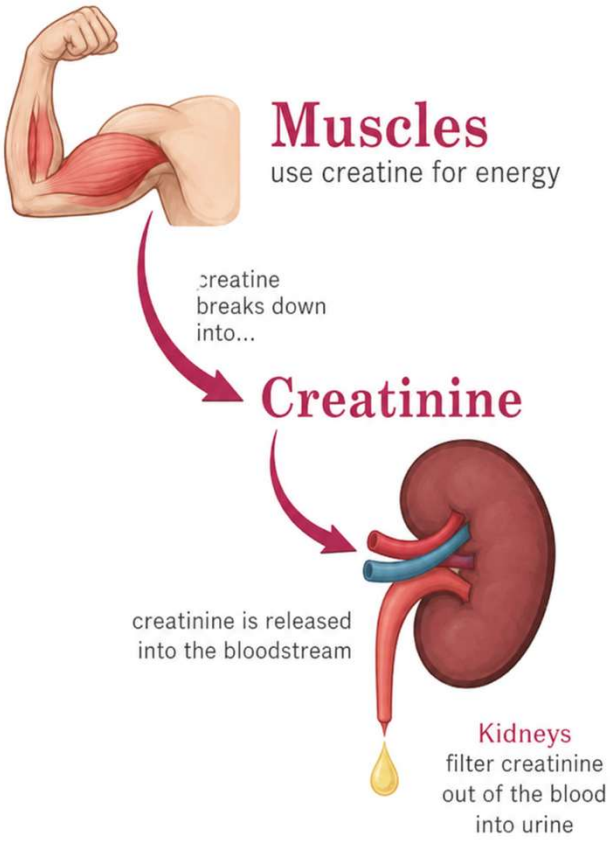
Urea


$CO_2 + NH_3 + NH_3$
H_2N
C
O
NH_2
Urea
Urea
Urine


CHICKEN SHAKE


UPPER GI BLEEDS

Creatinine

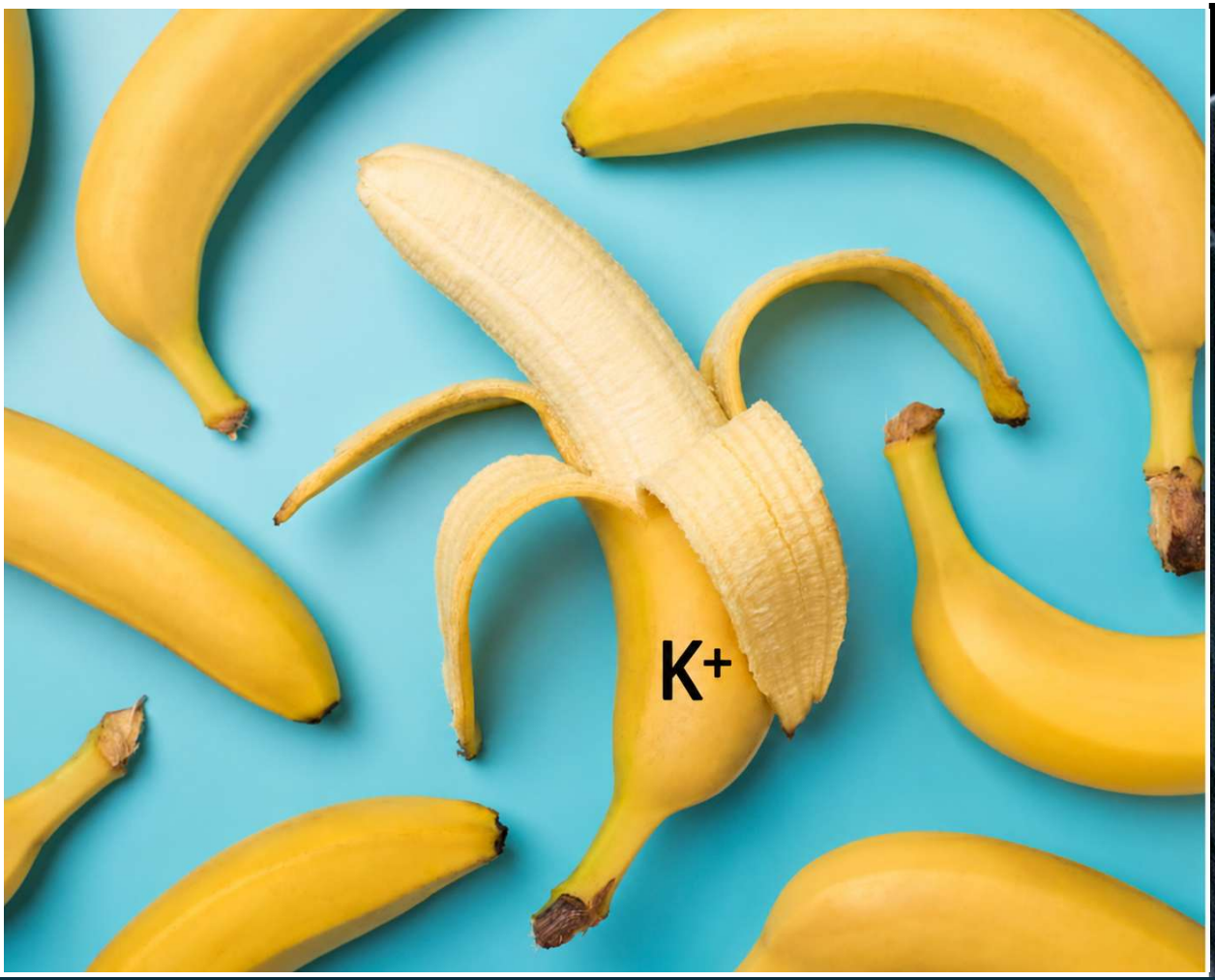

Muscles
use creatine for energy
creatine
breaks down
into...
Creatinine
creatinine is released
into the bloodstream
Kidneys
filter creatinine
out of the blood
into urine

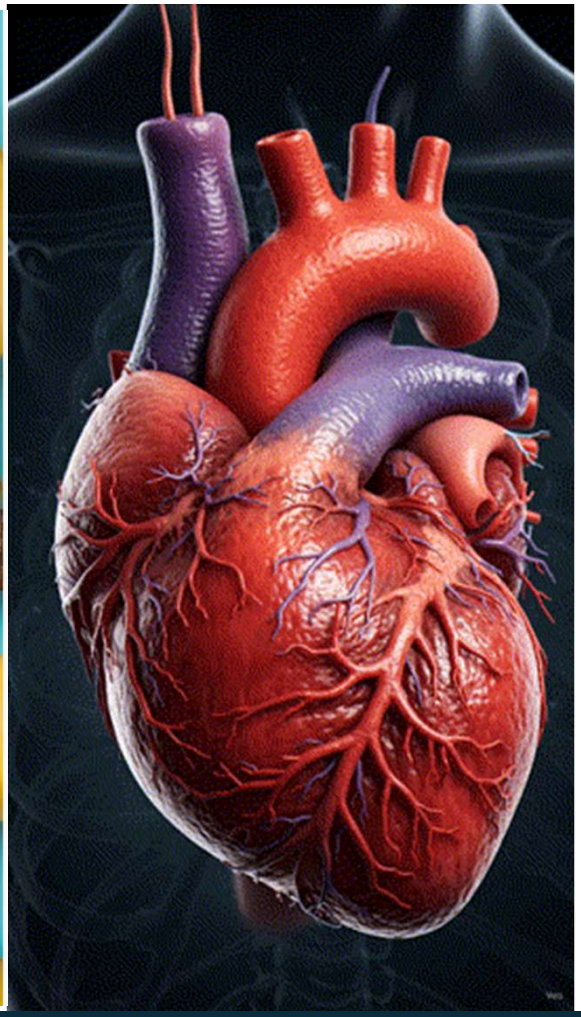

16oz
10oz

Estimated Glomerular Filtration rate

- Calculated from Creatinine levels, factoring in age & gender
- More accurate measure of filtration
- Normal values : 90-120 ml/min/1.73 m^2
- Helps stage CKD

ELECTROLYTES





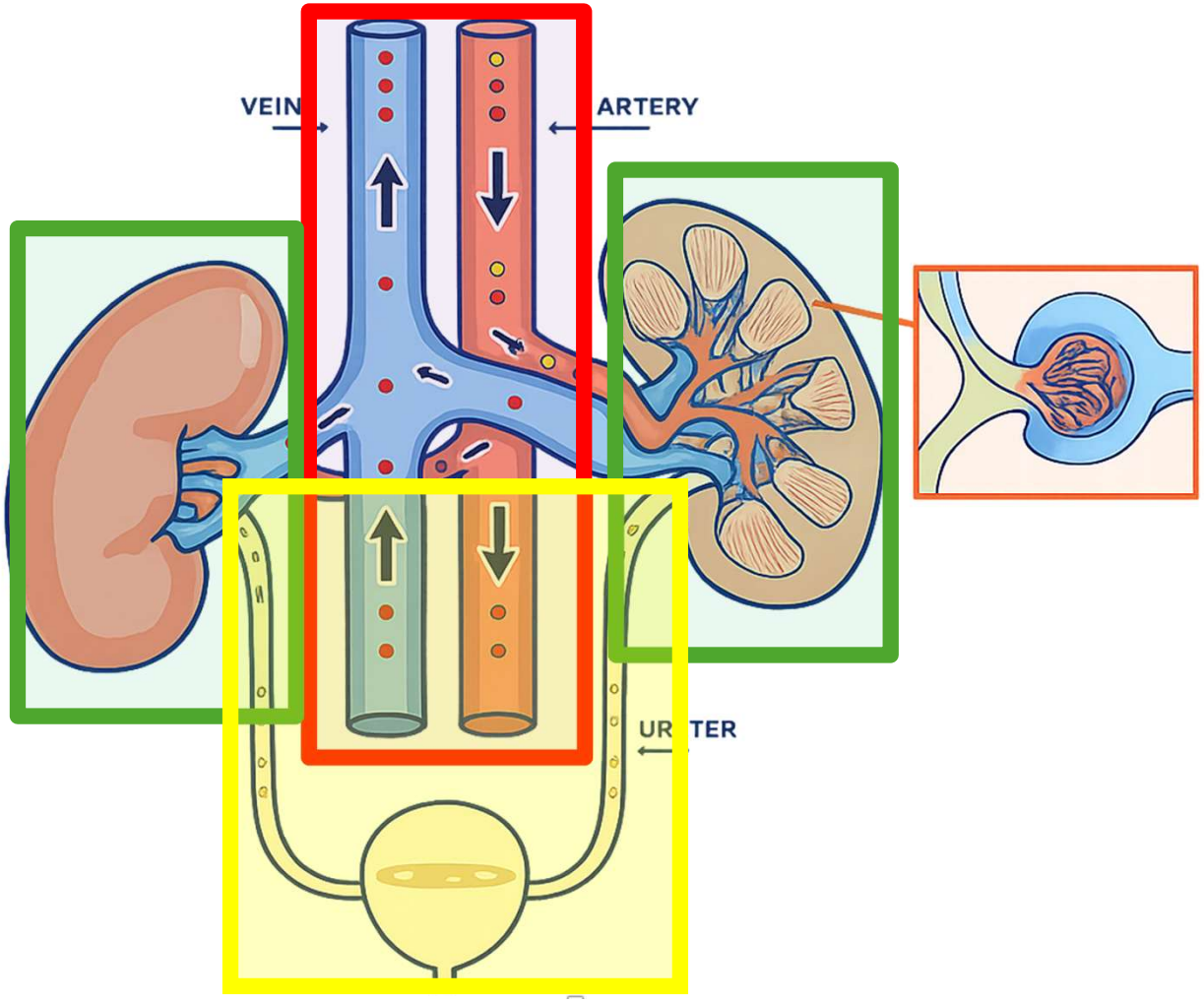
ELECTROLYTES

ROLE OF IMAGING

Prerenal

Renal

Postrenal



Case 1

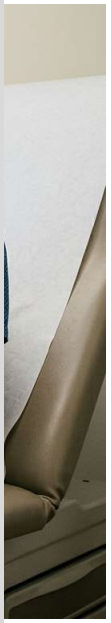
- 70 yr Male Presented to GP with increasing pedal oedema.
  - diabetic
  - hypertensive
- eGFR of 16 ml/min.
  - Past records show 45 ml/min 3 months prior and 60 ml/min previous year.
- Worsening renal function

HOW TO PROCEED

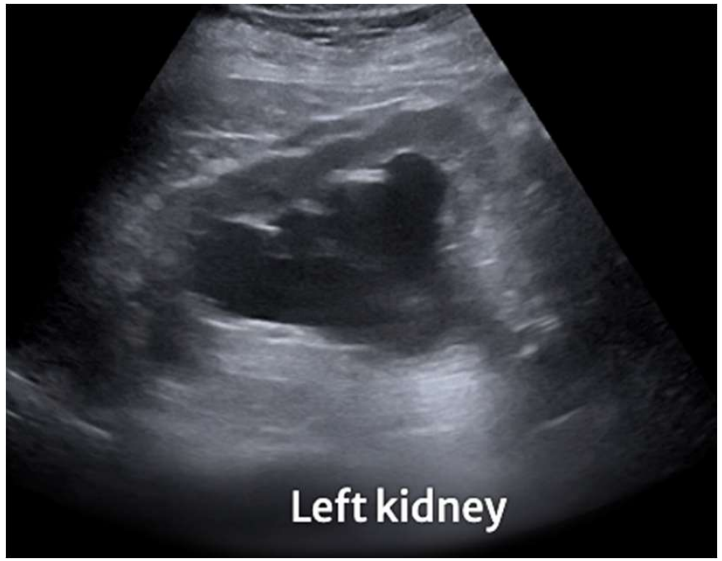
-Diagnosis : Acute upon chronic KD
  - Progressive

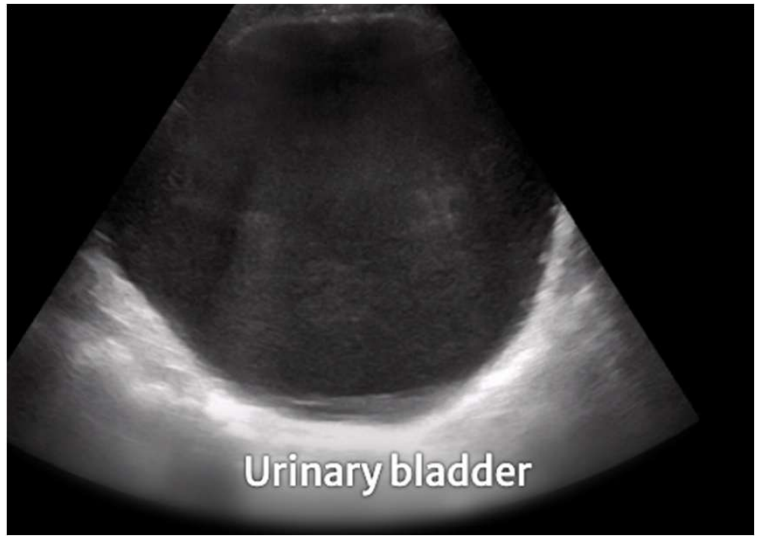
- Unknown reason for AKI component

- IMAGING – Is there a reversible cause ?



ULTRASOUND





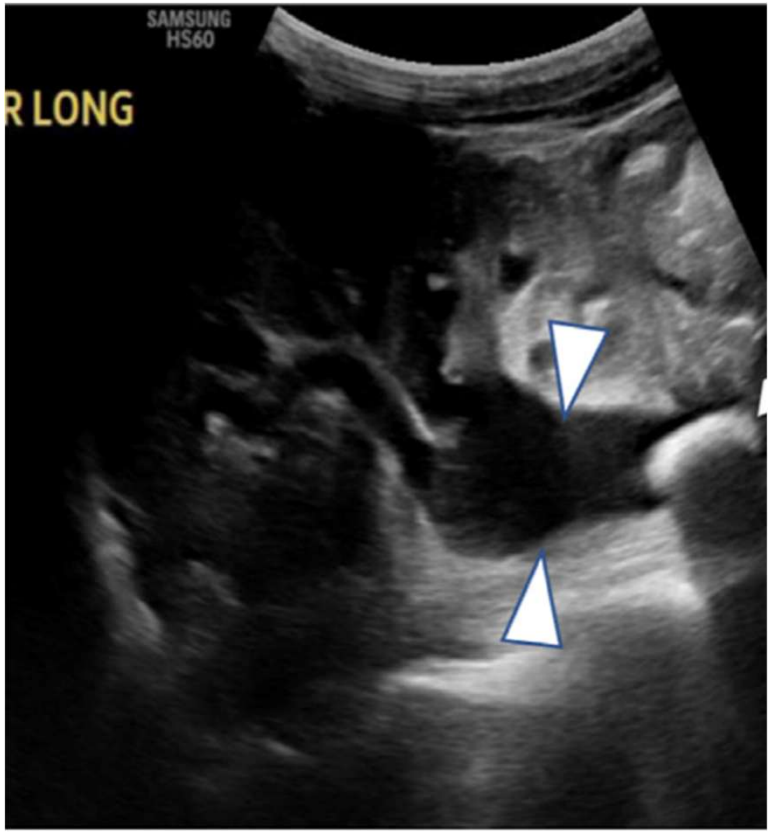
https://nephropocus.com/2022/09/04/a-case-of-hydronephrosis/

Follow up

- ED catheterisation drained 6L urine.
- 4-week follow up symptoms had resolved
- Serum creatinine trended down
- The eGFR back to baseline

- BP normalised without medication changes !!!!

COMPANION CASE



Teaching Point

- Obstruction can occur in previously diseased compensated kidney pushing it over the edge.
- Clinically can be surprisingly subtle.

- In the context of AKI on CKD or unexplained AKI, role of imaging is to identify a structural, treatable cause.

- Has an easy fix to regain function especially if in retention – catheterize !

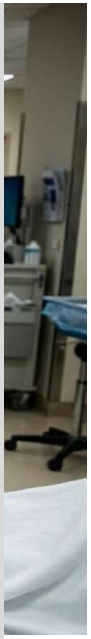
Case 2

- 75 yr old male, presented to ED with lethargy, altered sensorium.
- O/E he was febrile with abnormal U &E ‘s.
- Past history of renal tract calculi, urinary retention requiring catheterisation

HOW TO PROCEED

- Diagnosis : AKI probably due to sepsis

- Question : Is this an obstructed/infected system ?



Ultrasound

https://nephropocus.com/2024/05/11/emphysematous-pyelonephritis-a-diagnosis-not-to-be-missed-on-pocus/

Teaching Point

- Moving echogenic foci in the kidney are gas pockets !!
- Emphysematous pyelonephritis
- Emergent CT to confirm, inform the clinical team.
- RED ALERT

Case 3

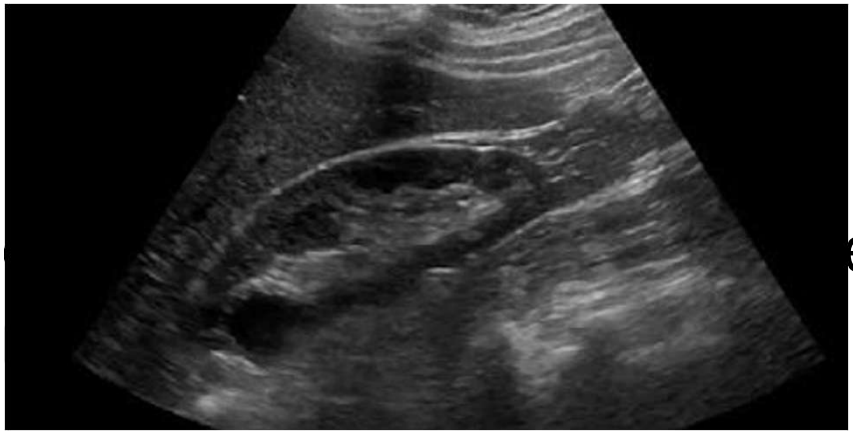
- 35 year woman
  - facial swelling.
  - No history of hypertension.
  - No family history of renal disease
- Urine showed haematuria, proteinuria
- Abnormal U & E ‘s.

Ultrasound

First question – Is there Kidney disease?

S e

o



Teaching Point

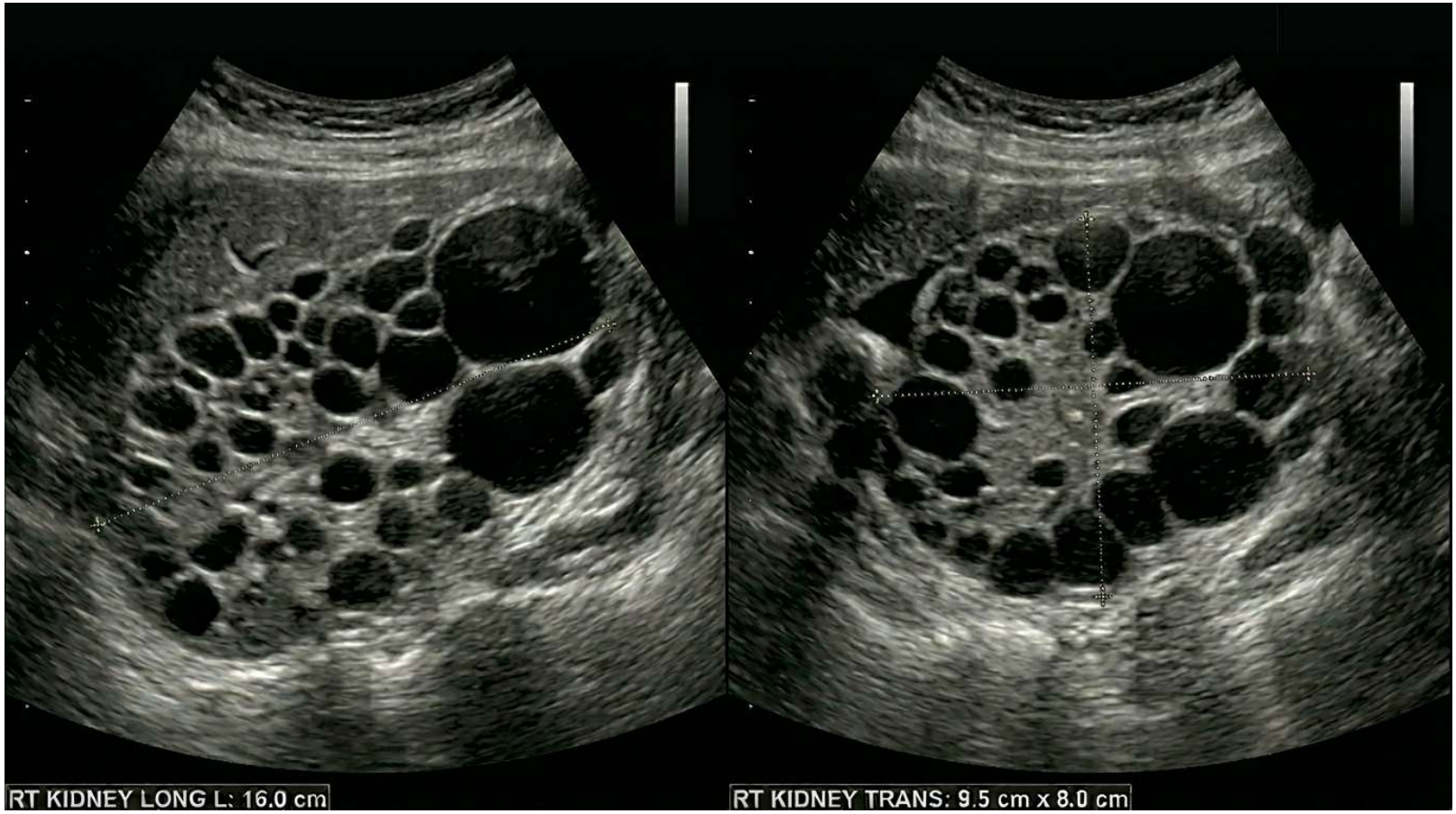
- Increased echogenicity NOT EQUAL to chronic kidney disease.

- Most specific sign of CKD is cortical atrophy
  - MENTION thickness on reports.
- If too thin, not a candidate for diagnostic renal biopsy.

Case 4

- 40-year male
  - epigastric pain which gets worse with food intake.
  - Reports palpitations
- Has hypertension, single ACE inhibitor.
- U & E s are normal.
- No family members have kidney disease.

Ultrasound

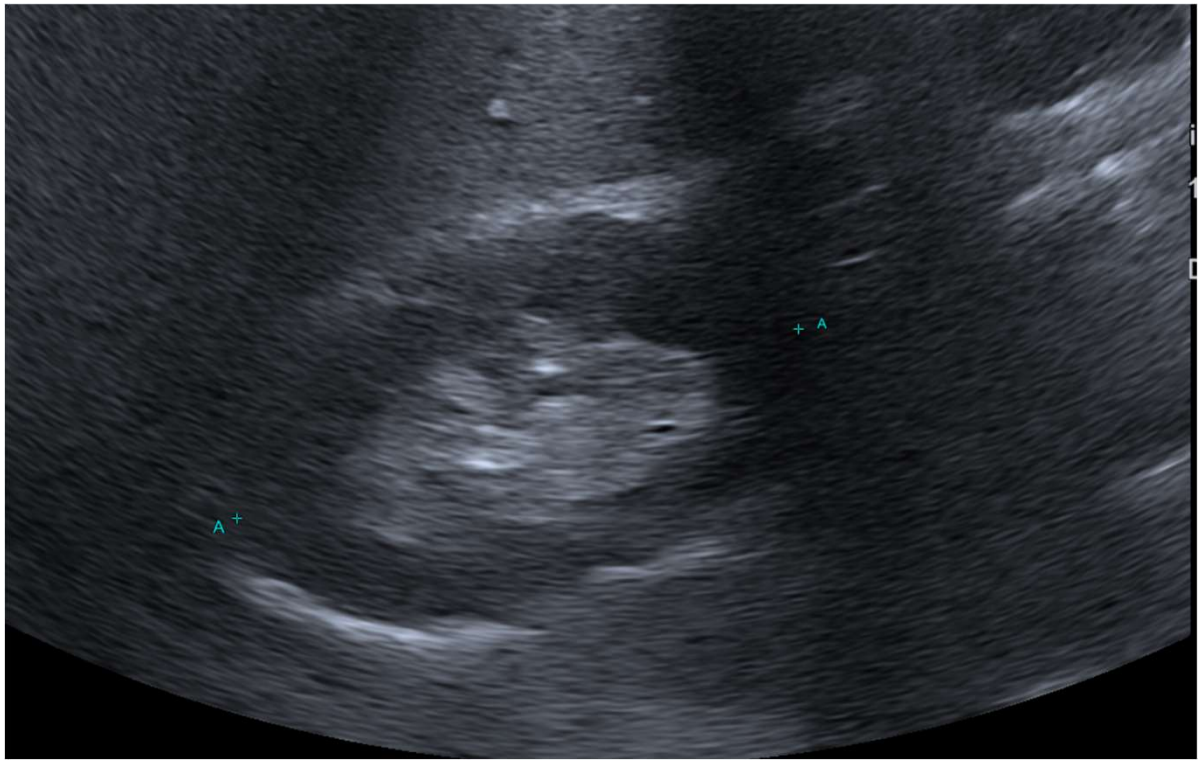


Teaching Point

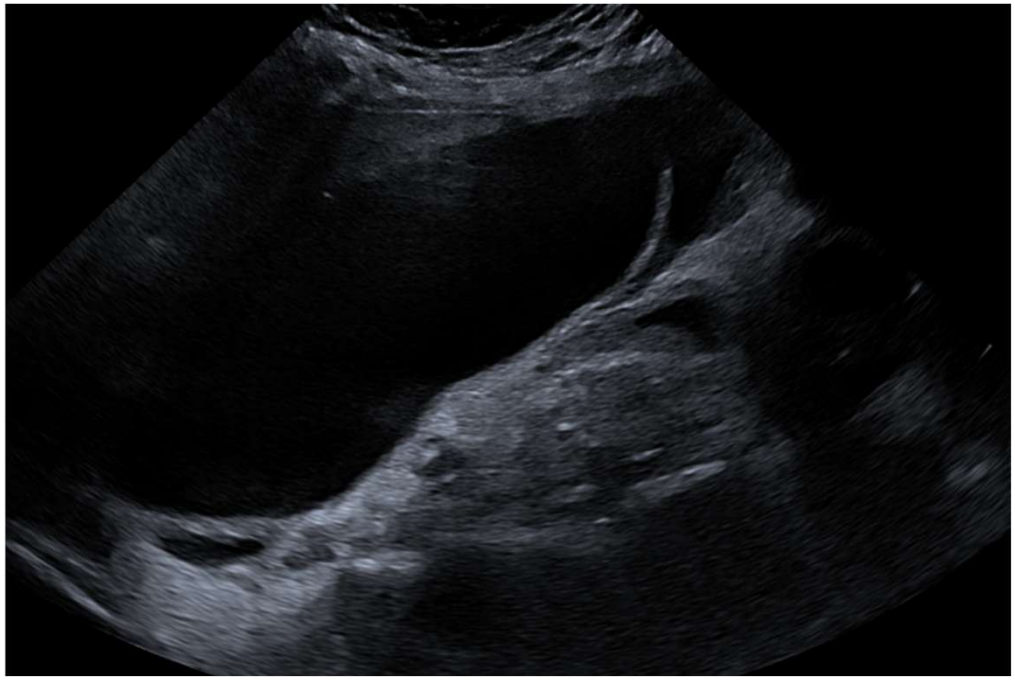
- ADPKD is essentially an imaging diagnosis.
- Can be picked up incidentally in scans for alternative indications.

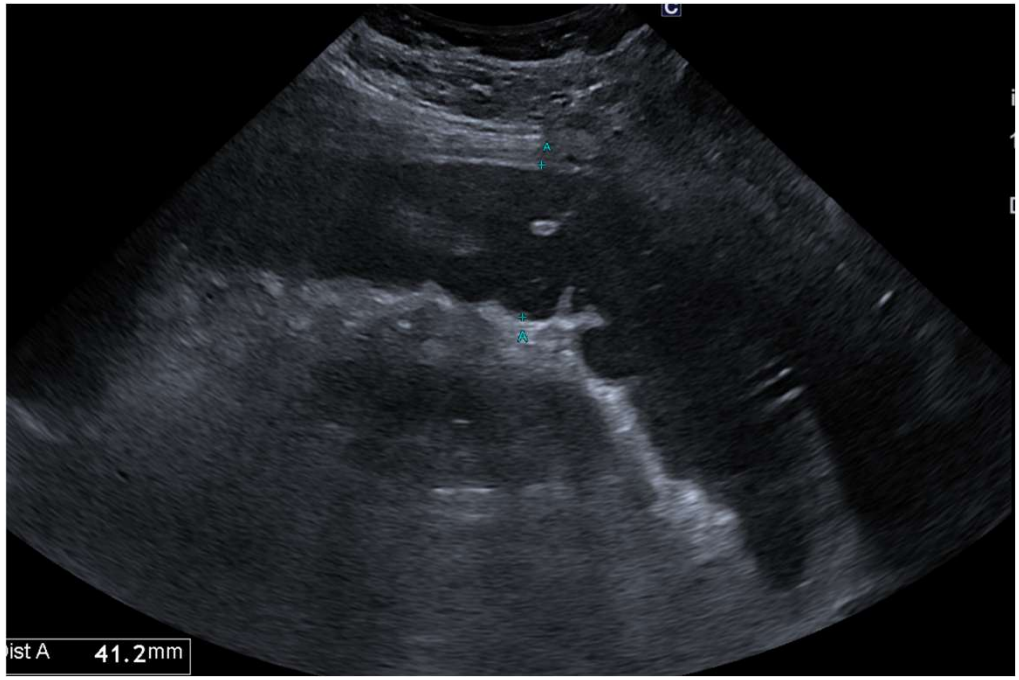
- Enlargement of kidney, extra renal cysts highly suggestive
- RENAL size important to mention (> 16 cm higher risk for progression)

Final Case !

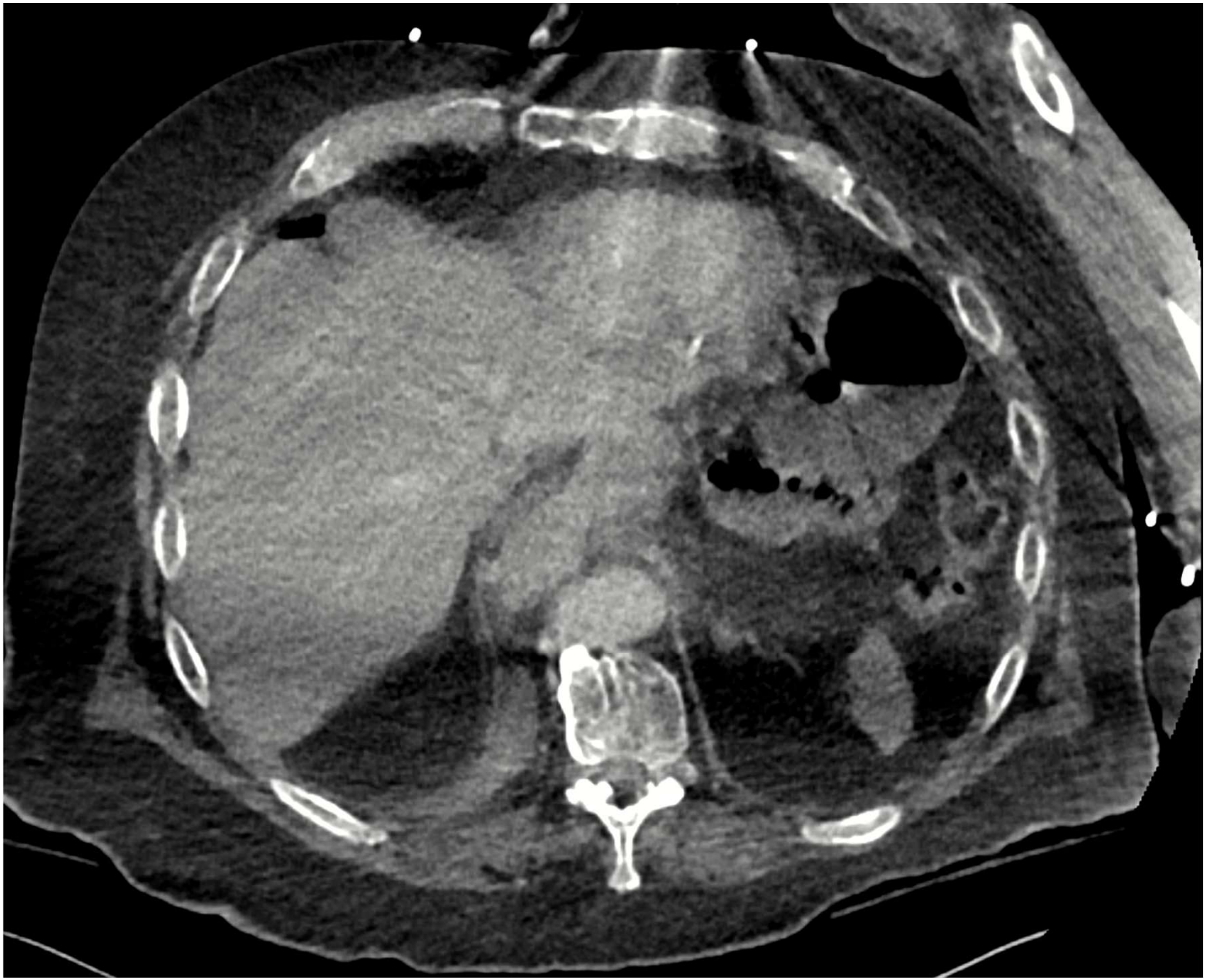


Day 1

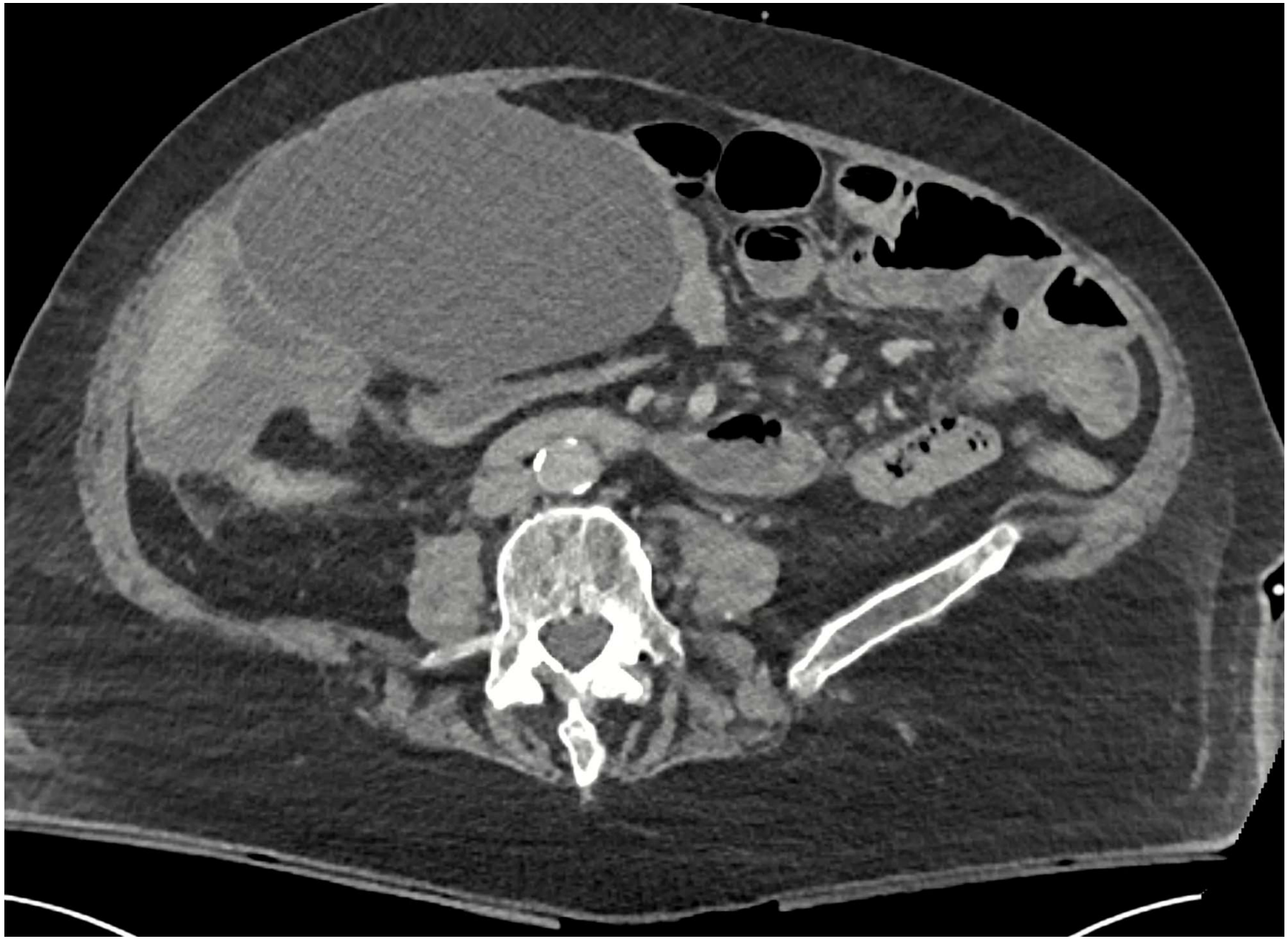




Day 1



Day 2



Day 7

Teaching Point

- Morphologically normal kidneys in AKI, always screen the abdomen for sepsis.

- Sometimes the clincher is the EXTRARENAL FINDINGS !!!

HOW CAN IMAGING ADD VALUE to abnormal U&E's?

- Is there a reversible insult i.e POST RENAL?
- Do we need IR/ Surgery ?
- What is the time frame for intervention?
- Is there underlying CKD ?
- Are there specific imaging clues to a diagnosis?

Learning Objectives

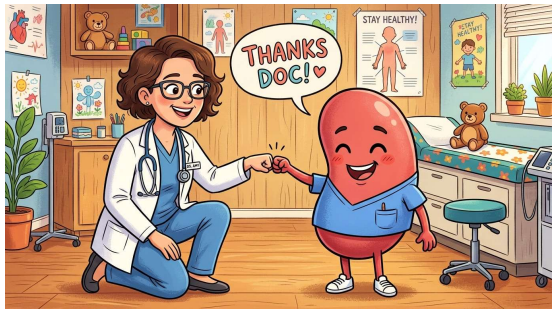
- Glean the Clinical Perspective
- Basics of renal Physiology
- What & Why of U & E’s
- Case Scenarios
- Building an Imaging approach to abnormal U&E’S

TAKE HOME

AKI

Are the kidneys obstructed?

Is there underlying CKD ?



CKD

"Is this irreversible disease ?

Is there an obvious structural cause ?"