

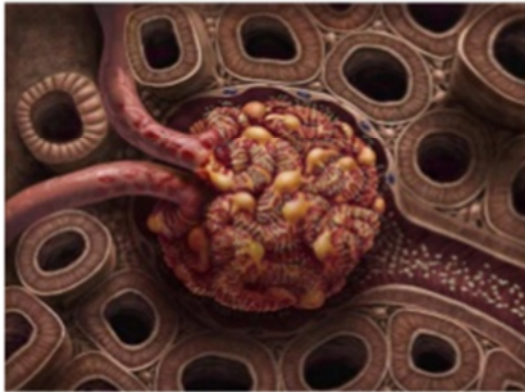
Proteinuria in Children

Alaleh Gheissari, MD
Pediatric Nephrologist
Professor of Pediatrics
IUMS



Protein Handling

MECHANISMS OF PROTEIN HANDLING BY KIDNEY

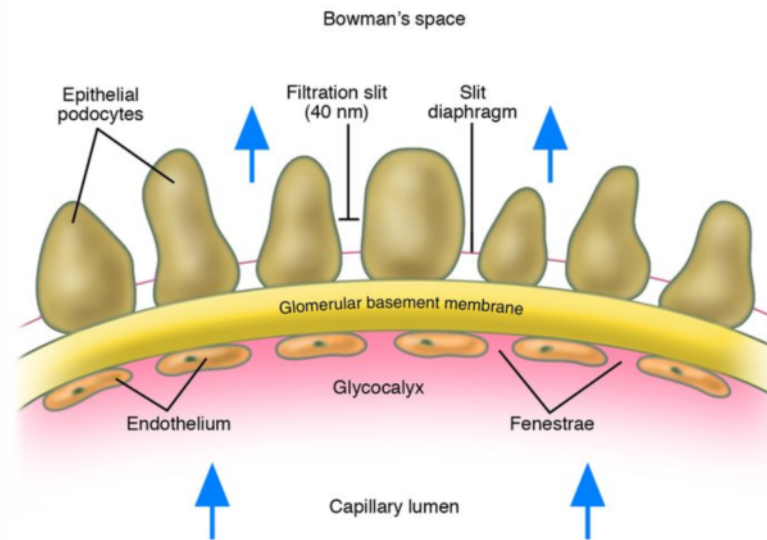


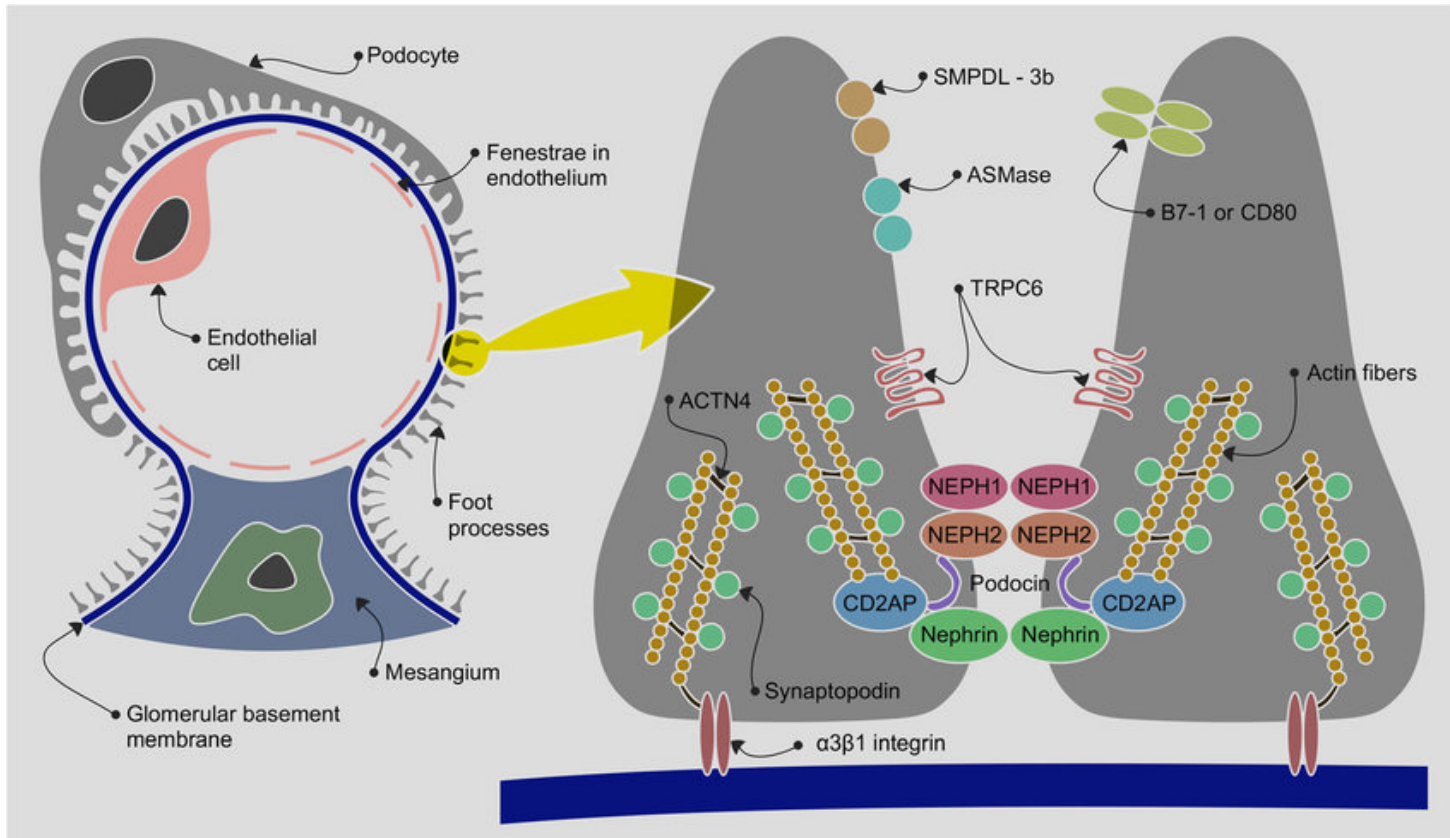
- Glomerular capillary wall permits passage of small molecules while restricting macromolecules



Glomerular Capillary Wall

- Endothelial Cell
- Basement Membrane
- Epithelial Cell (Podocyte)

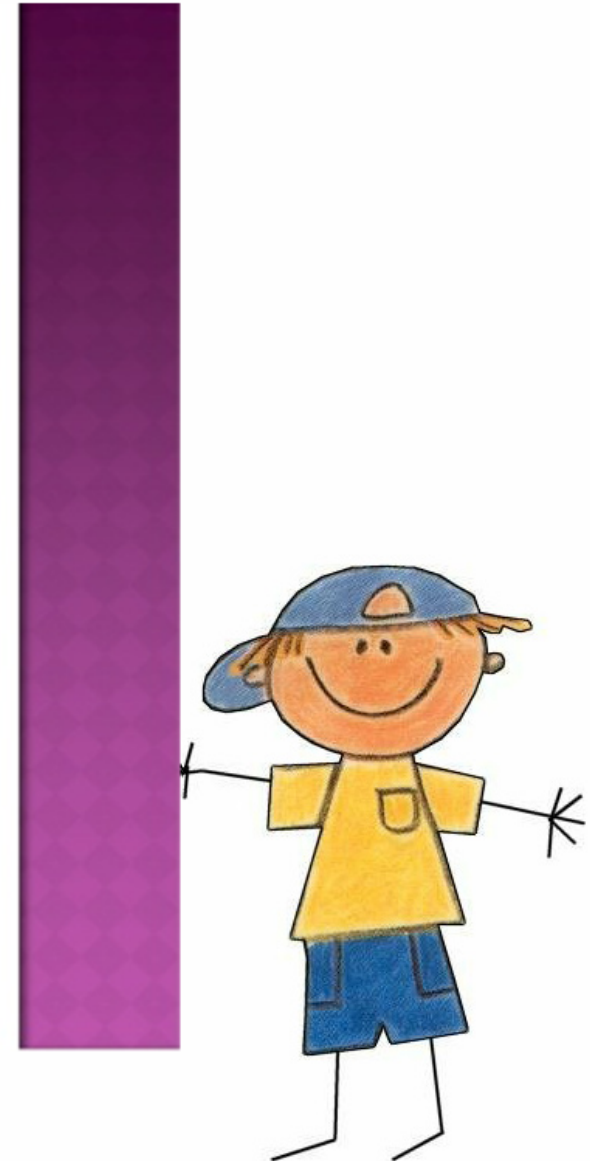




MECHANISMS OF PROTEIN HANDLING BY KIDNEY

▣ Glomerular permeability

- The charge and size selective properties of the glomerular capillary wall prevent significant amounts of albumin, globulin, and other large plasma proteins from entering the urinary space
- LMW protein do cross the capillary wall but are reabsorbed by the proximal tubule.
- small amount o f protein that normally appears in the urine is the result of normal tubular secretion.



Urine Dipstick Measurement of Protein

- Dipsticks primarily detect albuminuria and are less sensitive for other forms of proteins (low-molecular-weight proteins, Bence Jones protein, gamma globulins).
- The dipstick is reported as:
 - negative,
 - trace (10-29 mg/dL),
 - 1+ (30-100 mg/dL),
 - 2+ (100-300 mg/dL),
 - 3+ (300-1000 mg/dL),
 - 4+ (>1000 mg/dL).



Normal Protein Excretion

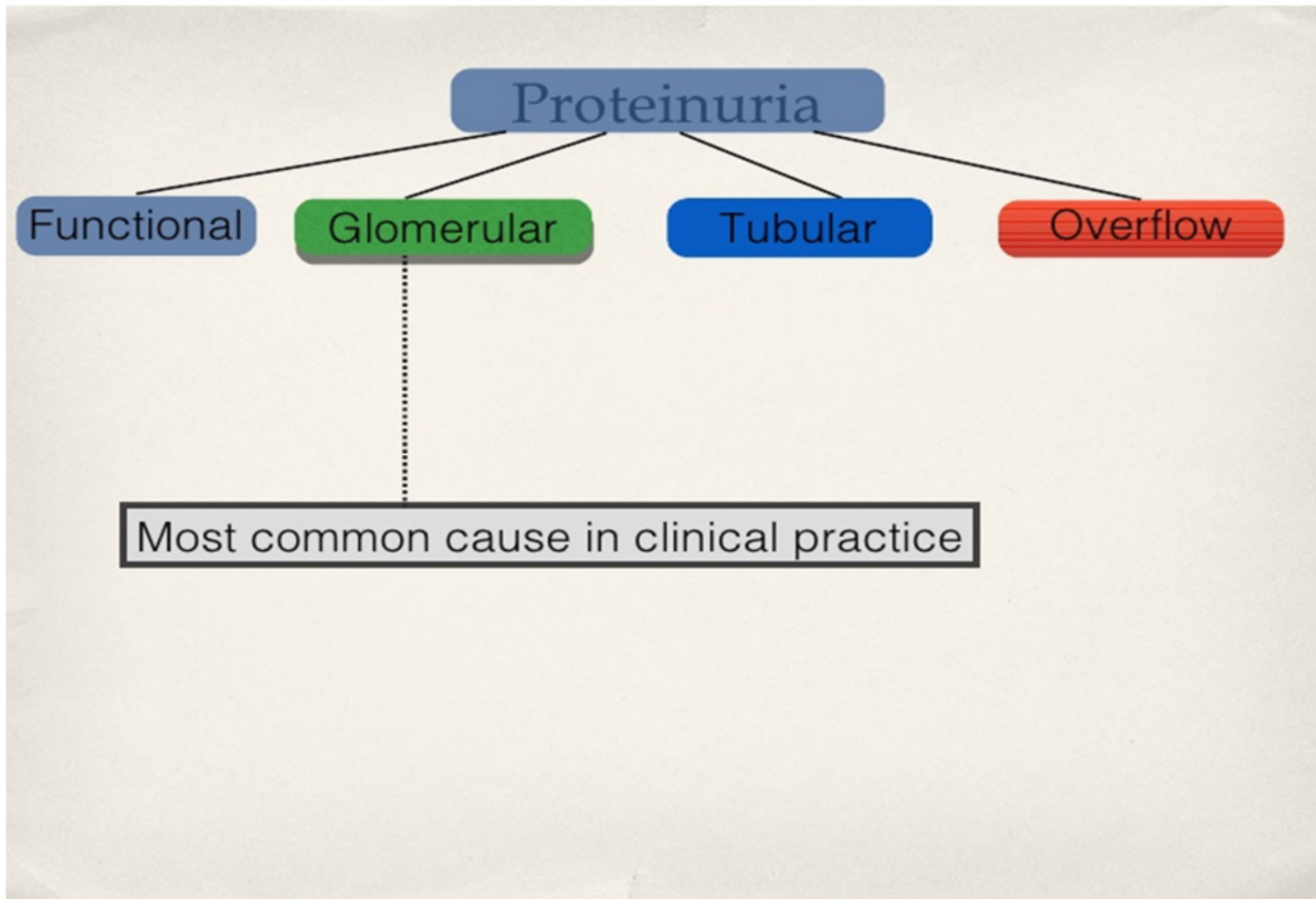
- Positive urine dipstick test:
 - > Trace
 - SG < 1010
- If SG > 1015
- Then dipstick \geq +1 is considered positive
- Timed (24-hr) urine collections: more precise
- Urinary protein excretion in the normal child is less than 100 mg/m²/day or a total of 150 mg/day.
- In neonates, normal urinary protein excretion is higher, up to 300 mg/m², because of reduced reabsorption of filtered proteins.



Normal Protein Excretion

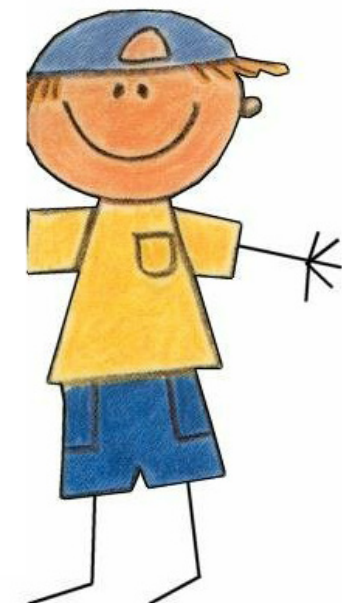
- **In Timed- Urine Collection:**
- Normal protein excretion in children is defined as ≤ 4 mg/m² /hr;
- Abnormal proteinuria is defined as excretion of 4-40 mg/m² /hr;
- Nephrotic-range proteinuria is defined as > 40 mg/m² /hr.





Proteinuria

| Glomerular | ↓ Tubular absorption | ↑ Protein overload |
|---|---|--|
| <ul style="list-style-type: none"> • Congenital: <ul style="list-style-type: none"> - Finish-type - TORCH infection • Nephritis: <ul style="list-style-type: none"> - postinfectious GN - lupus - Wegner - HUS - Goodpasture • Nephrotic: <ul style="list-style-type: none"> - Minimal change - FSGS - MPGN • Drugs: captopril • Neoplasia • Renal vein thrombosis | <ul style="list-style-type: none"> • ATN • Fanconi Syndrome • Cystic/dysplastic • Interstitial nephritis • Pyelonephritis <div data-bbox="763 1059 1659 1270" style="border: 1px solid black; background-color: #e0f2f7; padding: 5px; margin-top: 10px;"> <p>Urine electrophoresis:</p> <ul style="list-style-type: none"> • Glomerular: albumin • Tubular: other proteins.. </div> | <ul style="list-style-type: none"> • Hemolysis • Rhabdomyolysis • Light chain |

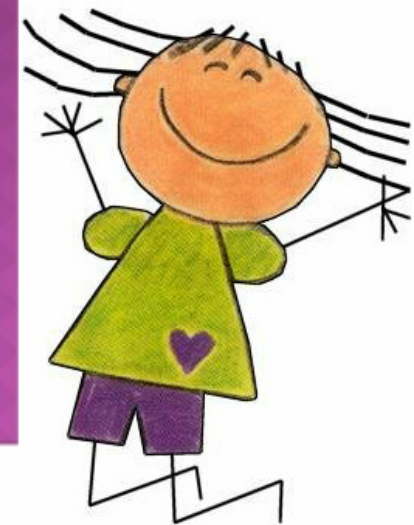


ABNORMAL PROTEIN EXCRETION

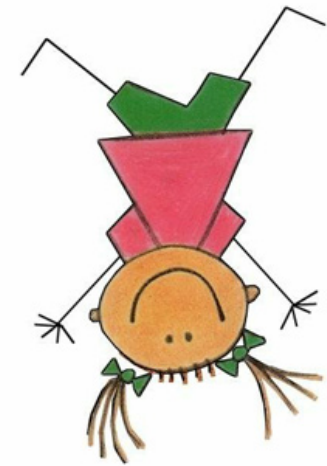
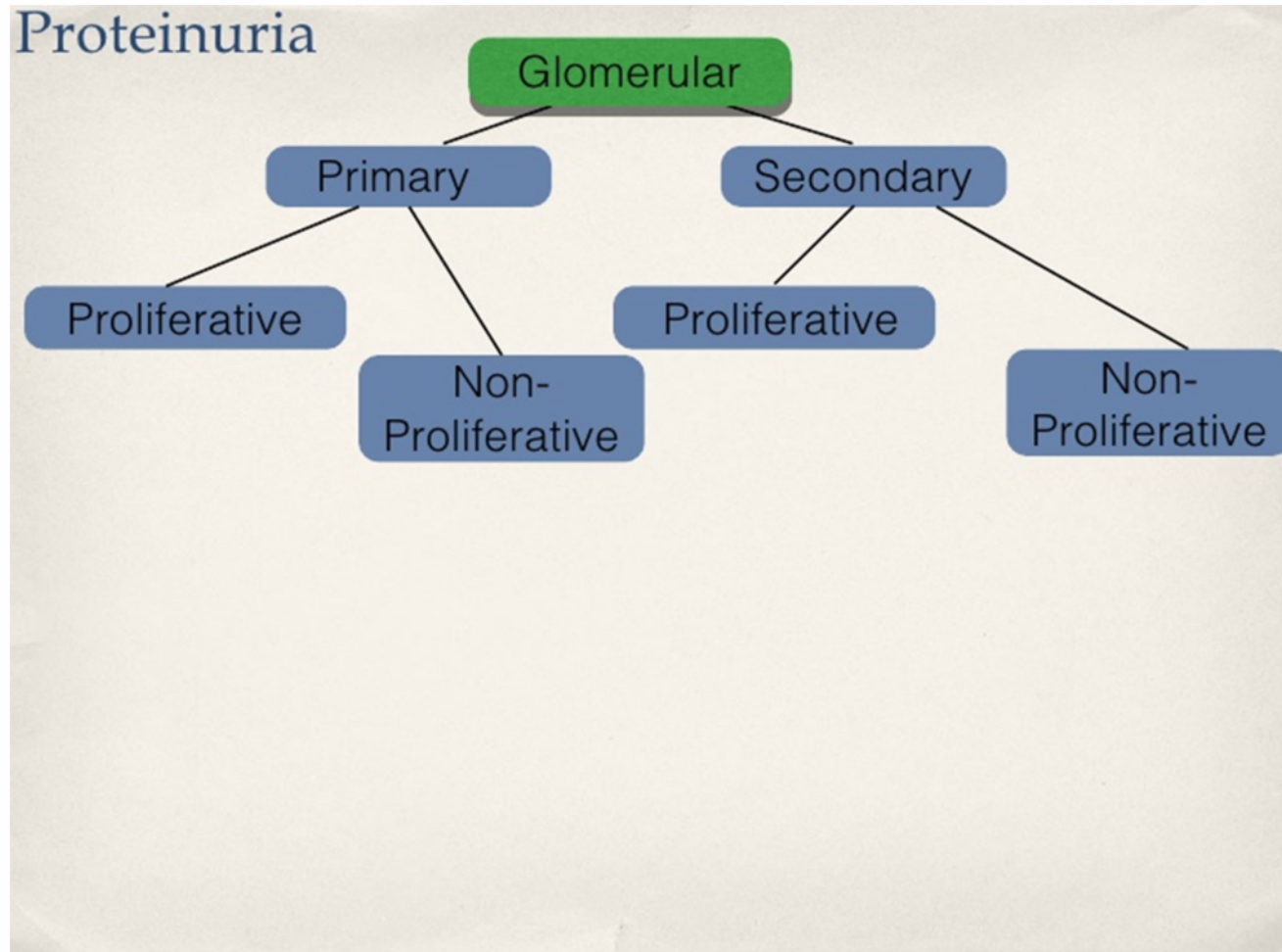
3 possible mechanisms

▮ Glomerular proteinuria

- Due to increased filtration of macromolecules
- May result from glomerular disease (most often minimal change disease) or from nonpathologic conditions such as fever, intensive exercise, and orthostatic (or postural) proteinuria



Glomerular Proteinuria

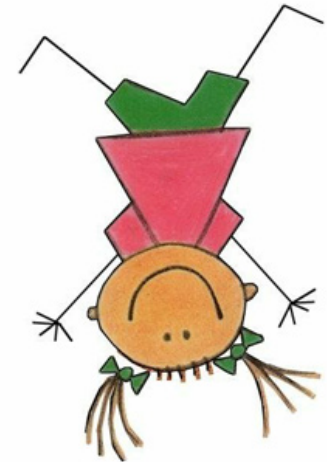


Tubular Proteinuria

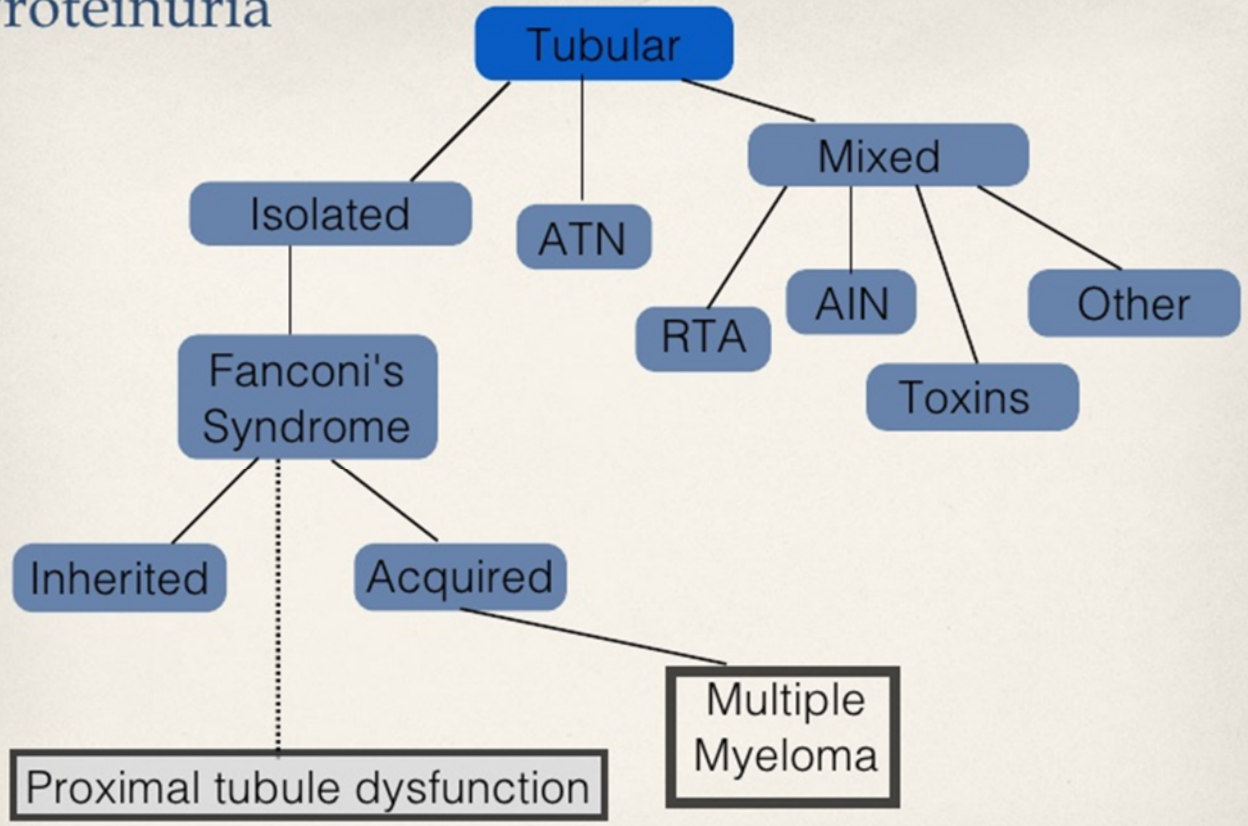
ABNORMAL PROTEIN EXCRETION

▣ Tubular proteinuria

- Results from increased excretion of low molecular weight proteins such as beta-2-microglobulin, alpha-1-microglobulin, and retinol-binding protein
- Tubulointerstitial diseases, can lead to increased excretion of these smaller proteins



Proteinuria



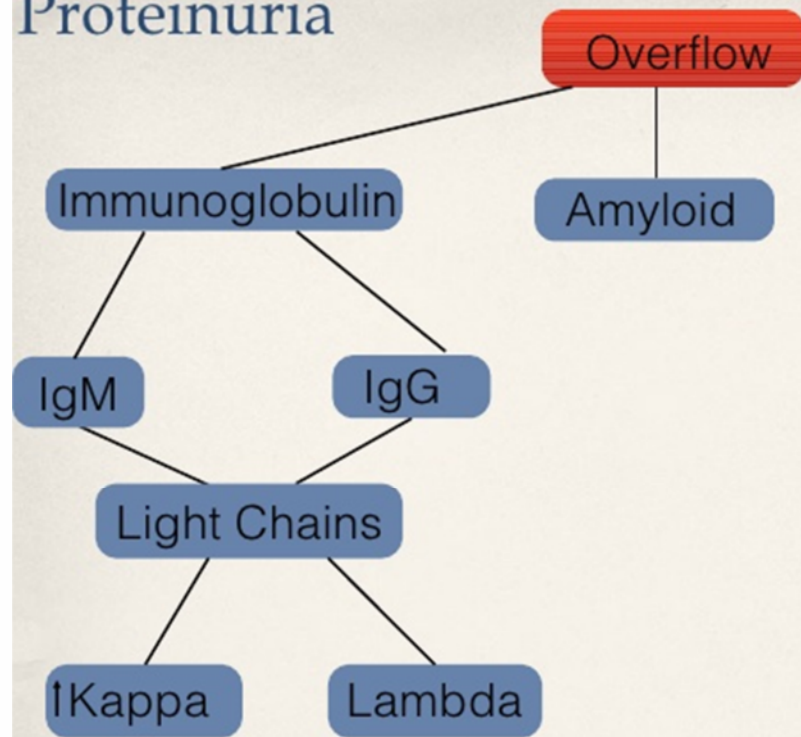
ABNORMAL PROTEIN EXCRETION

▮ Overflow Proteinuria

- Results from increased excretion of low molecular weight proteins due to marked overproduction of a particular protein to a level that exceeds tubular reabsorptive capacity



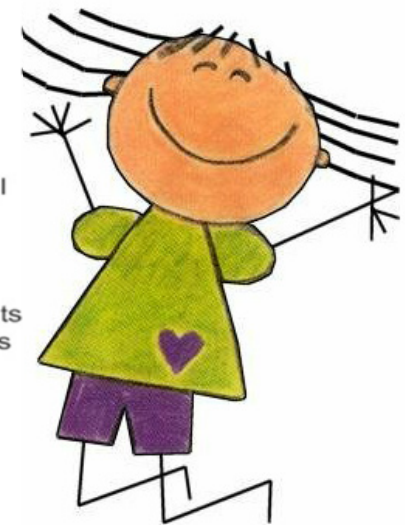
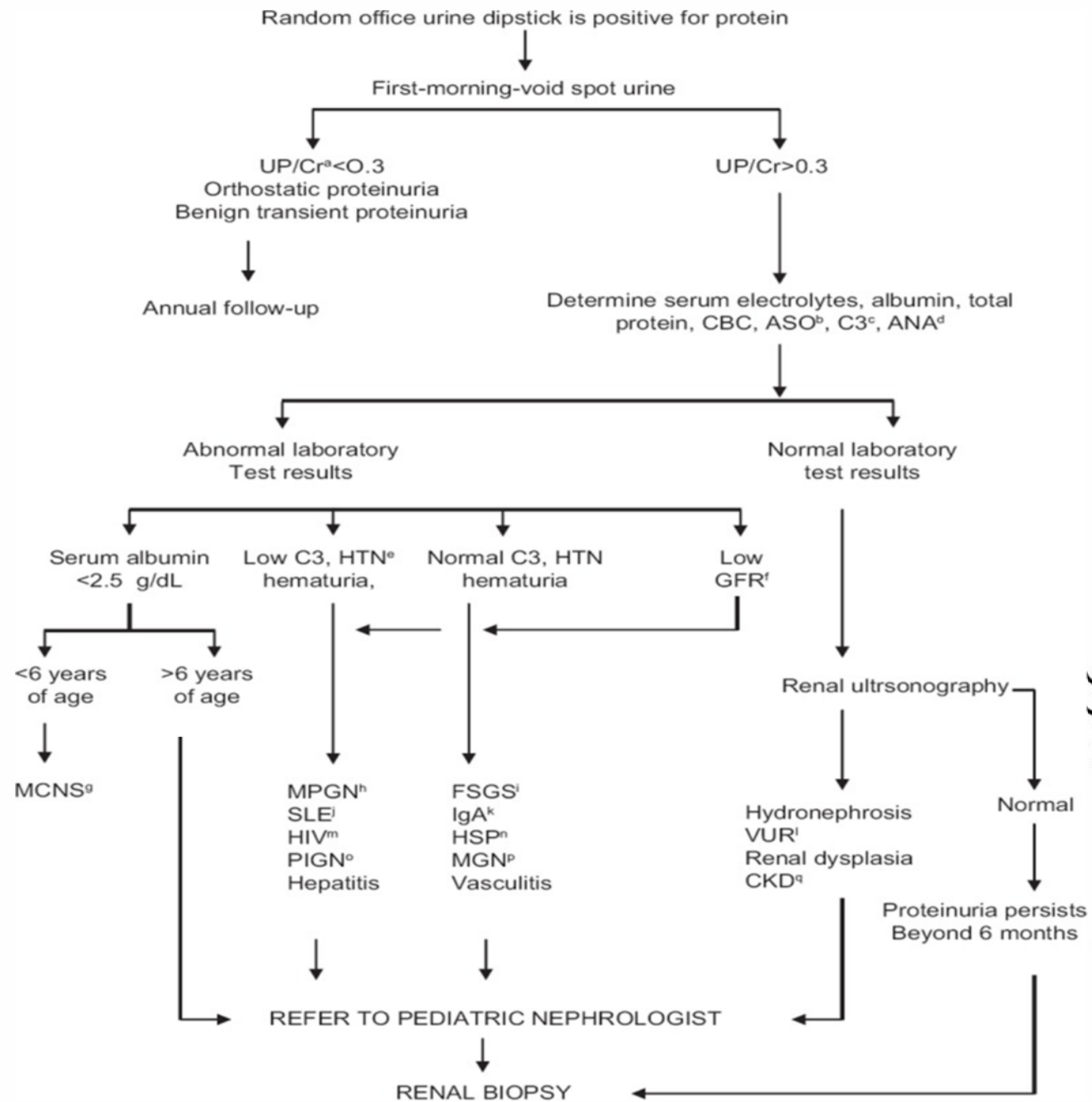
Proteinuria



ORTHOSTATIC PROTEINURIA

- Most common cause (60%) of persistent proteinuria
- Increase in protein excretion in the erect position compared with levels measured during recumbency
- Proteinuria usually does not exceed 1-1.5 gm/day
- Mechanism postulated to involve an increased permeability of the glomerular capillary wall and a decrease in renal plasma flow
- Long-term studies have documented the benign nature of this condition, with recorded normal renal function up to 50 years later

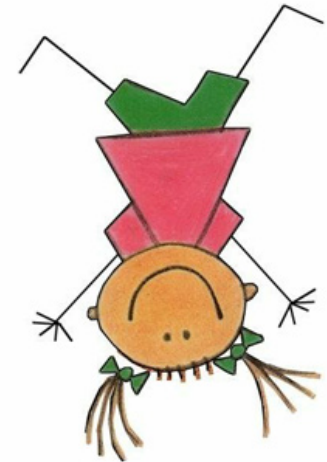




Case Presentation

Case 1

- 15 year old, athletic boy
- Regular check up:
 - Urine dip: Prot 2+
 - Urine prot/Cr ratio: 50 mg/mmol
- What next?



Case 1

- 8 am: urine prot/Cr ratio- 10 mg/mmol
- 4 pm: urine prot/Cr ratio- 50 mg/mmol

Orthostatic proteinuria



Case Presentation

Case 2

- 1 year old infant with failure to thrive. Both height and weight are below the 3rd percentile. He has sings of rickets in exam.
- Urine dip: Prot 3+ , Glu 2+



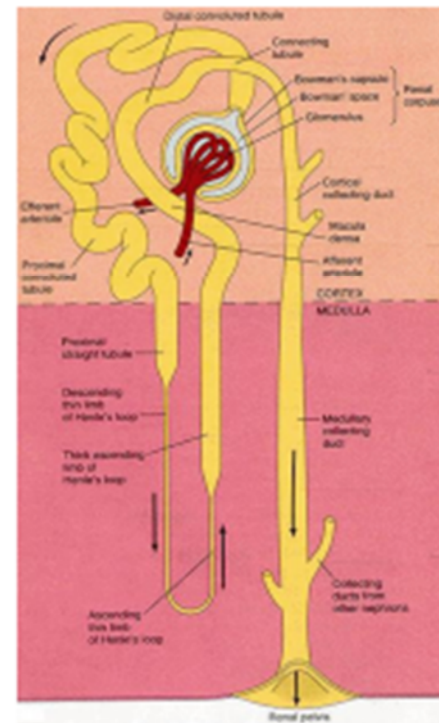


Derakhshan Ali et al. Saudi J Kidney Dis Transpl. 2007 Oct-Dec;18(4):585-9.

Tubular Proteinuria

Fanconi Syndrome

- PCT defect
- Proximal renal tubular acidosis (type II RTA)
- Glucosuria
- Aminoaciduria
- Phosphaturia
- hypokalemia



Case 3

- 5 year old boy, presenting with puffy eyes, enlarged tummy, and feet swelling.
- Exam: normal BP, ascites, pitting edema
- Urine dip: Prot 4+

- What's the next step?



Case Presentation

Glomerular Proteinuria

Case 3

- Urine prot/cr 1500 mg/mmol
- Serum albumin 15 g/l
- High cholesterol

