

Biomarkers of renal diseases

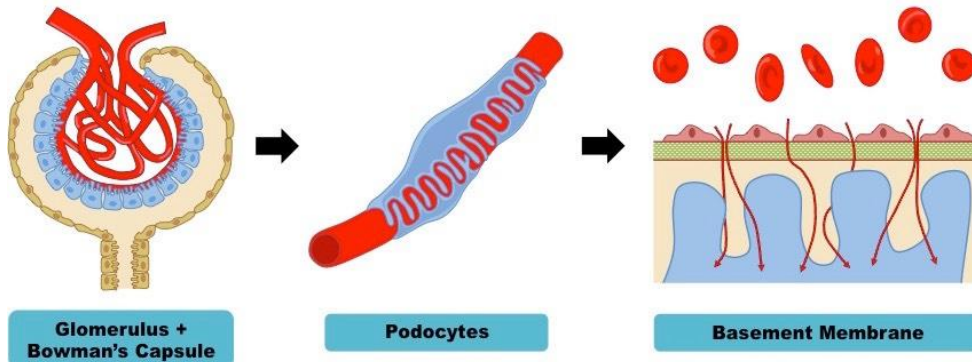
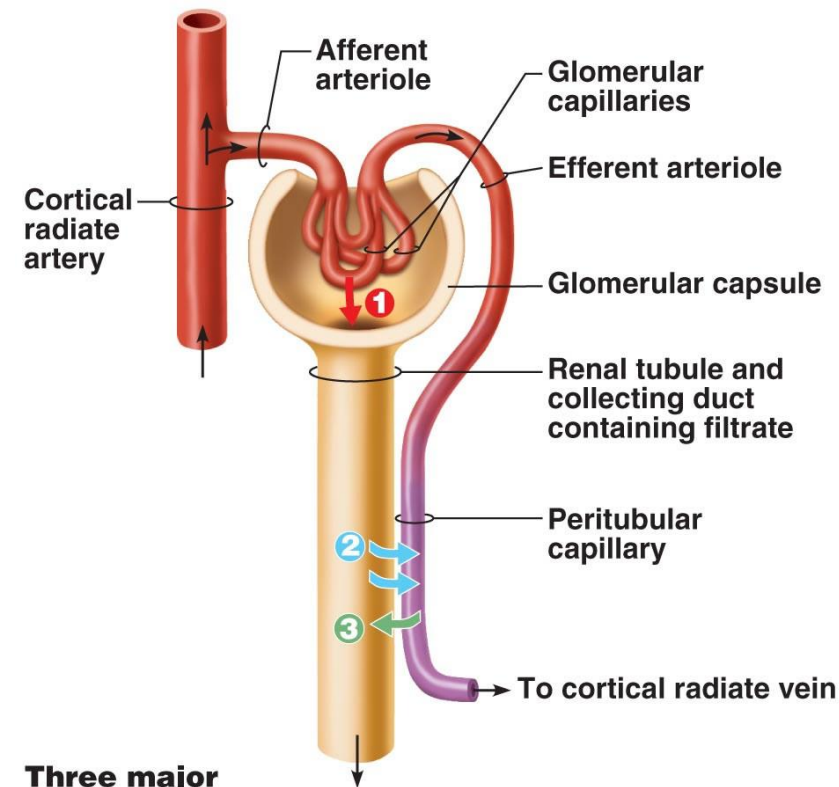
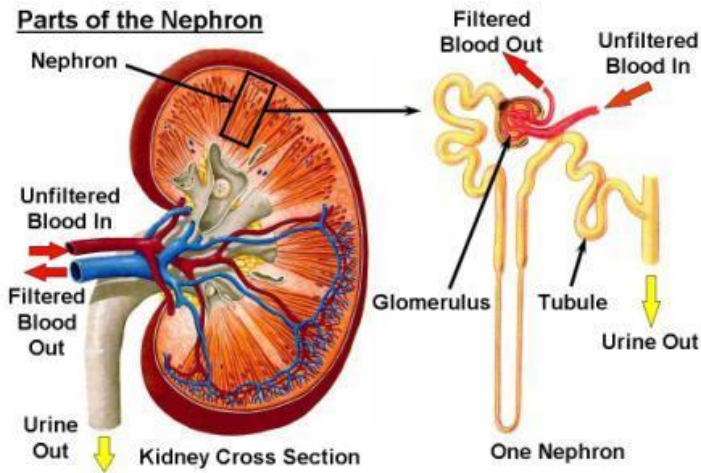
By
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Biomarkers of renal diseases

- **Introduction**
- Renal system performs several functions
- **Excretory**
 - Waste products like urea, creatinine, drug, toxins clearance
- **Regulatory**
 - Water, electrolyte and acid base balance
- **Endocrine**
 - Prostaglandins, erythropoitin, renin...
- **Metabolic**
 - Synthesis of vitamin D

Biomarkers of renal diseases

- Nephron is the functional unit of kidney
- Each kidney has 1-1.2 million units



- Three major renal processes:**
- ① → Glomerular filtration
 - ② → Tubular reabsorption
 - ③ → Tubular secretion

Biomarkers of renal diseases

- General biomarkers of renal function
- Color of urine
 - Normal urine color ranges from pale yellow to dark yellow
 - Abnormal colors results from changes in conc. pH, metabolic wastes, diet....
- Odor
 - Offensive odor can indicate infection
- Volume
 - **Oliguria** – renal ischemia, obstructions from due to renal calculi
 - **Polyurea** – several conditions

Biomarkers of renal diseases

Abnormalities in color

Colorless to pale yellow

- High intake of water
- Reduced sweat
- Using diuretics
- Diabetes Mellitus
- Diabetes Insipidus
- Alcohol intake
- Nervousness

Black urine

- Alkaptonurea – inborn error of metabolism (tyrosine metabolism)

Dark yellow, Amber, orange

- low water intake
- excessive sweating
- dehydration (high grade fever / burns)
- Diet (carrots , vitamin A supplements)
- some drugs

Pink – red

- Presence of blood – UTI infection, Trauma....

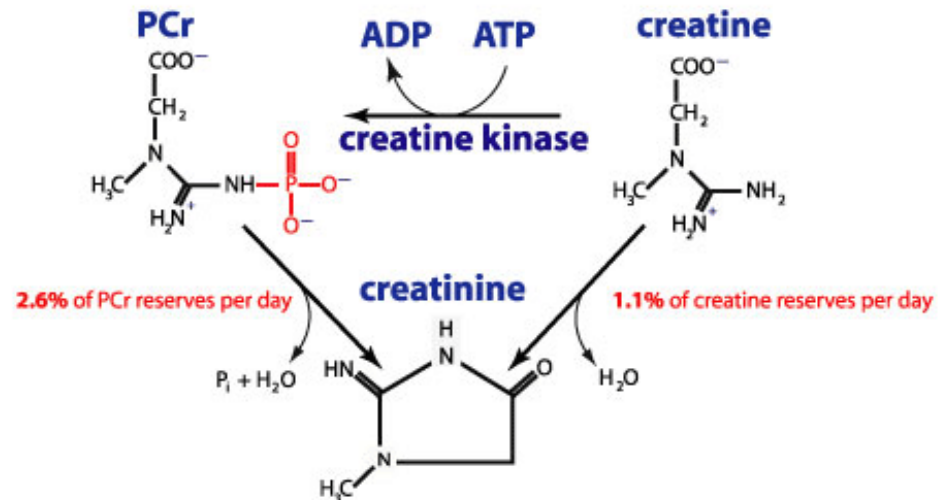
Blue – green

- Infection - Pseudomonas



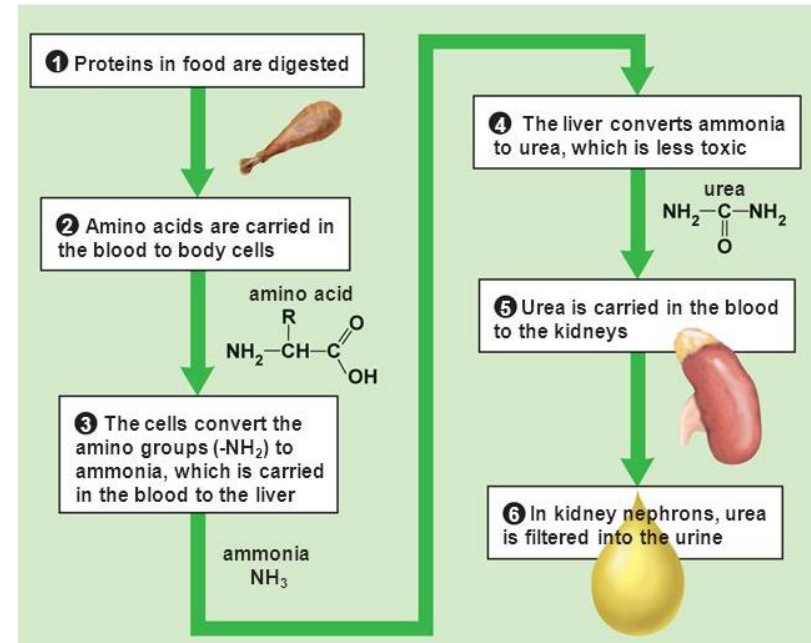
Biomarkers of renal diseases

- General biomarkers of renal function
- Serum creatinine
 - Waste product in the body from muscle metabolism
 - Kidneys clear the creatinine
 - Increase in serum creatinine indicate filtration problems



Biomarkers of renal diseases

- General biomarkers of renal function
- Blood urea nitrogen (BUN)
 - Urea is a waste product produced by metabolism of protein in the body
 - Cleared by kidneys
 - Increase in BUN indicate kidney function is slowed down
 - Transient increase is Normal (protein rich diet)



Biomarkers of renal diseases

- General biomarkers of renal function
- Cystatin C
 - A 13 KD low molecular weight protein
 - Removed from blood by kidneys
 - Direct indication of glomerular filtration rate
 - Increase in cystatin C in blood indicate problem with kidney filtration
 - Is independent of age, sex, muscle mass, diet

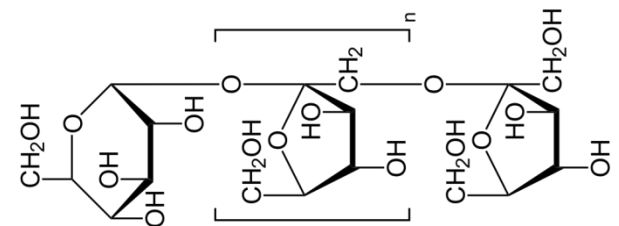


	Cystatin C		Creatinine		
	Creatinine-blind area →				
GFR mL/min/1.73m ²	>89	60 – 89	30 – 59	15 – 29	<15
Stage	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Kidney damage	Kidney damage with normal/elevated GFR	Mild kidney insufficiency	Moderate kidney insufficiency	Severe kidney insufficiency	End stage renal disease (ESRD)

Biomarkers of renal diseases

- General biomarkers of renal function
- GFR
 - Glomerular filtration rate
 - Flow rate of filtered fluid through kidneys
 - GFR can be measured by creatinin clearance of inulin clearance
 - Inulin is a fructan (polymer of fructose)
 - Naturally present in plants
 - As it is not reabsorbed by kidneys can be used to calculate GFR

$$\frac{\text{Inulin conc. in urine (mg/L)} \times \text{urine volume (ml/min)}}{\text{Inulin conc. in serum (mg/L)}}$$

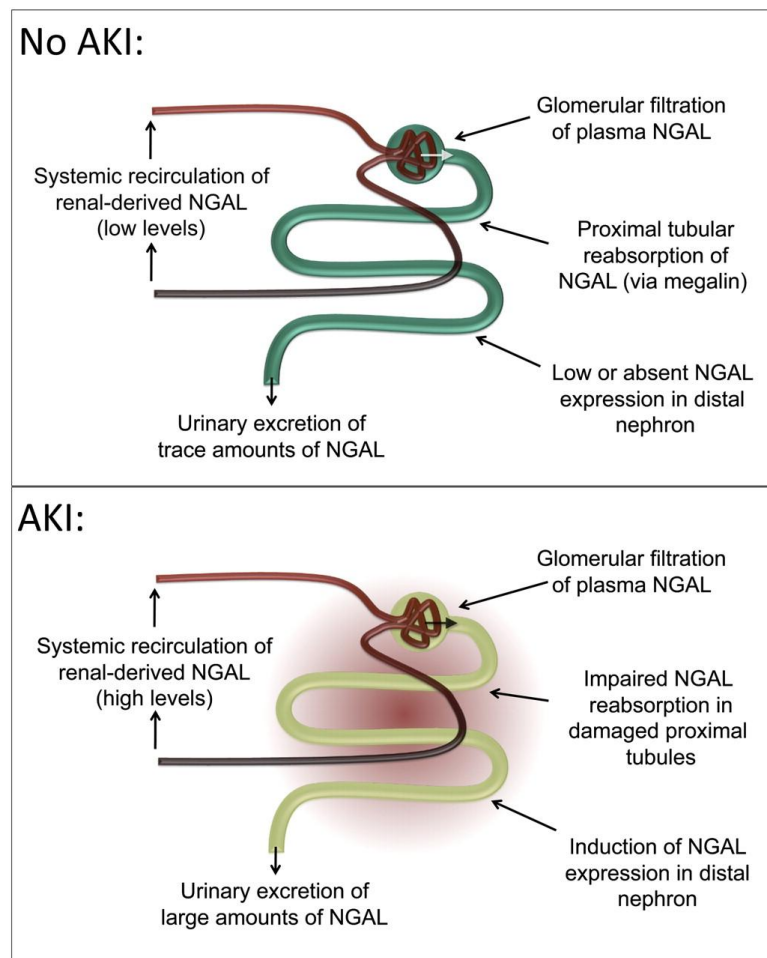


Biomarkers of renal diseases

- Acute kidney injury (AKI)
- NGAL – neutrophil gelatinase associated lipocalin
 - Expressed in neutrophils and also by kidney and parts of lungs
 - Neutrophils increase the production to hide the iron from bacteria during inflammation
 - Within couple of hours of acute kidney injury levels of NGAL increase in urine and blood
 - AKI results mainly because of low blood supply to kidneys and cancers also
 - Sepsis and trauma also results in AKI
 - Over usage of NSAIDs also may result in AKI

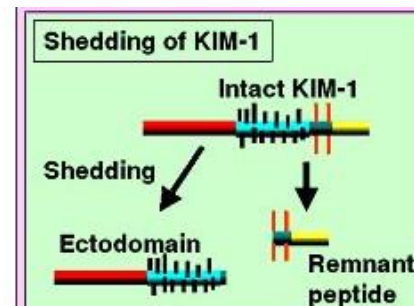
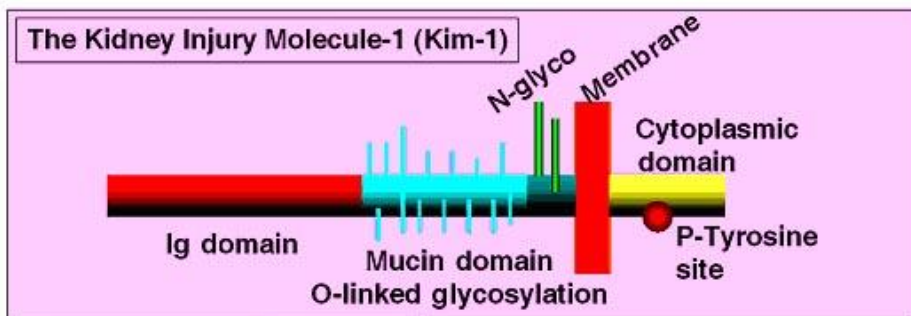
Biomarkers of renal diseases

- Acute kidney injury
- NGAL – neutrophil gelatinase associated lipocalin



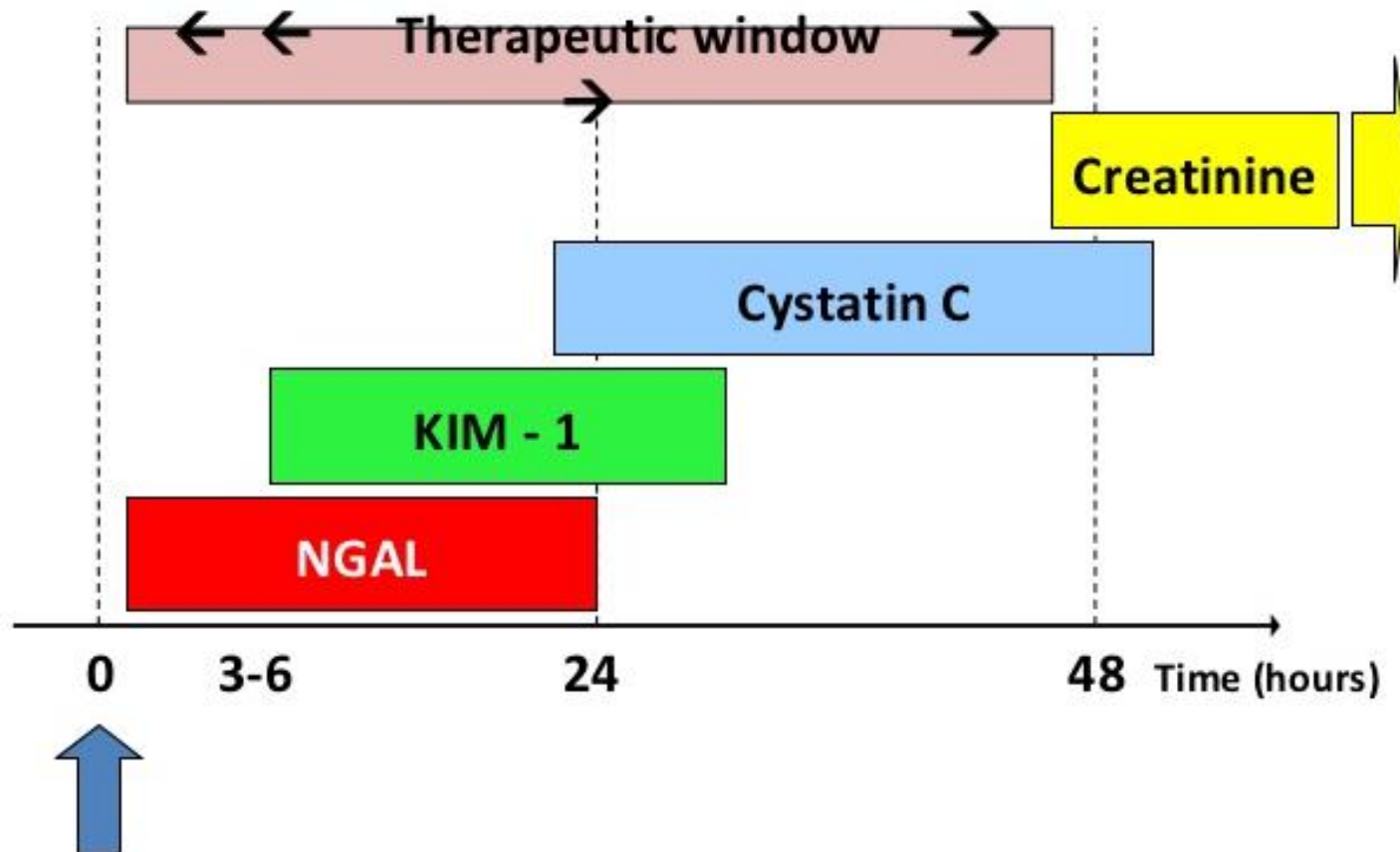
Biomarkers of renal diseases

- Acute kidney injury
- KIM-1 (kidney injury molecule 1)
- It is a type of transmembrane glycoprotein
- KIM-1 expressed on the surface of tubular epithelial cells in the kidneys
- Normally undetected (<1 ng/ml urine)
- Ischemic conditions leads to over expression and elevated in urine (3 – 7 ng/ml urine)
- Serves as excellent early biomarker of AKI



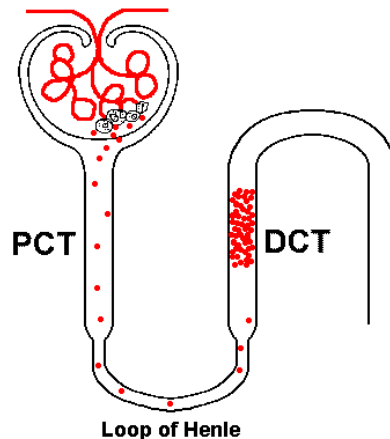
Biomarkers of renal diseases

- Acute kidney injury time course



Biomarkers of renal diseases

- Other markers associated with clinical conditions
- Increased protein in urine – Diabetic nephropathy
- > 3.5 g/day loss of protein – Nephrotic syndrome
- Hematuria and RBC casts – Nephritic syndrome

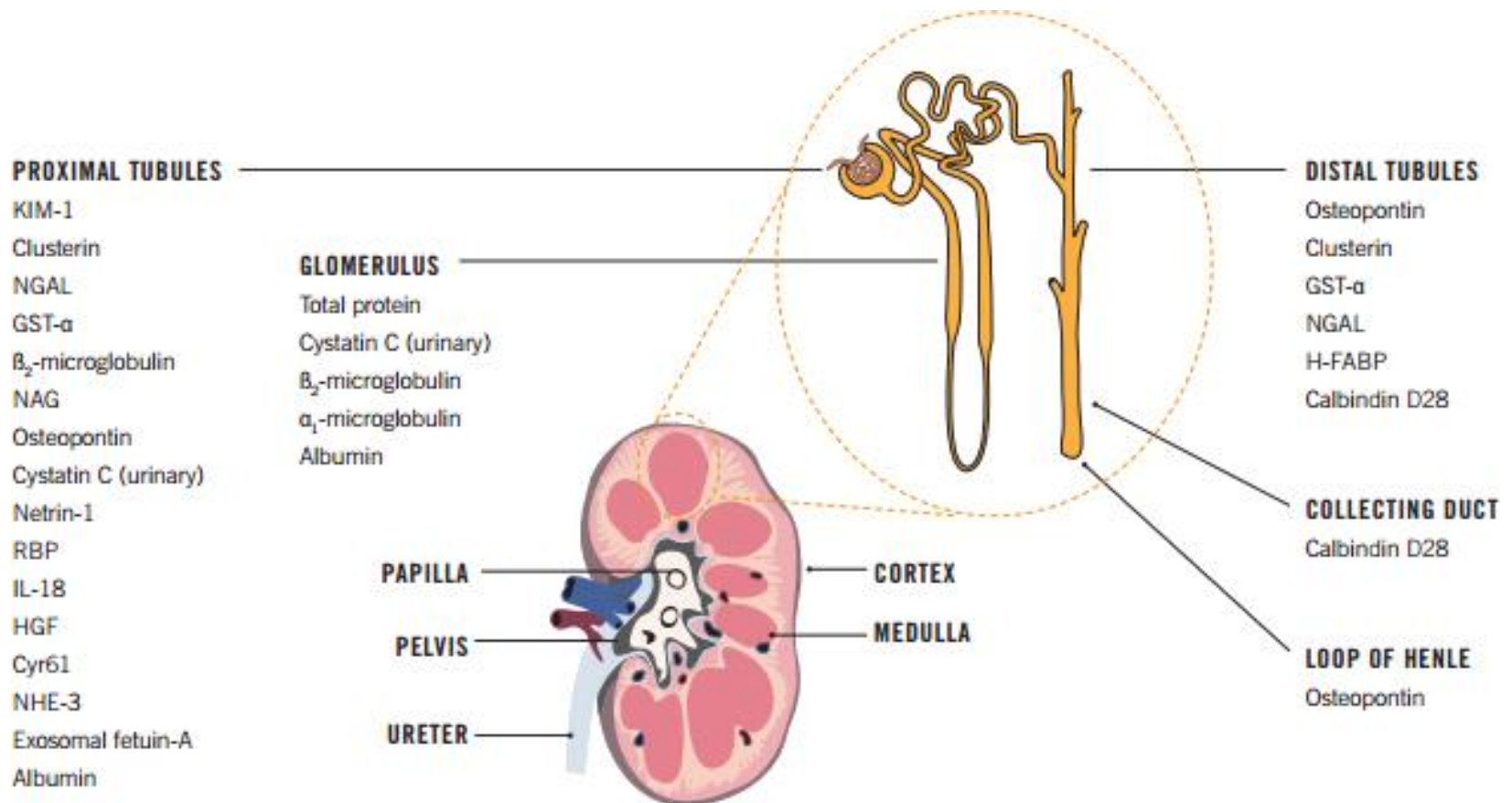


Biomarkers of renal diseases

- Other markers associated with clinical conditions
- Increased protein in urine, blood – **Lupus nephritis** – anti nuclear antibody-antigen complex depositions
 - Genetic predisposition to lupus
- Chronic renal failure – increased CRP

Biomarkers of renal diseases

- Other biomarkers



Next class

- Next class.....
 - Biomarkers of Pulmonary diseases