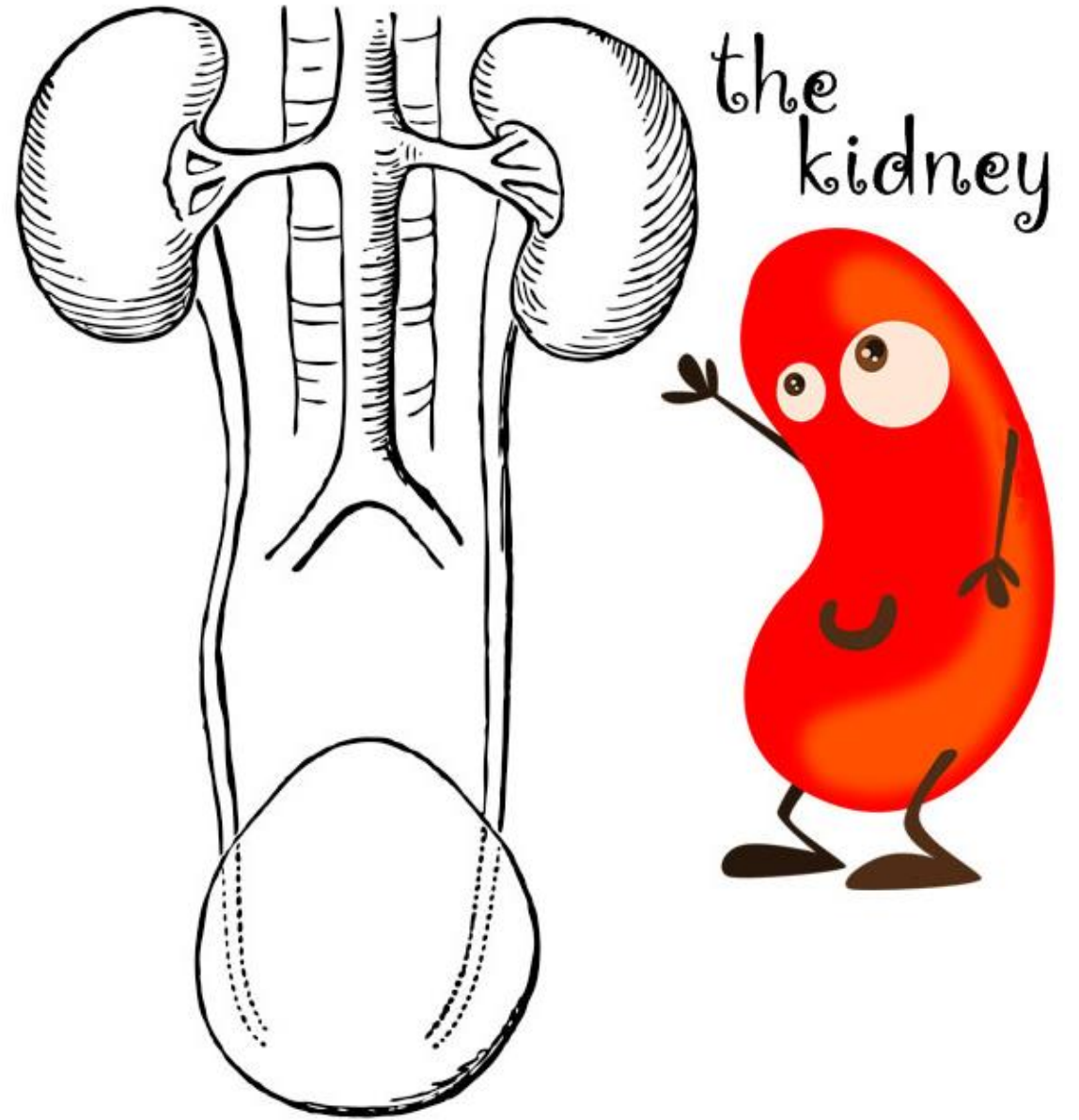


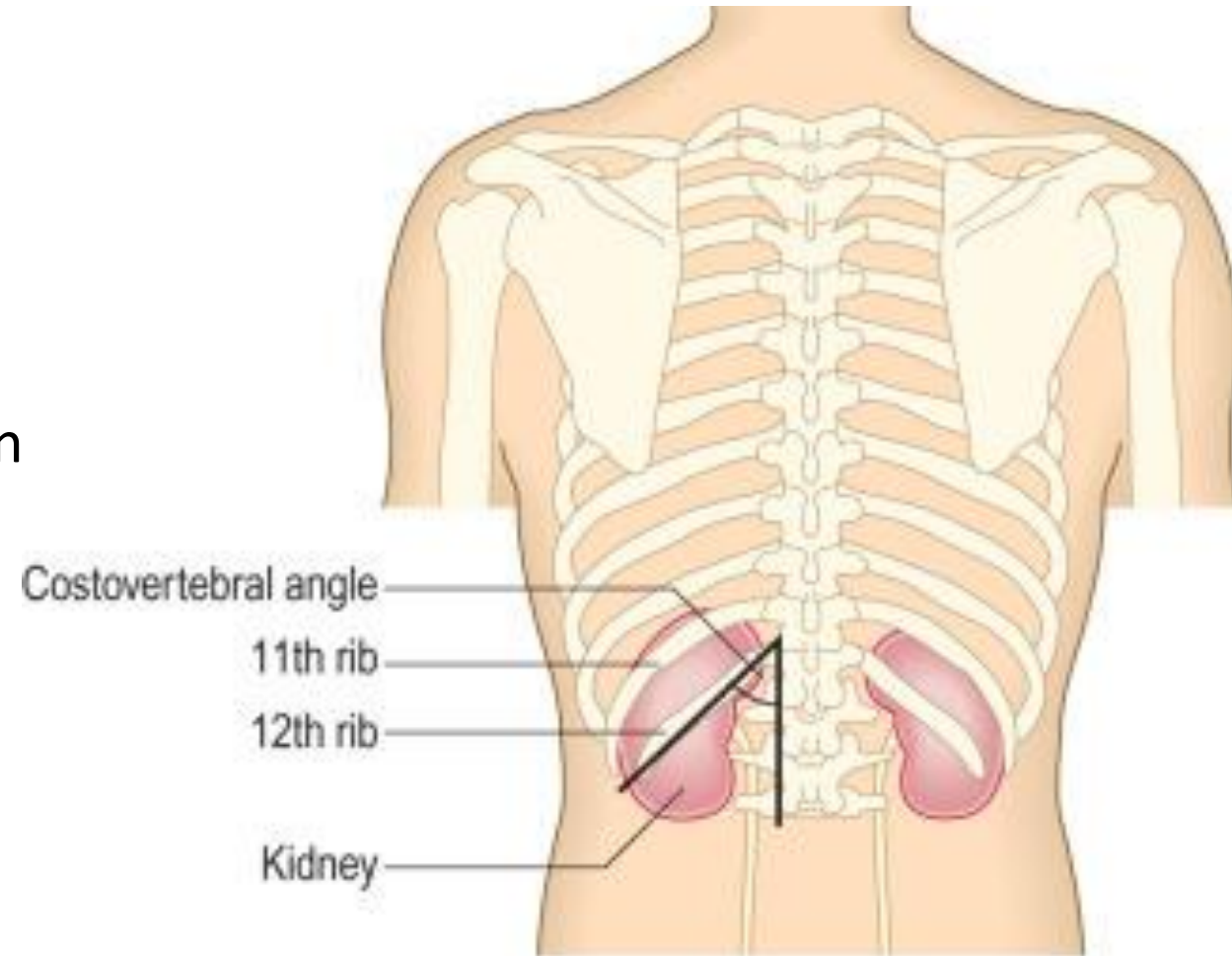
# The renal system

Dr. Amal Owaydah



# The kidneys

- Position (Rt , Lt)
- 25% of cardiac output
- Each contains one million nephron
- Function
- Innervation (T10-L1)



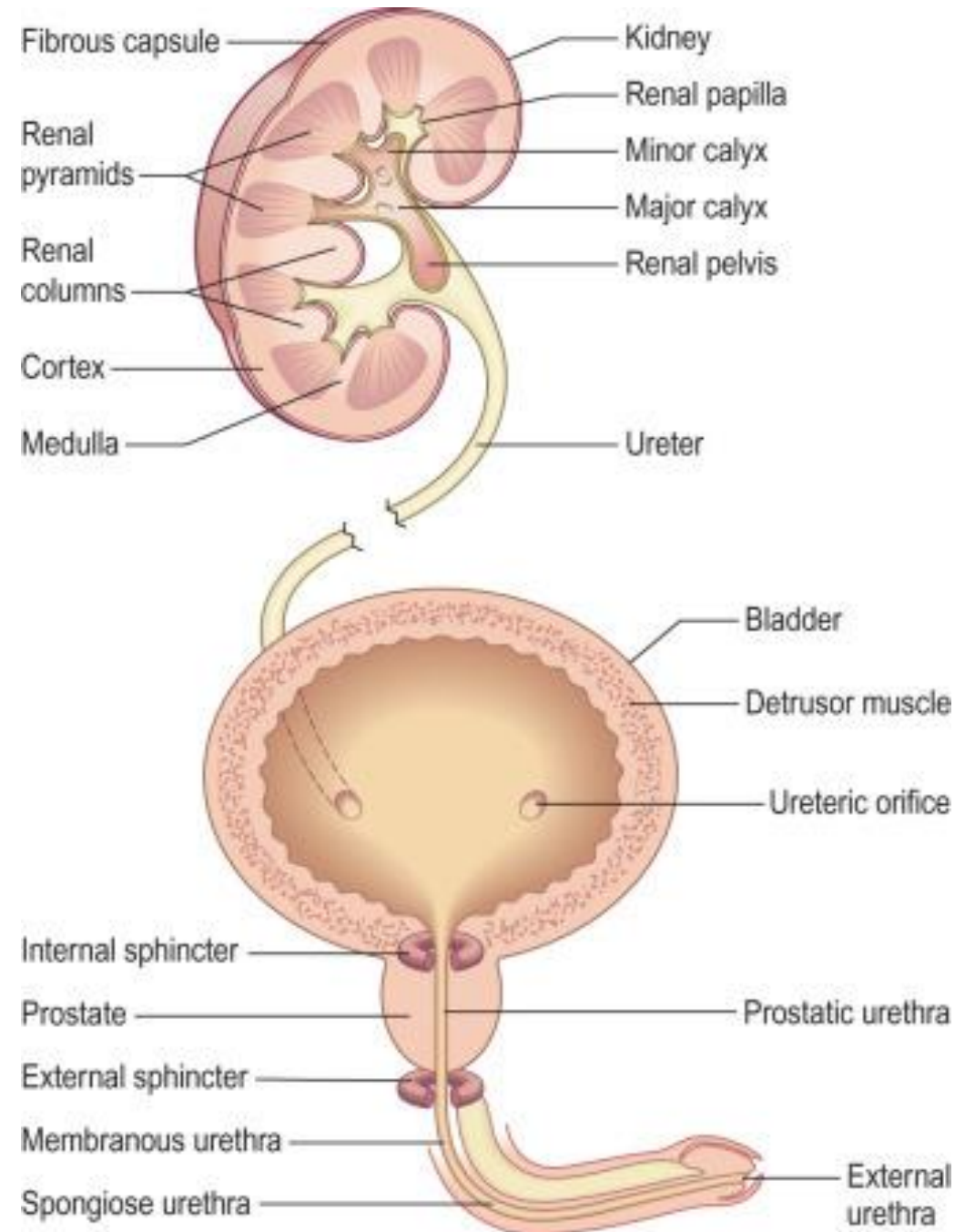
# The bladder

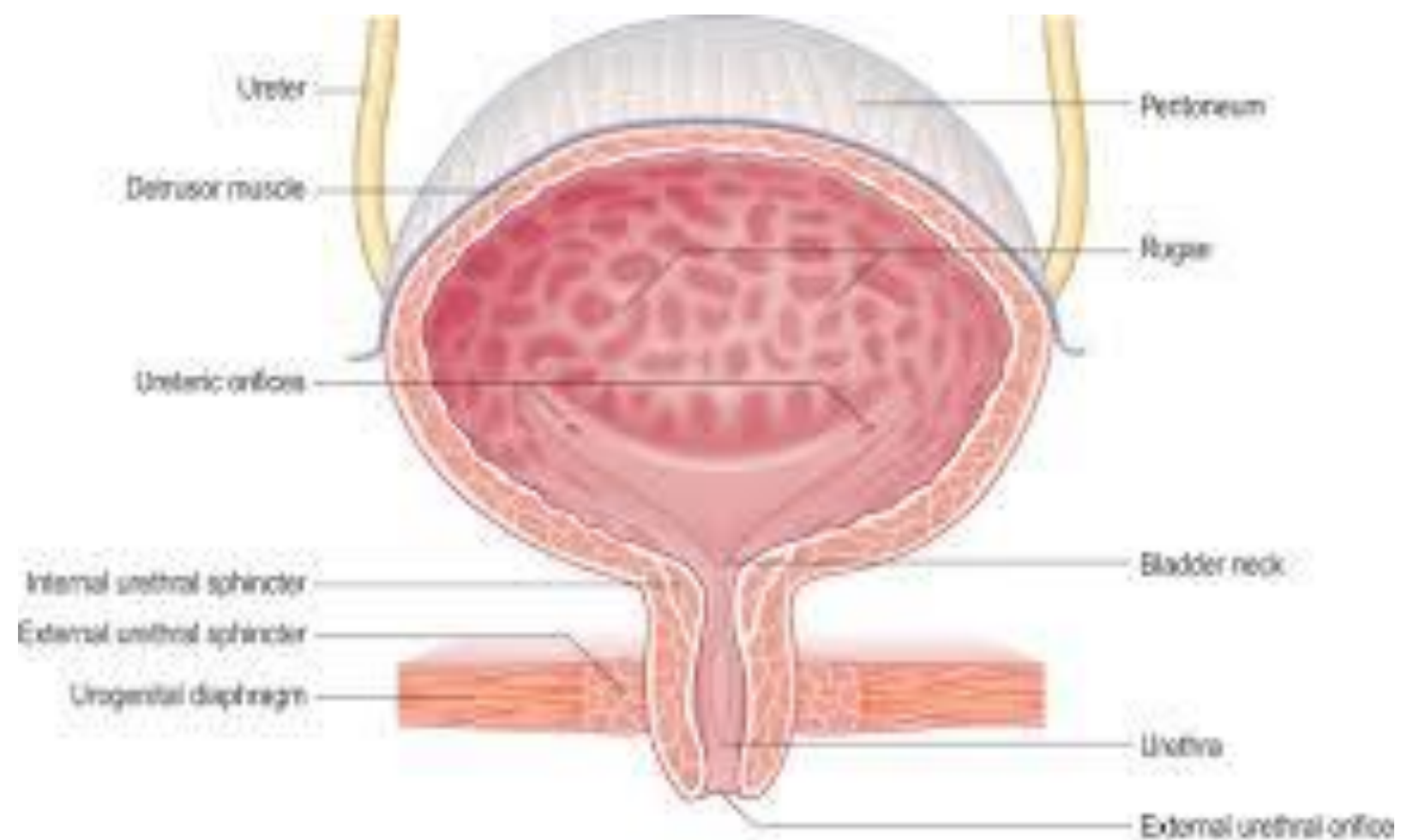
- position
- Structure (the detrusor)

## Urethra in males and females

Sphincters controlling micturition :

1. Internal sphincter
2. External sphincter . Innervation





# The history

- Sever renal ds. may be asymptomatic.
- Urine and blood test are essentials to assess for renal function.

A 50 year old man presented with loin pain .

**SOCRATES ?**

# Common presenting symptoms

## Loin pain

- usually due to ureteric obstruction
- Renal Calculi , bleeding from a renal or ureteric tumor , infection (pyelonephritis) or non-renal
- Colicky , Location, radiation, associated symptoms

# Common presenting symptoms

## Dysuria

- pain or discomfort during urination
- Common symptom of UTI
- Associated urinary frequency and urgency, suprapubic discomfort, severe perineal or rectal pain, fever, flank pain .
- Sexual history
- Symptoms of urine outflow obstruction



# Common presenting symptoms

## Voiding symptoms

### ➤ Storage symptoms :

- Urgency, frequency, nocturia and urge incontinence
- associated with bladder, prostate or urethral problems, such as UTI, tumor, urethral calculi or obstruction from prostatic enlargement, or neurological disease like MS.
- Urgency: sudden strong need to pass urine
- Frequency: micturating more often with no increase in the total urine output
- Nocturia : waking more than twice at night to void

## Voiding symptoms

### ➤ Voiding phase symptoms :

- Hesitancy, poor stream, straining to void and terminal dribbling. May be followed by a sense of incomplete emptying.
- The result of bladder outflow obstruction from prostatic enlargement (in men), urethral obstruction or genital prolapse (in women).
- Hesitancy: difficulty or delay in initiating urine flow

## Voiding symptoms

- Stress and urge incontinence

Involuntary release of urine may occur with a need to void (urge) , result from increase intraabdominal pressure (stress)

Overflow incontinence occurs without warning, often on changes in position, and is painless.

- Polyuria

- Oliguria

- Pneumaturia,

# Common presenting symptoms

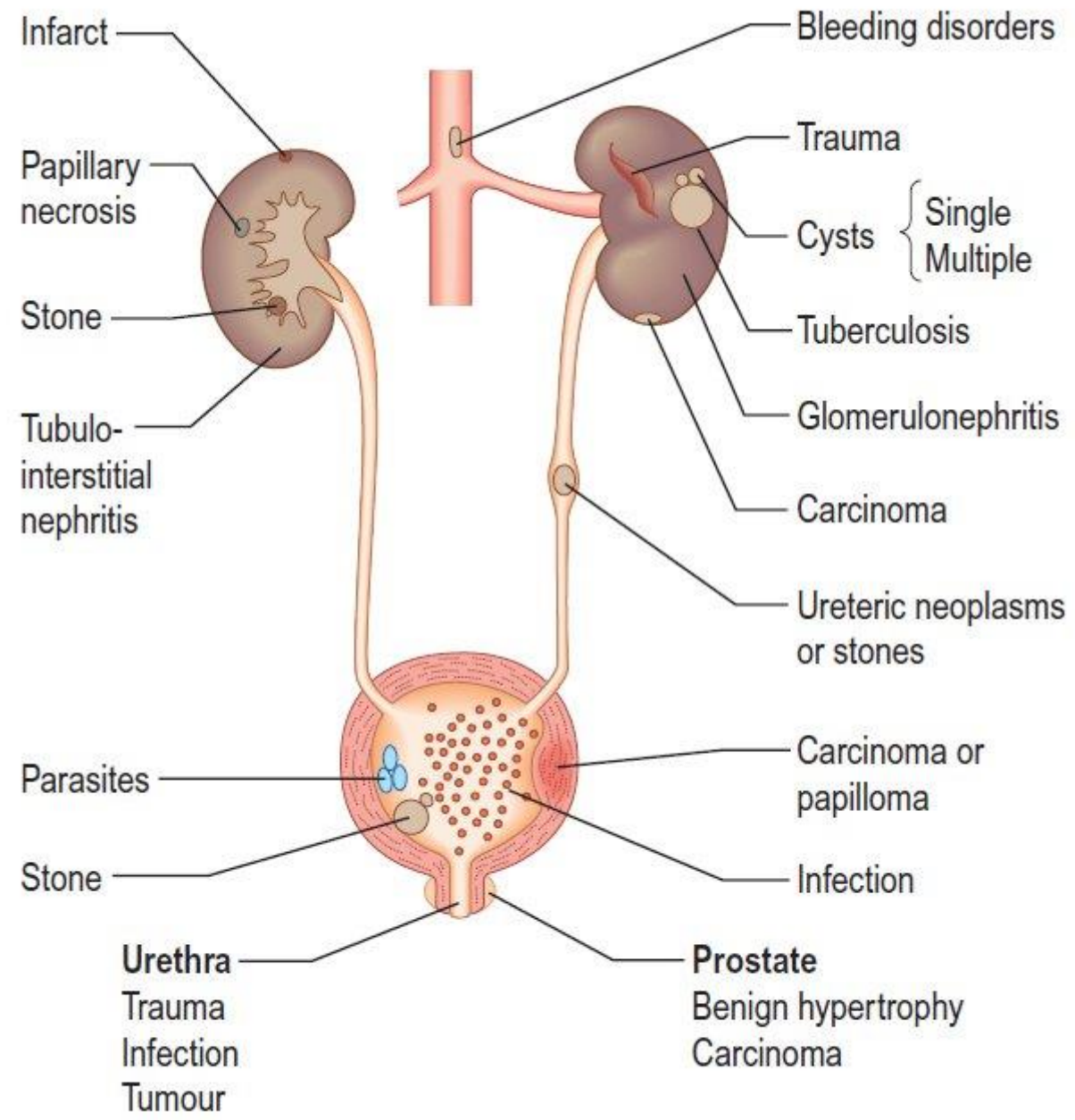
## **Hematuria**

### ➤ Visible hematuria

- Can arise anywhere along the renal tract from the glomerulus to the bladder
- Ask if persistent or intermittent
- Associated symptoms Loin pain , Fever, dysuria, suprapubic pain and urinary frequency
- Family history of renal disease

### ➤ Non-visible hematuria

- It can indicate renal or urinary tract disease



**Sites and causes of bleeding from the UT**

# Common presenting symptoms

## **Proteinuria**

Proteinuria is the excretion of more than 150 mg per day of protein in the urine.

Nephrotic syndrome is characterized by the combination of heavy proteinuria (> 3.5 g/24 hours), hypoalbuminemia and Oedema. Hyperlipidemia, hypercoagulability and an increased risk of infection may also develop .

- Causes
- Edema, SOB , abdominal distension

# Acute kidney injury

Definition (RIFLE)

## 12.1 Definition of acute kidney injury

| RIFLE <sup>a</sup><br>AKIN <sup>b</sup> | Serum creatinine criteria  | Urine output criteria                            |
|---|--|--|
| Risk<br>AKIN stage 1                    | Increase > 50%   | <0.5 mL/kg/h for 6 hours                         |
| Injury<br>AKIN stage 2                  | Increase > 100%  | <0.5 mL/kg/h for 12 hours                        |
| Failure<br>AKIN stage 3                 | Increase > 200% or serum creatinine > 350 $\mu\text{mol/L}$ (3.96 mg/dL) | <0.3 mL/kg/h for 24 hours or anuria for 12 hours |
| Loss                                    | Renal replacement therapy for > 4 weeks                                  | —  |
| End-stage kidney disease                | Renal replacement therapy for > 3 months                                 | —  |

<sup>a</sup>Risk, Injury, Failure, Loss, End-stage kidney disease.

<sup>b</sup>Acute Kidney Injury Network.

# Acute kidney injury

## Prerenal AKI

- Hypovolaemia (e.g. blood loss, diarrhoea, vomiting, diuresis, inadequate oral intake)
- Relative hypovolaemia (e.g. heart failure, nephrotic syndrome)
- Sepsis
- Drugs (e.g. antihypertensives, diuretics, non-steroidal anti-inflammatory drugs)
- Renal artery stenosis or occlusion
- Hepatorenal syndrome



# Acute kidney injury

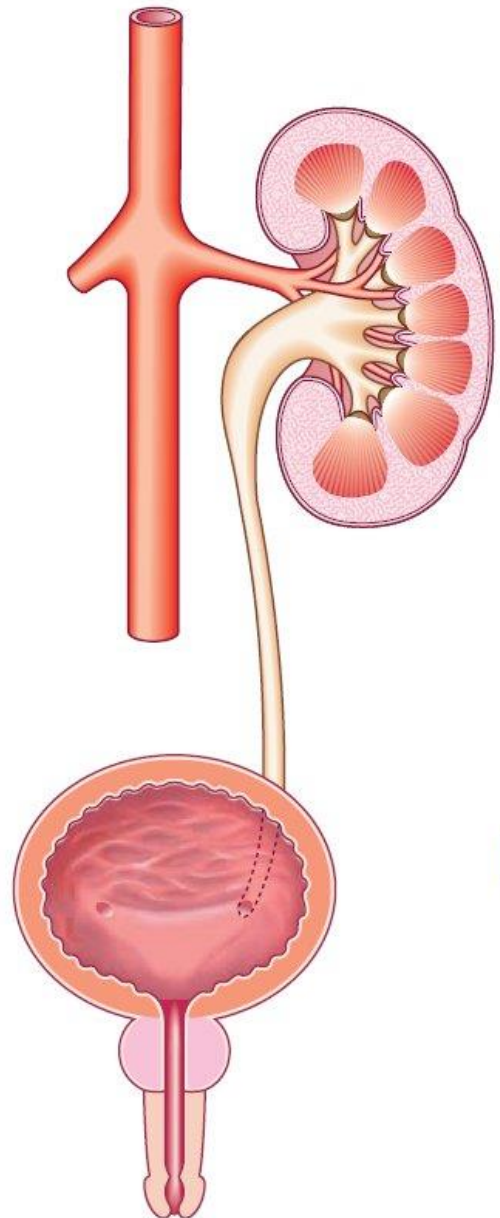
## Intrinsic AKI

- Acute tubular necrosis/injury (may follow a prerenal cause)
- Rhabdomyolysis
- Glomerular disease (e.g. systemic vasculitis, SLE, immunoglobulin A nephropathy)
- Interstitial nephritis (drug-induced)
- Multiple myeloma
- Intrarenal crystal deposition (e.g. urate nephropathy, ethylene glycol poisoning)
- Thrombotic microangiopathy (e.g. haemolytic uraemic syndrome, scleroderma renal crisis)
- Accelerated-phase hypertension
- Cholesterol emboli

# Acute kidney injury

## Postrenal AKI

- The most common cause is bladder outflow obstruction
- Acute urinary retention vs chronic
- For ureteric disease to cause AKI, both kidneys need to be affected



### PRE-RENAL

Impaired perfusion:

- Cardiac failure
- Sepsis
- Blood loss
- Dehydration
- Vascular occlusion

### RENAL

- Glomerulonephritis
- Small-vessel vasculitis
- Acute tubular necrosis
  - Drugs
  - Toxins
  - Prolonged hypotension
- Interstitial nephritis
  - Drugs
  - Toxins
  - Inflammatory disease
  - Infection

### POST-RENAL

- Urinary calculi
- Retroperitoneal fibrosis
- Benign prostatic enlargement
- Prostate cancer
- Cervical cancer
- Urethral stricture/valves
- Meatal stenosis/phimosis

Causes of acute kidney injury.

# Chronic kidney disease

- Renal dysfunction and/or the presence of proteinuria for at least 3 months.
- Previous medical history , Previous incidental urine abnormalities, family history may help

| 12.3 Definition of chronic kidney disease (CKD)   |                                    |                                    |  |
|---|------------------------------------|------------------------------------|--|
| CKD stage   | eGFR (mL/min/1.73 m <sup>2</sup> ) | Description                        | Management                                       |
| 1   | ≥90                                | Kidney damage with normal or ↑ GFR | Observe; control blood pressure and risk factors |
| 2   | 60–89                              | Kidney damage with mild ↓ GFR      |  |
| 3A  | 45–59                              | Moderate ↓ GFR                     |  |
| 3B  | 30–44                              |                                    |  |
| 4   | 15–29                              | Severe ↓ GFR                       | Prepare for end-stage kidney disease             |
| 5   | <15                                | End-stage kidney disease           | Dialysis, transplantation or conservative care   |
| <p>p: the addition of p to a stage (e.g. 2p, 3Bp) means that there is significant proteinuria. Proteinuria is quantified on the basis of an albumin : creatinine (ACR) or protein : creatinine (PCR; see Box 12.4).</p> <p>T: the addition of T to a stage (e.g. 4T) indicates that the patient has a renal transplant.</p> <p>D: the addition of D to stage 5 CKD (i.e. 5D) indicates that the patient is on dialysis.</p> |                                    |                                    |  |
| <i>(e)GFR, (estimated) glomerular filtration rate.</i>  |                                    |                                    |  |

# Chronic kidney disease

## Uremic symptoms (GFR <10)

- anorexia, nausea and vomiting
- lethargy
- poor concentration Click to add text
- pruritus
- breathlessness, which may occur due to fluid overload, worsening acidosis and/or anaemia
- peripheral oedema.
- features of pericarditis or peripheral neuropathy.

# Chronic kidney disease

## ➤ Renal transplant

- The main presenting problems are a decline in kidney function ,infection or malignancy
- ask about :Date of transplant operation,
  - Current and previous immunosuppression
  - Fever, weight loss, cough, breathlessness, dysuria and tenderness over the graft

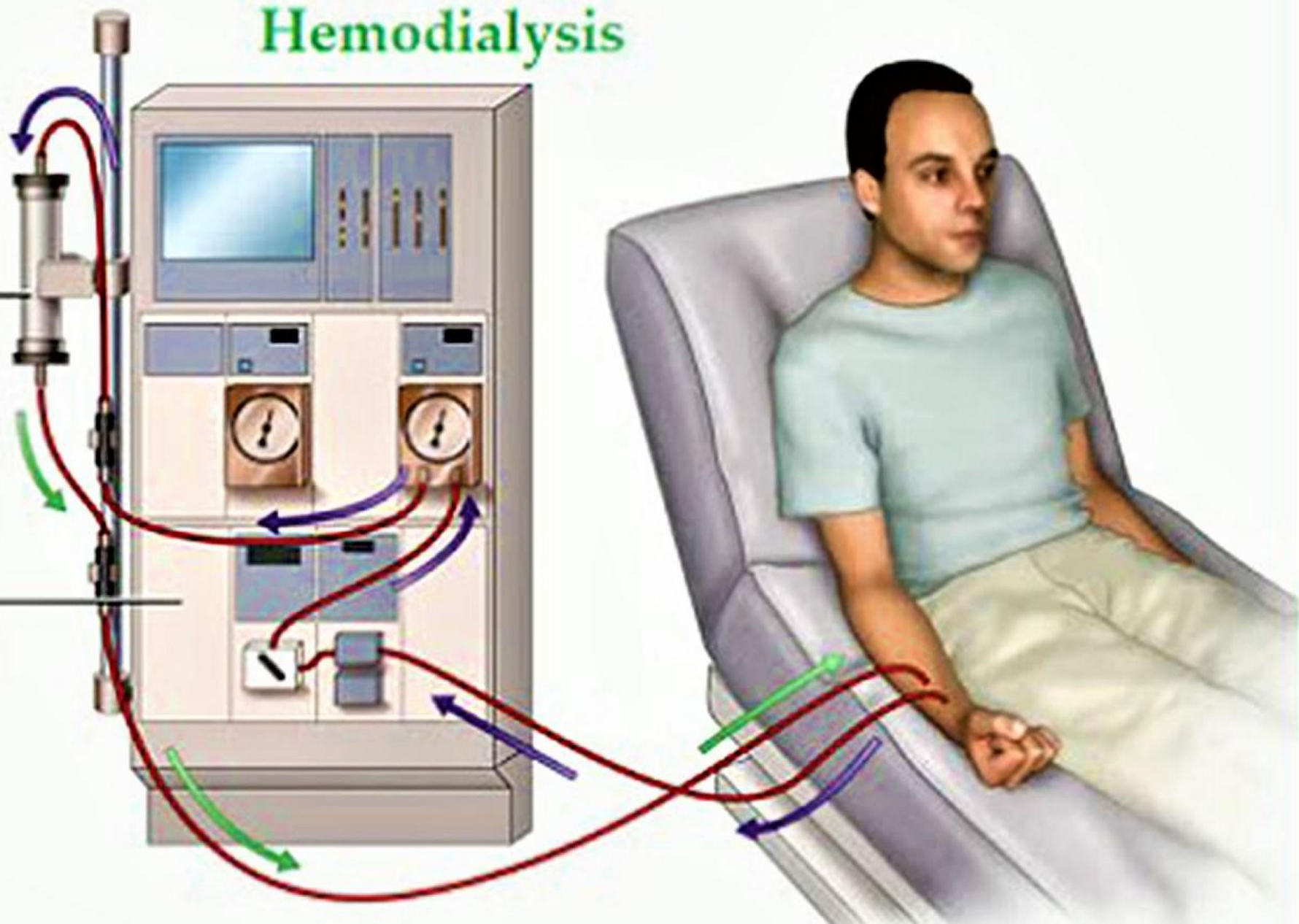
## ➤ The dialysis patient

- Hemodialysis : infection or thrombosis of fistula /catheter
- peritoneal dialysis : infection (fever, abdominal pain, change of fluid color)

## Hemodialysis

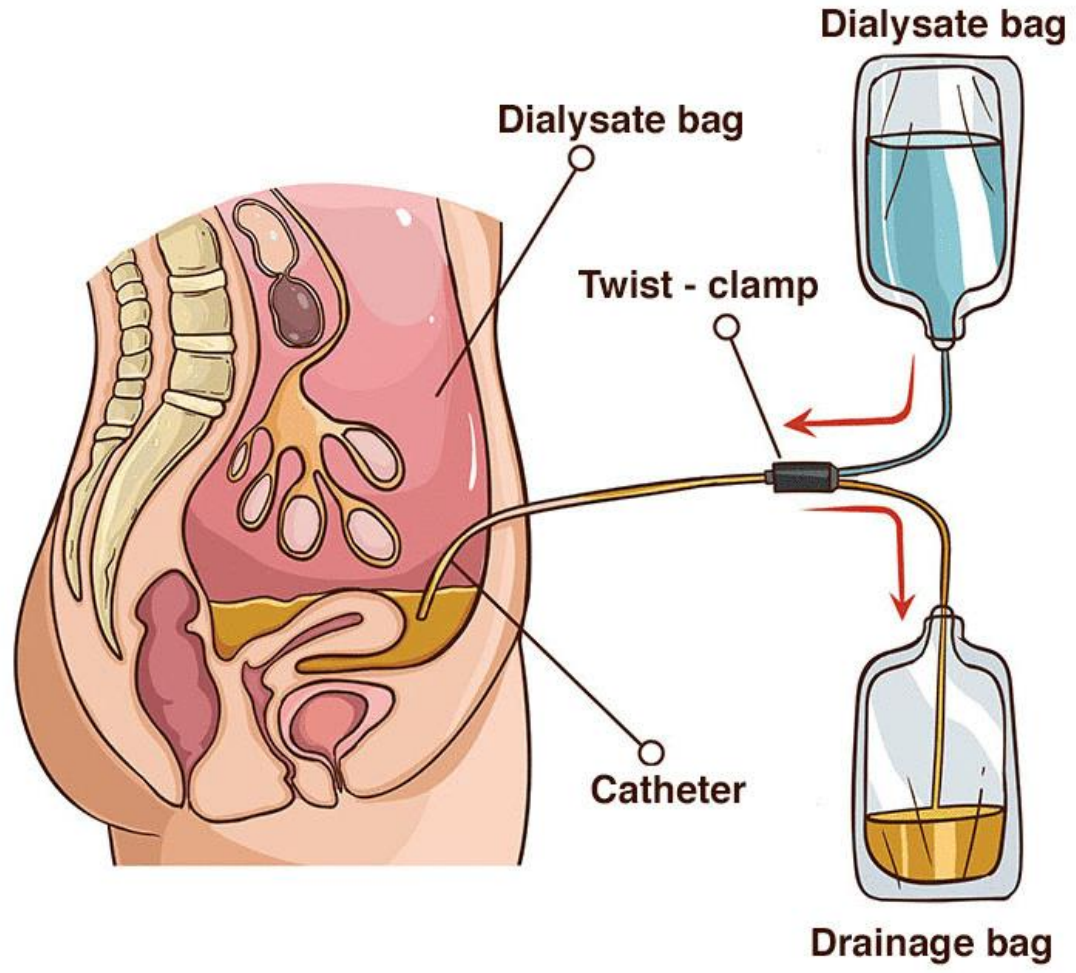
Blood filtered  
and cleaned  
in the dialyzer

Dialysis  
machine





# Peritoneal dialysis





# Common presenting symptoms

Hypertension, anemia and electrolyte disorders are common features of renal disease .

➤ **Past medical history**

➤ **Drug history**

➤ **Family history**

- autosomal dominant polycystic kidney disease (ADPKD) and Alport syndrome.

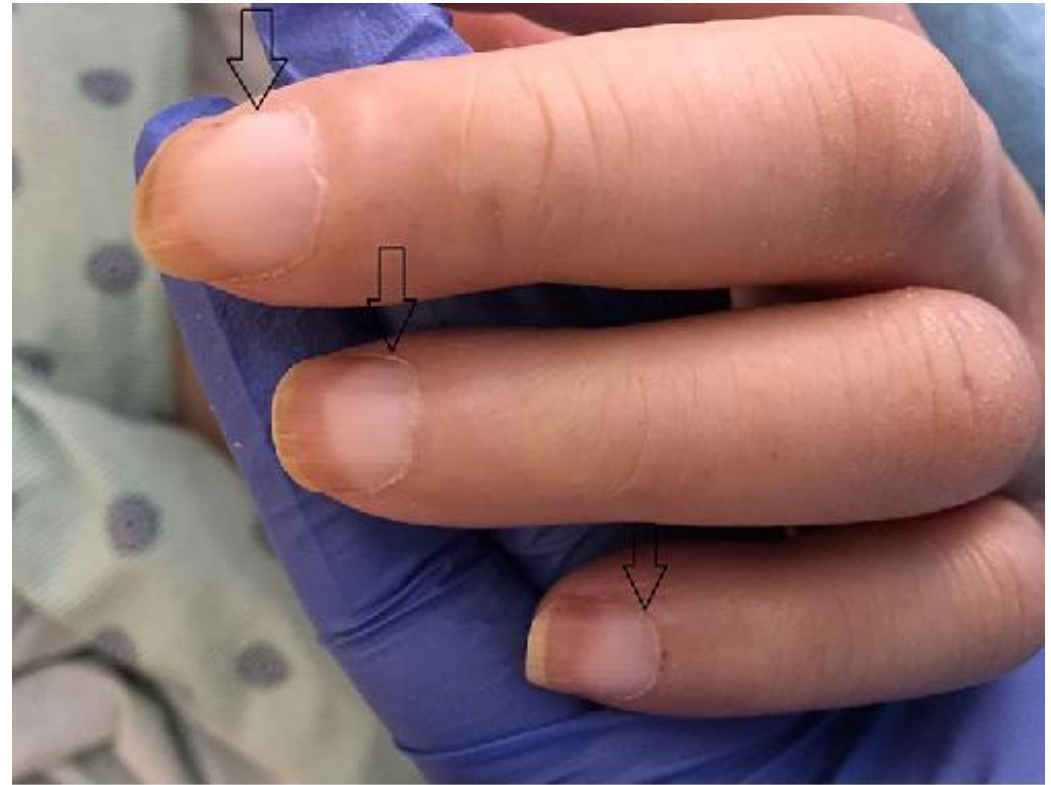
➤ **Social history**

# The physical examination

- **General appearance**
- **Assessment of fluid balance**
- **Abdominal examination**
- **Targeted examination of other systems**

# General appearance

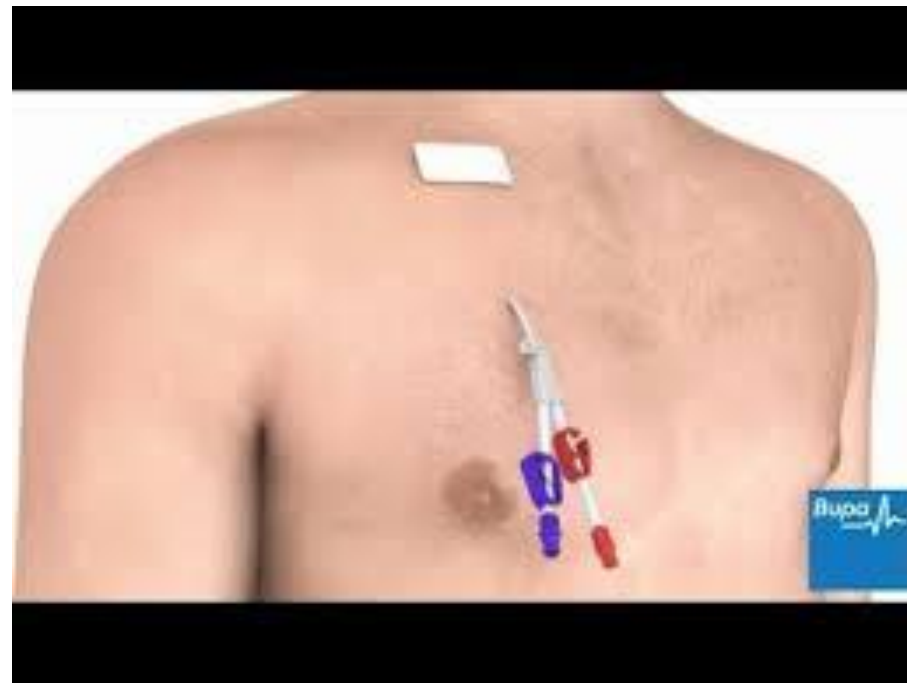
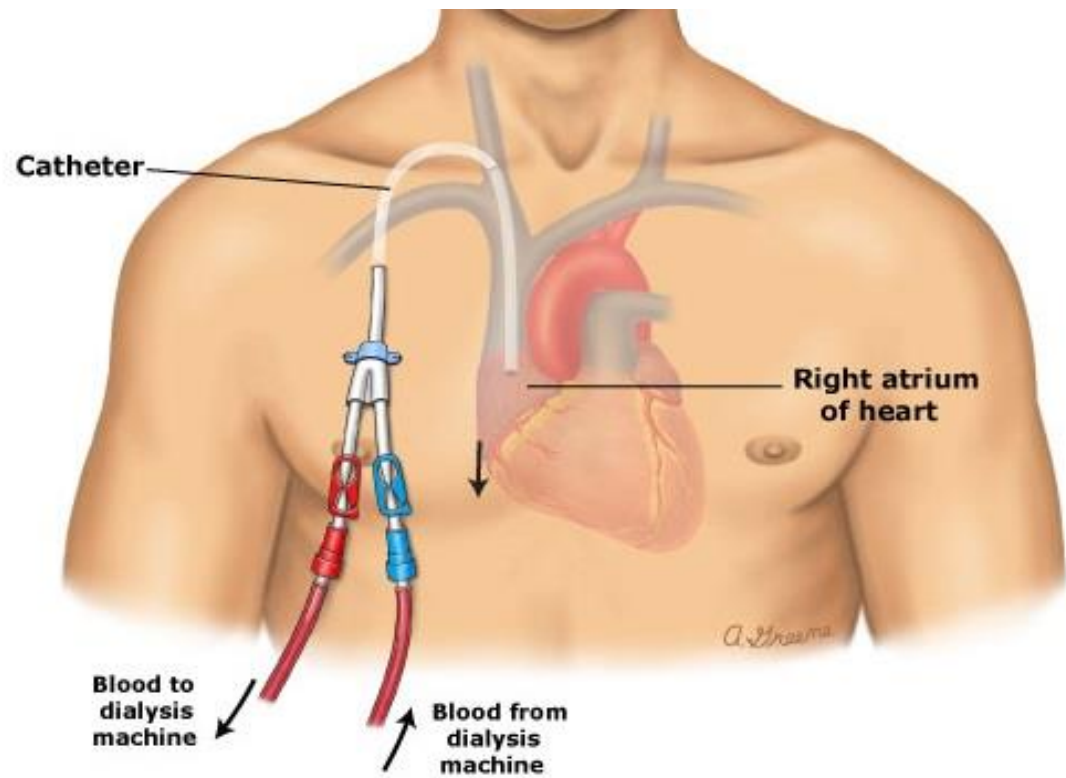
- Pallor/yellow, drowsiness, myoclonic twitching, asterixis, Breathlessness
- **Hands:** pallor of the palmar creases, Muehrcke's Lines, the half-and-half (Lindsay's) nails



# General appearance

Dialysis access





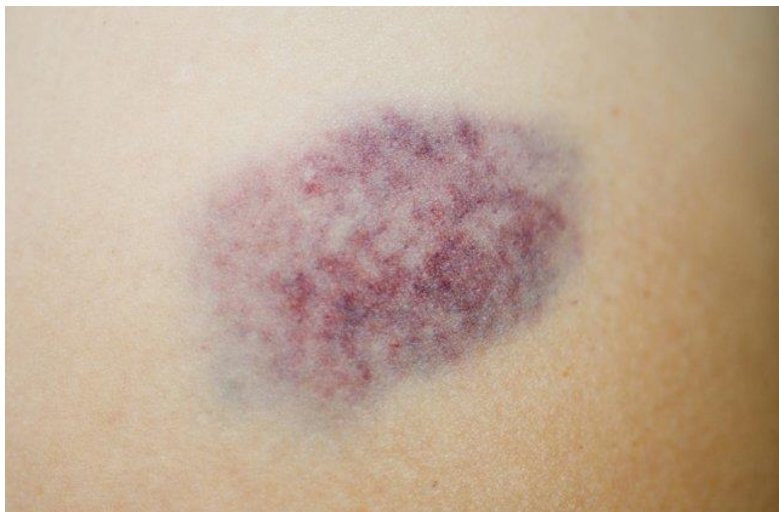
# General appearance

## Face

- rashes, conjunctival pallor, scleritis and/or uveitis
- Fundoscopic examination , gingival hyperplasia, Uremic fetor

## Skin

- rashes, bruising, scratch marks and excoriations, vasculitic rash





# Assessment of fluid balance

- **General appearance**
- **Pulse and blood pressure (orthostatic)**
- **Jugular venous pressure**
- **Examination of the chest**
- **Peripheral oedema**
- **Weight**
- **Fluid balance charts**

# Abdominal examination

- Position
- exposure
- Inspection

Scars, distension, peritoneal catheter



- Palpation

ballotting technique, A transplanted kidney, bladder ,renal angle  
tenderness



# Abdominal examination

- Percussion

Ascites ,enlarged bladder ,enlarged kidneys

- Auscultation

Aorta, renal arteries

# The physical examination

- **General appearance**
- **Assessment of fluid balance**
- **Abdominal examination**
- **Targeted examination of other systems**  
Joints, nervous system, prostate

# Urine analysis

| 12.5 Key elements of urine dipstick test |   |
|--|---|
| Investigation                            | Comment   |
| Specific gravity                         | Reflects urine solute concentration. Varies between 1.002 and 1.035. Raised when kidneys actively reabsorb water, e.g. in fluid depletion or renal failure due to decreased perfusion. Abnormally low values indicate failure to concentrate urine  |
| pH                                       | Normally 4.5–8.0. In renal tubular acidosis, pH never falls <5.3 despite acidaemia  |
| Glucose                                  | Small amounts may be excreted by normal kidneys. Glycosuria may indicate poorly controlled diabetes mellitus. It may occur in intrinsic renal disease when tubular glucose reabsorption is impaired   |
| Ketones                                  | Test is specific for acetoacetate and does not detect other ketones, e.g. $\beta$ -OH butyrate, acetone. Ketonuria occurs in diabetic ketoacidosis, starvation, alcohol use and very-low-carbohydrate diets   |
| Protein                                  | Varies between trace and 4+. The greater the degree of proteinuria, the more likely there is to be significant renal disease. Most patients with nephrotic syndrome will have 4+ protein. The presence of both blood ( $\geq 2+$ ) and protein ( $\geq 2+$ ), an 'active urinary sediment', often indicates intrinsic renal disease. As urinalysis is semiquantitative, confirmatory laboratory quantification should be undertaken using either a urine albumin:creatinine or protein:creatinine ratio (see <a href="#">Box 12.4</a> ) |
| Blood                                    | $\geq 1+$ is positive for non-visible haematuria. The test does not differentiate between haemoglobin and myoglobin. If you suspect rhabdomyolysis, measure myoglobin with a specific laboratory test   |
| Bilirubin and urobilinogen               | Bilirubin is not normally present. Urobilinogen may be up to 33 $\mu\text{mol/L}$ in health. Abnormalities of bilirubin and urobilinogen require investigation for possible haemolysis or hepatobiliary disease   |
| Leucocyte esterase                       | Indicates the presence of neutrophils in urine. Seen in urinary tract infection or inflammation, stone disease and urothelial cancers   |
| Nitrite                                  | Most Gram-negative bacteria convert urinary nitrate to nitrite. A positive result indicates bacteriuria but a negative result does not exclude its presence   |



# Investigation of renal function

- Functional assessment of lower urinary tract :

Urodynamic tests

- Blood and urine investigations

Urea, creatinine, electrolytes, ANCA ,..

- Imaging

U/S, CT , renal biopsy ,..

Thank you