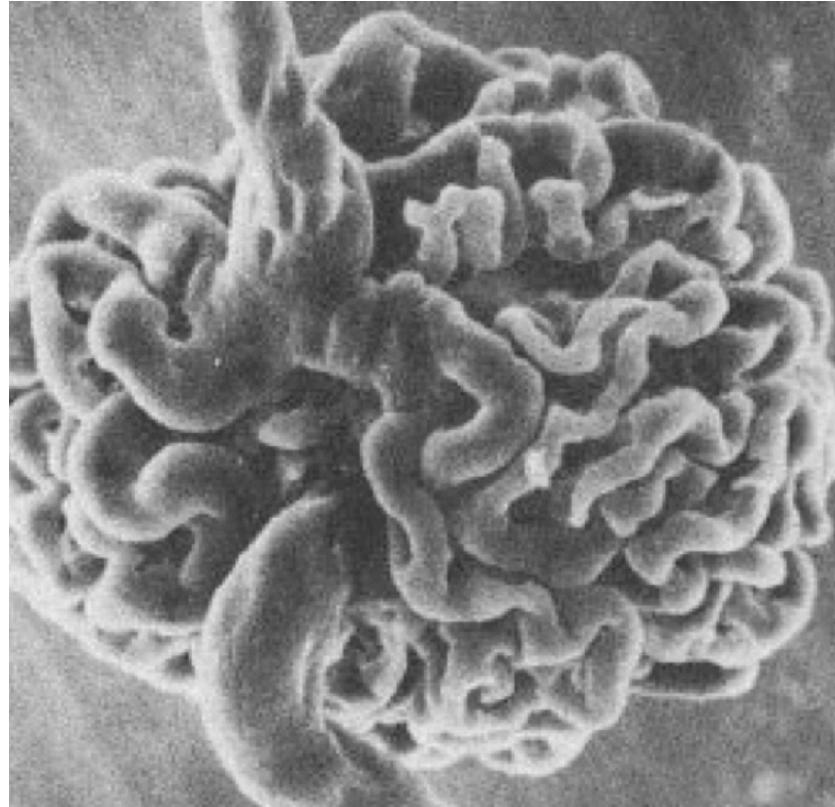


Part I. Glomerular Disorders for USMLE Step One



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Glomerulopathies

Think categorically: Deduce, Don't Memorize

Nephrotic

Nephritic

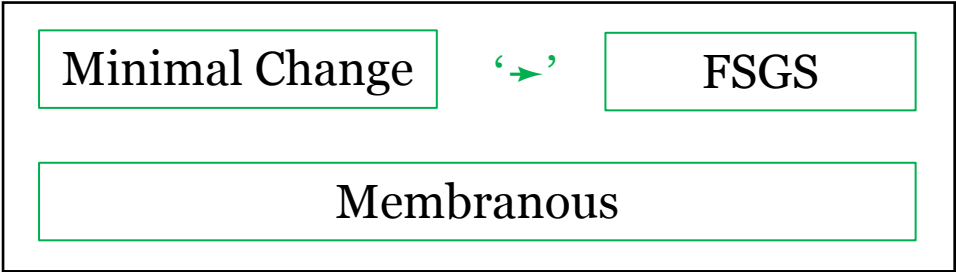


CT Scan Image of My Mind's Eye

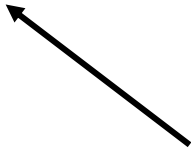
Glomerulopathies

Nephrotic

Nephritic



Podocyte → *Foot Process Effacement*



Mechanism/Site of Injury

Think categorically: Deduce, Don't Memorize

Glomerulopathies

Nephrotic

Minimal Change ‘→’ FSGS

Membranous

Podocyte → *Foot Process Effacement*

Nephritic

IgA Nephropathy
PSGN

Wegener’s (GPA)
Goodpasture

Broken GBM → **AKI/RBC**

Mechanism/Site of Injury ↗

Think categorically: Deduce, Don’t Memorize

Glomerulopathies

Nephrotic

Nephritic

Minimal Change



FSGS

IgA Nephropathy
PSGN

Wegener's (GPA)
Goodpasture's

Membranous



Glomerulopathies

Nephrotic

Nephritic

Minimal Change

‘→’

FSGS

IgA Nephropathy
PSGN

Wegener's (GPA)
Goodpasture's

Membranous

Membranoproliferative

SLE

Amyloid
Diabetes

Alport's
Thin Basement Membrane Disease

Glomerulopathies: the Language

Nephrotic

Nephritic

Proteinuria (>3.5 g/day)



Parlez vous, Nephrotic Syndrome



Glomerulopathies

Nephrotic

Nephritic

Proteinuria (>3.5 g/day)



Proteinuria, Mild

Glomerulopathies

Nephrotic

Nephritic

Proteinuria (>3.5 g/day)



Proteinuria, Mild

	Ref Range & Units	
Color, Urine	Colorless, Light Yellow, Yellow, Dark Yellow	Amber !
Clarity, Urine	Clear	Cloudy !
Specific Gravity, Urine	1.005 - 1.030	1.019
pH, Urine	4.6 - 8.0	5.0
Protein, Urine	Negative	2+ !
Glucose, Urine	Negative	Negative
Ketones, Urine	Negative	Negative
Bilirubin, Urine	Negative	Negative
Blood, Urine	Negative	2+ !
Nitrite, Urine	Negative	Negative
Urobilinogen, Urine	Normal	Normal

Glomerulopathies

Nephrotic

Proteinuria (>3.5 g/day)

Nephritic

RBC Casts (or hematuria)

Glomerulopathies

Nephrotic

Proteinuria (>3.5 g/day)

Some RBCs



Nephritic

Proteinuria, Mild

RBC Casts (or hematuria)

Glomerulopathies: the Language

Nephrotic

Proteinuria (>3.5 g/day)

Nephritic

RBC Casts (or hematuria)



Glomerulopathies: the Language

Nephrotic

Proteinuria (>3.5 g/day)

Nephritic

RBC Casts (or hematuria)



Membranoproliferative: mesangial cell → splitting of GBM (tram-track)

SLE: immune complex deposition in subendothelial space

Glomerulopathies

Nephrotic

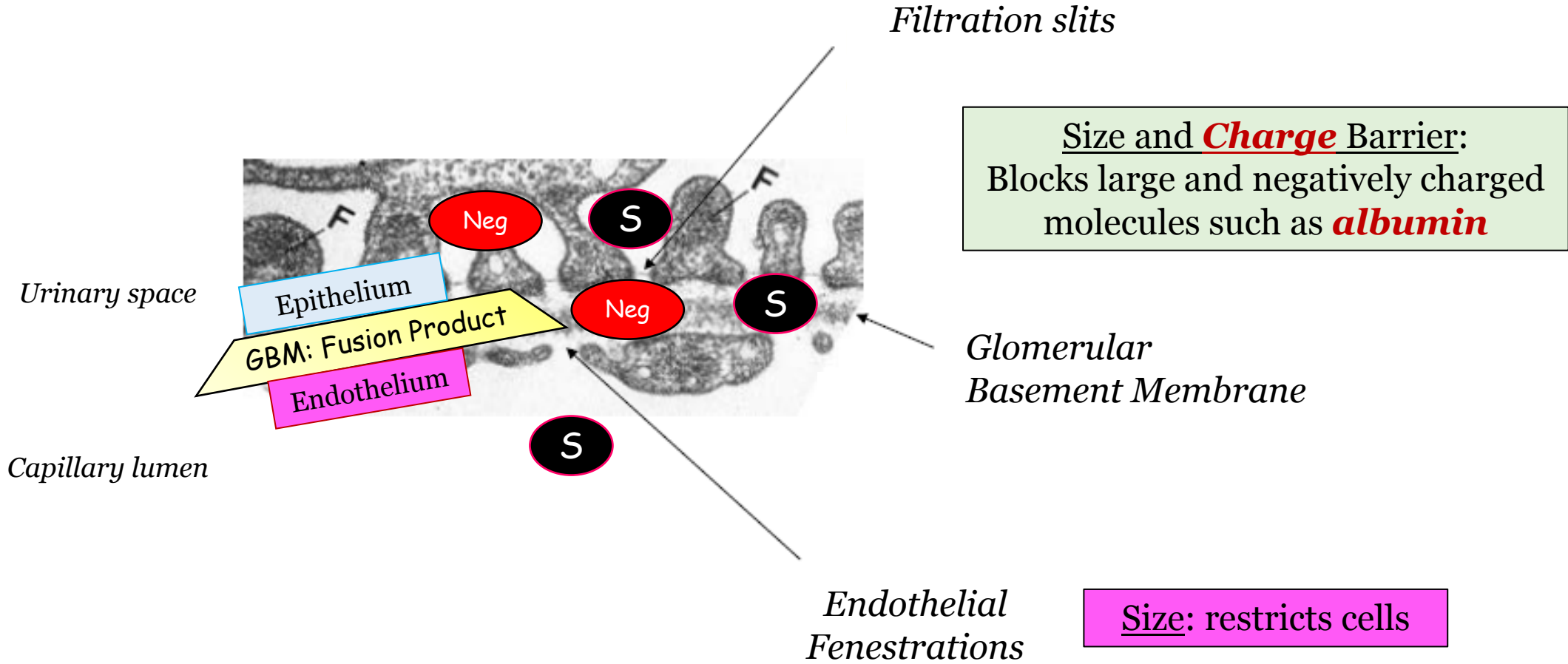
Proteinuria (>3.5 g/day)

Nephritic

RBC Casts (or hematuria)

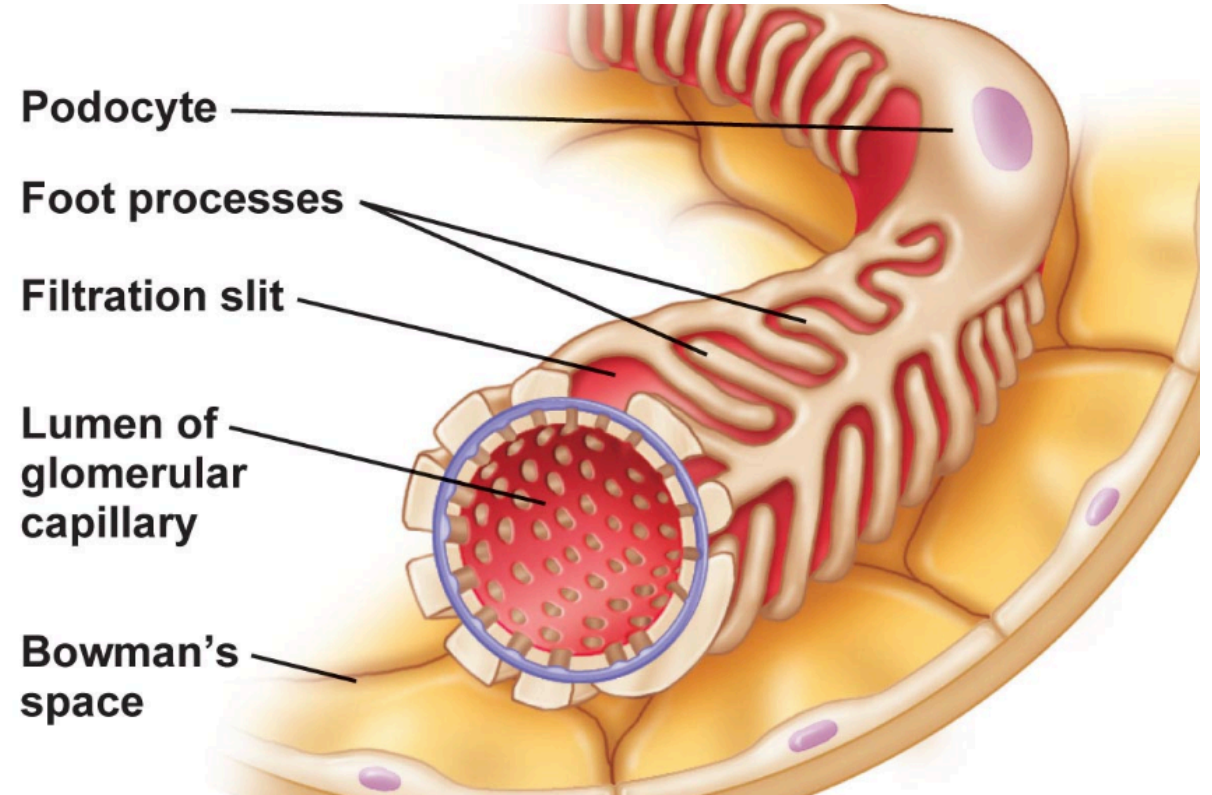
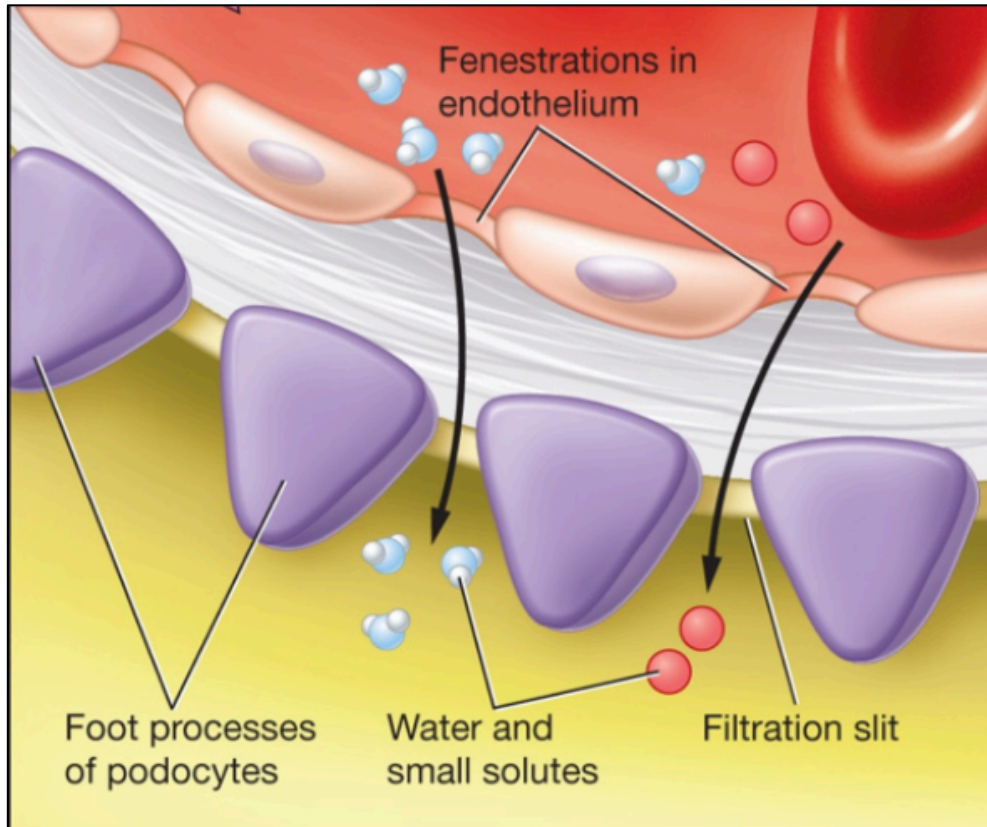


The Filtration Barrier



Cross Sectional Images of:

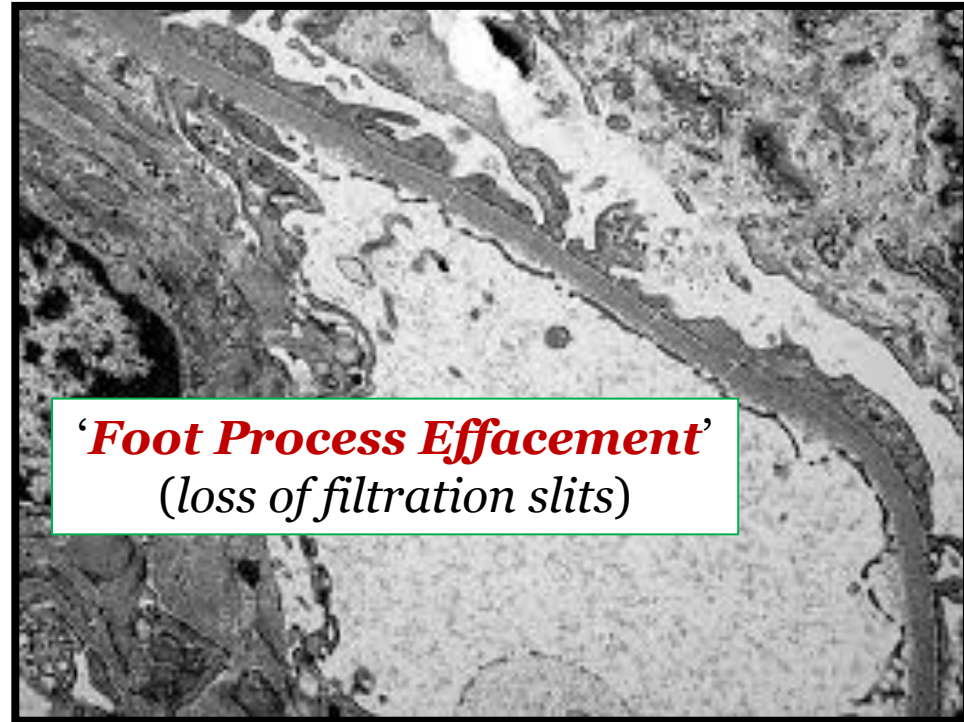
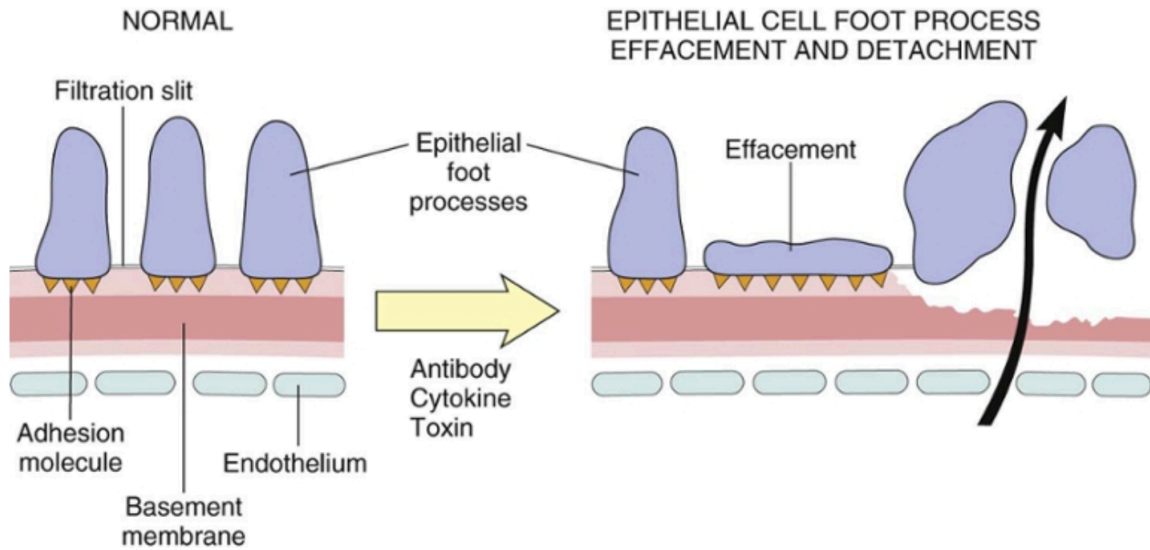
- Capillary endothelium with fenestrations
- Glomerular basement membrane (fusion product)
- Filtration slits of podocyte foot processes



Size and Charge (*not shown*) Barriers

The Filtration Barrier

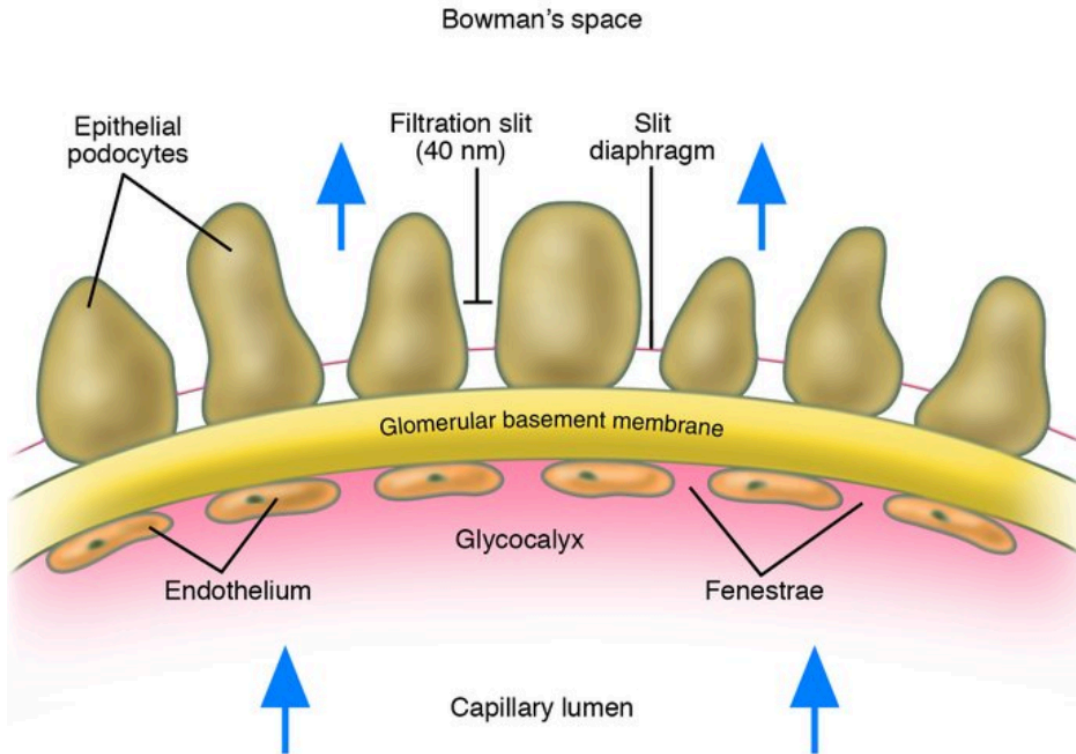
Nephrotic (*MC, FSGS, MN*)



Proteinuria (>3.5 g/day)

The Filtration Barrier

Nephrotic



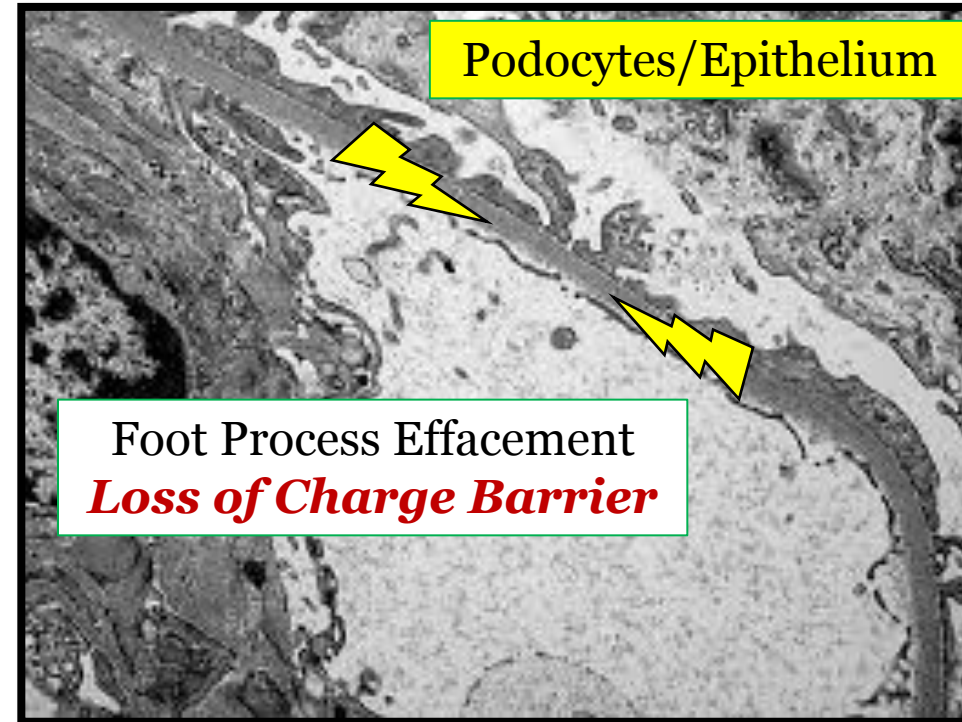
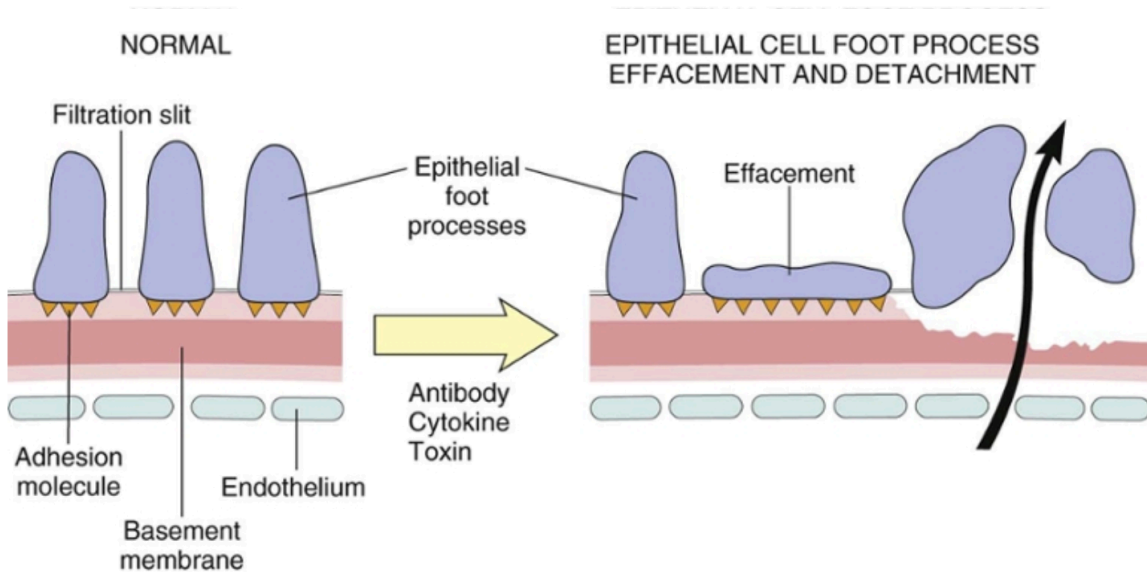
Podocytes/Epithelium

'Foot Process Effacement'
(loss of filtration slits)

Proteinuria (>3.5 g/day)

The Filtration Barrier

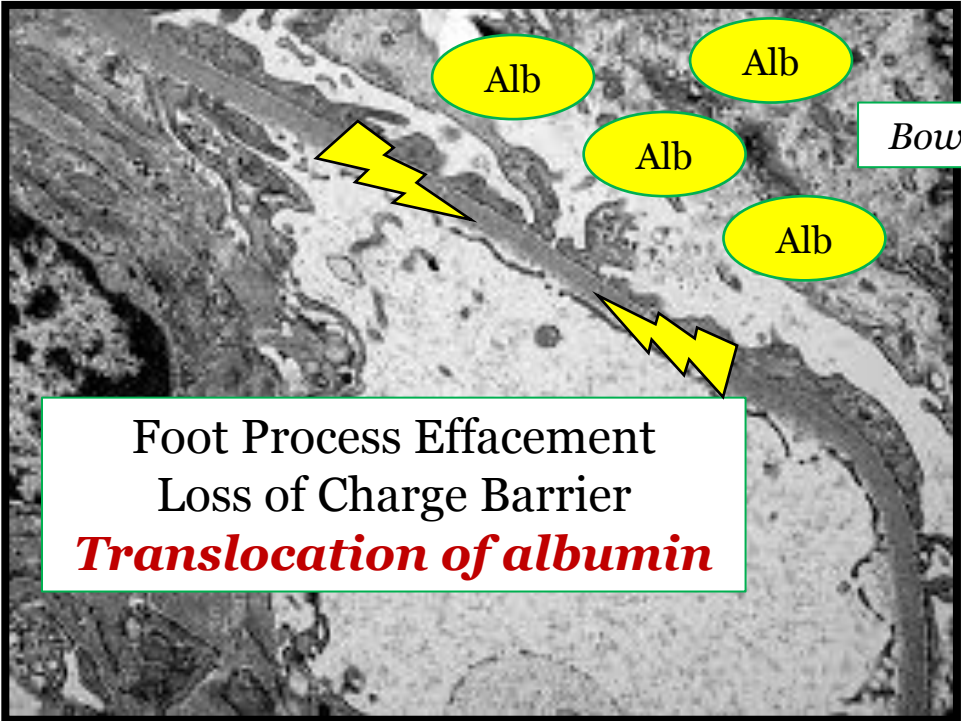
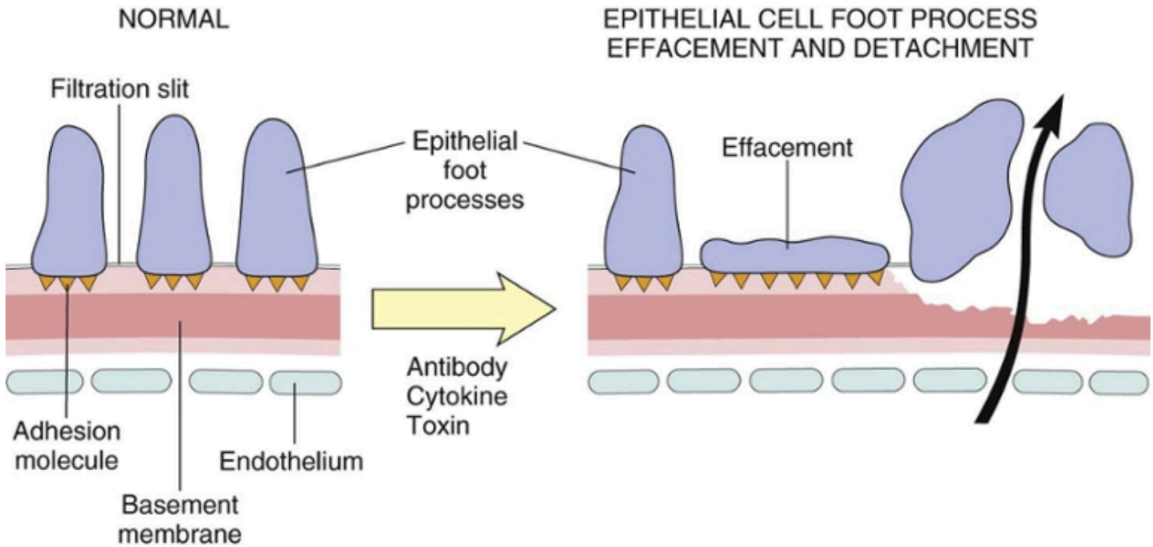
Nephrotic



Proteinuria (>3.5 g/day)

The Filtration Barrier

Nephrotic

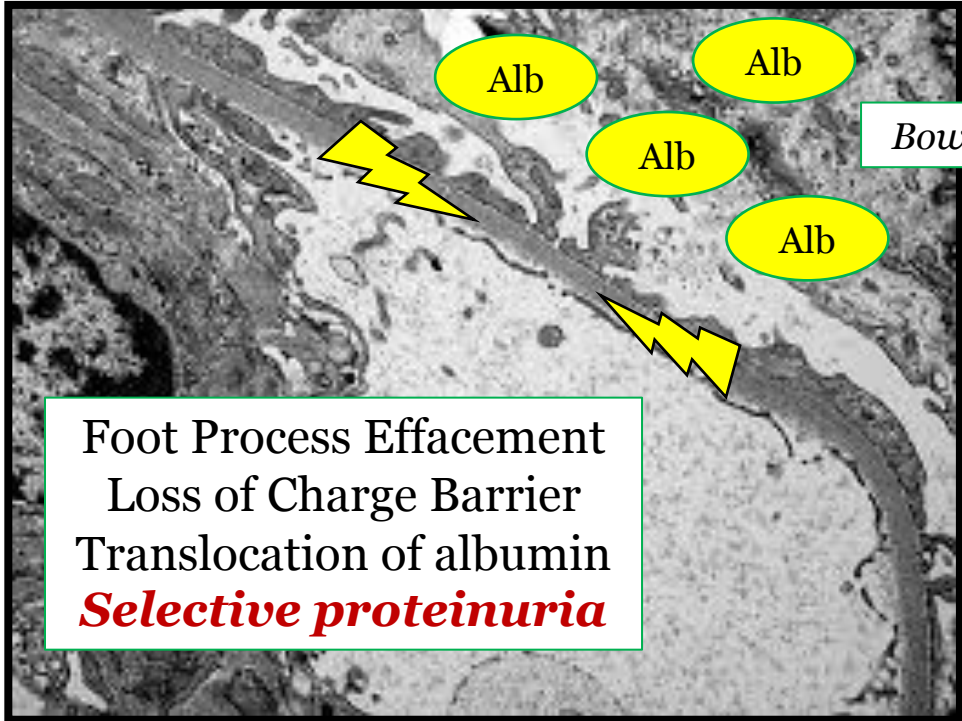
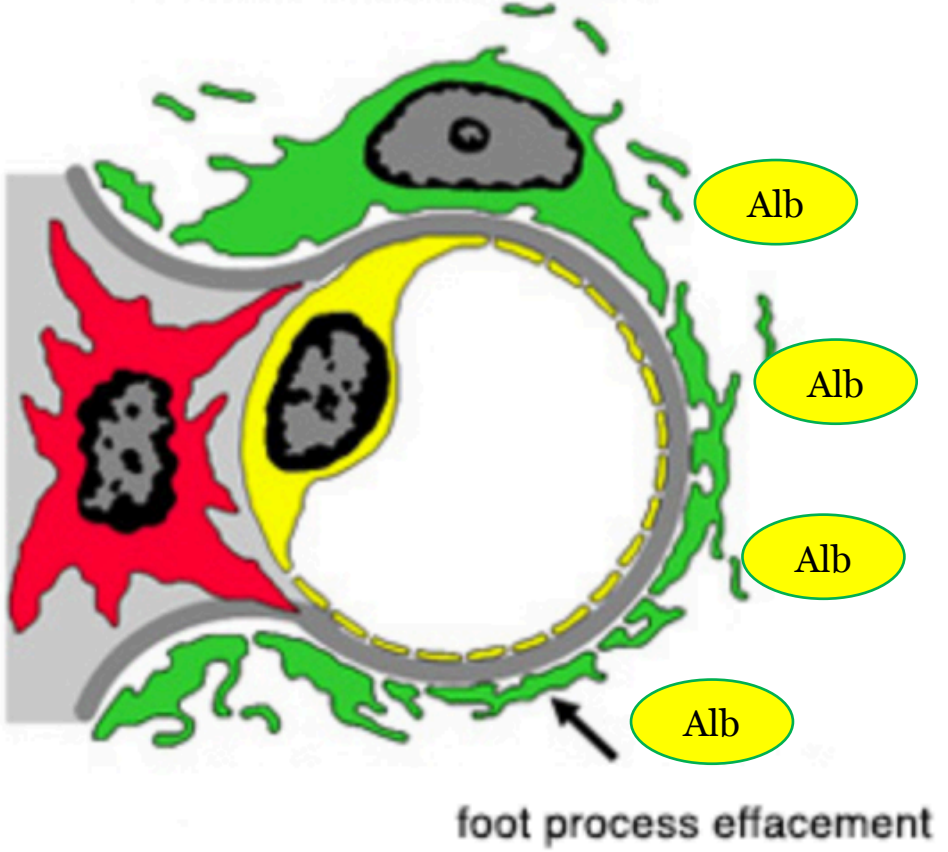


Foot Process Effacement
Loss of Charge Barrier
Translocation of albumin

Proteinuria (>3.5 g/day)

The Filtration Barrier

Nephrotic

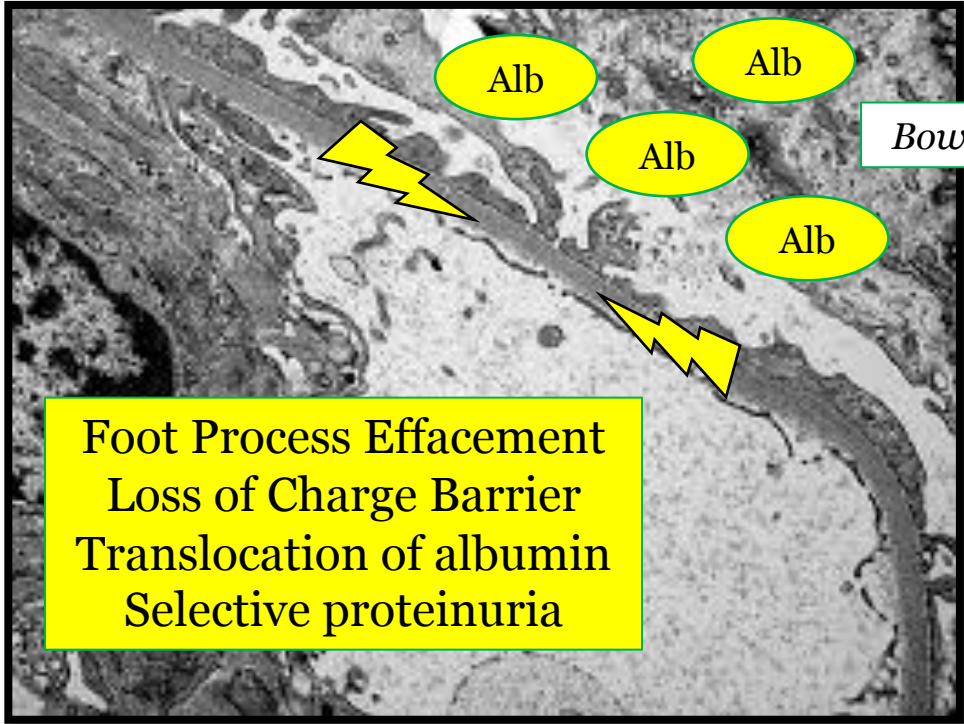


Foot Process Effacement
Loss of Charge Barrier
Translocation of albumin
Selective proteinuria

Proteinuria (>3.5 g/day)

The Filtration Barrier

Nephrotic



Bowman's space

Foot Process Effacement
Loss of Charge Barrier
Translocation of albumin
Selective proteinuria

Proteinuria (>3.5 g/day)

the Nephrotic Syndromes
Minimal Change
FSGS
Membranous

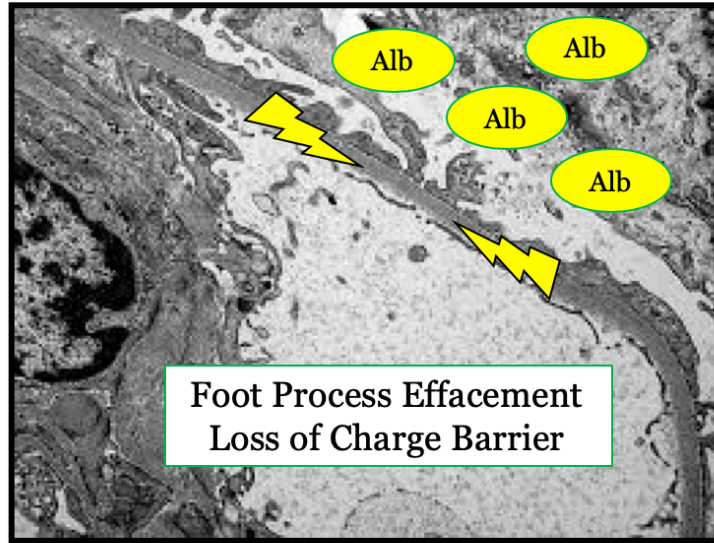


Consequences of this fun little tale...

Edema
↓ Oncotic mm Hg



Nephrotic



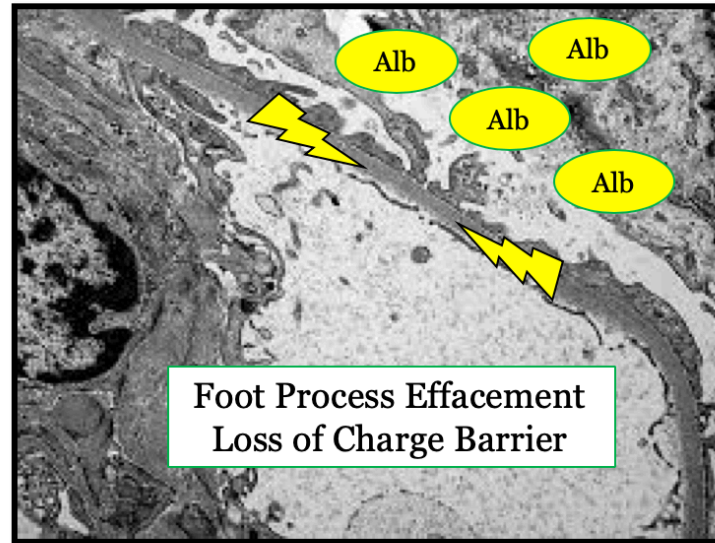
Proteinuria (>3.5 g/day)

Consequences of this fun little tale...

Edema
↓ Oncotic mm Hg

Thrombosis
Loss: *ATIII, plasminogen, C, S*
Gain: *fibrinogen*

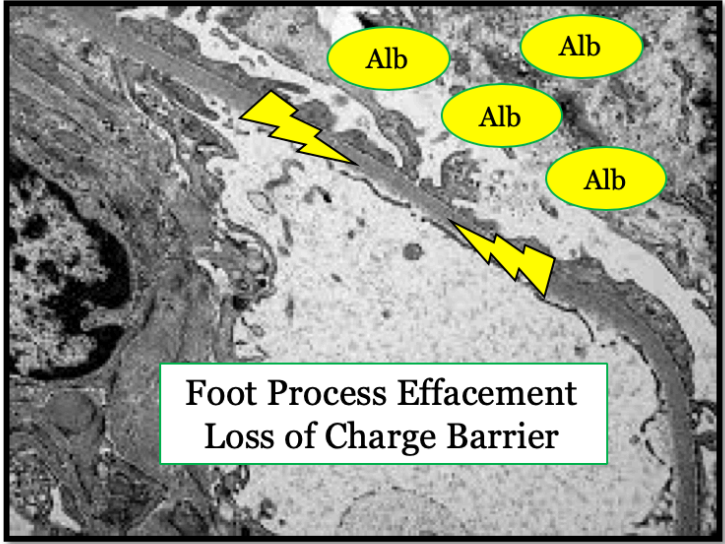
Nephrotic



Proteinuria (>3.5 g/day)

Consequences of this fun little tale...

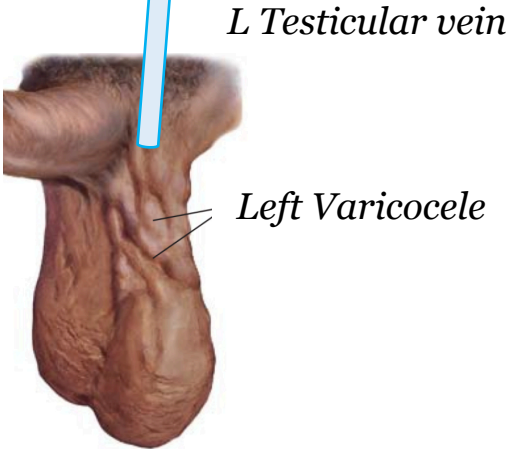
Nephrotic



Proteinuria (>3.5 g/day)

Edema
↓ Oncotic mm Hg

Thrombosis
Loss: *ATIII, plasminogen, C, S*
Gain: *fibrinogen*



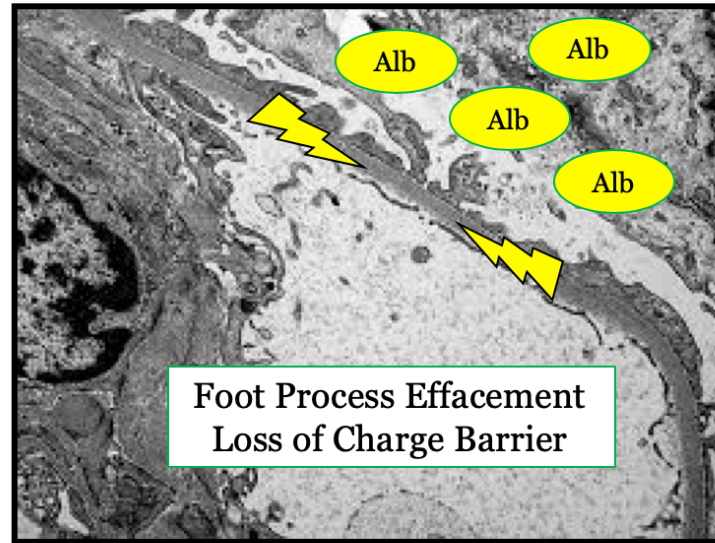
Consequences of this fun little tale...

Edema
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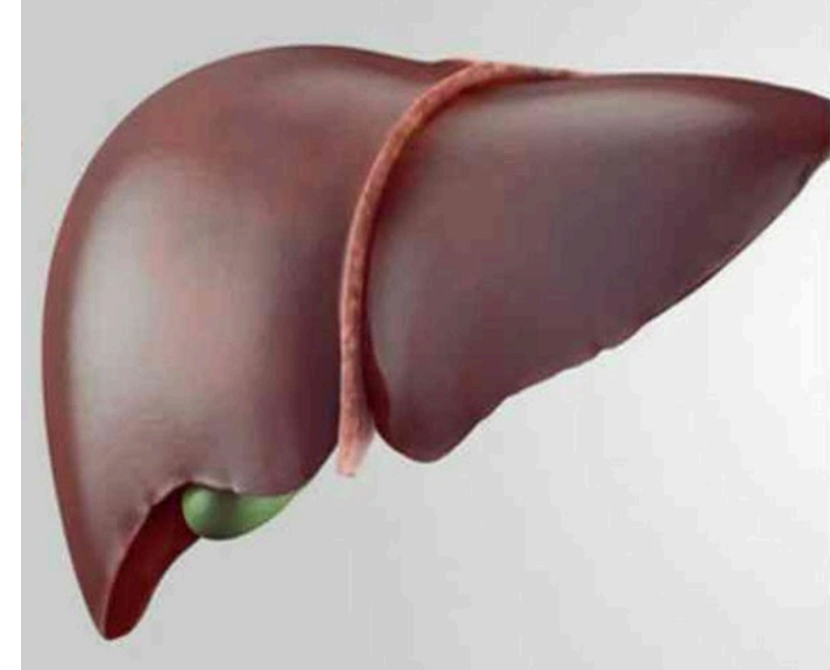
Thrombosis
Loss: *ATIII, plasminogen, C, S*
Gain: *fibrinogen*

Liver
↑ (Lipo-)protein synthesis

Nephrotic



Proteinuria (>3.5 g/day)



Edema

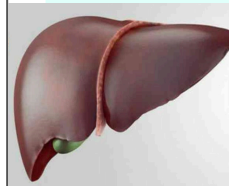
↓ Oncotic mm Hg

Thrombosis

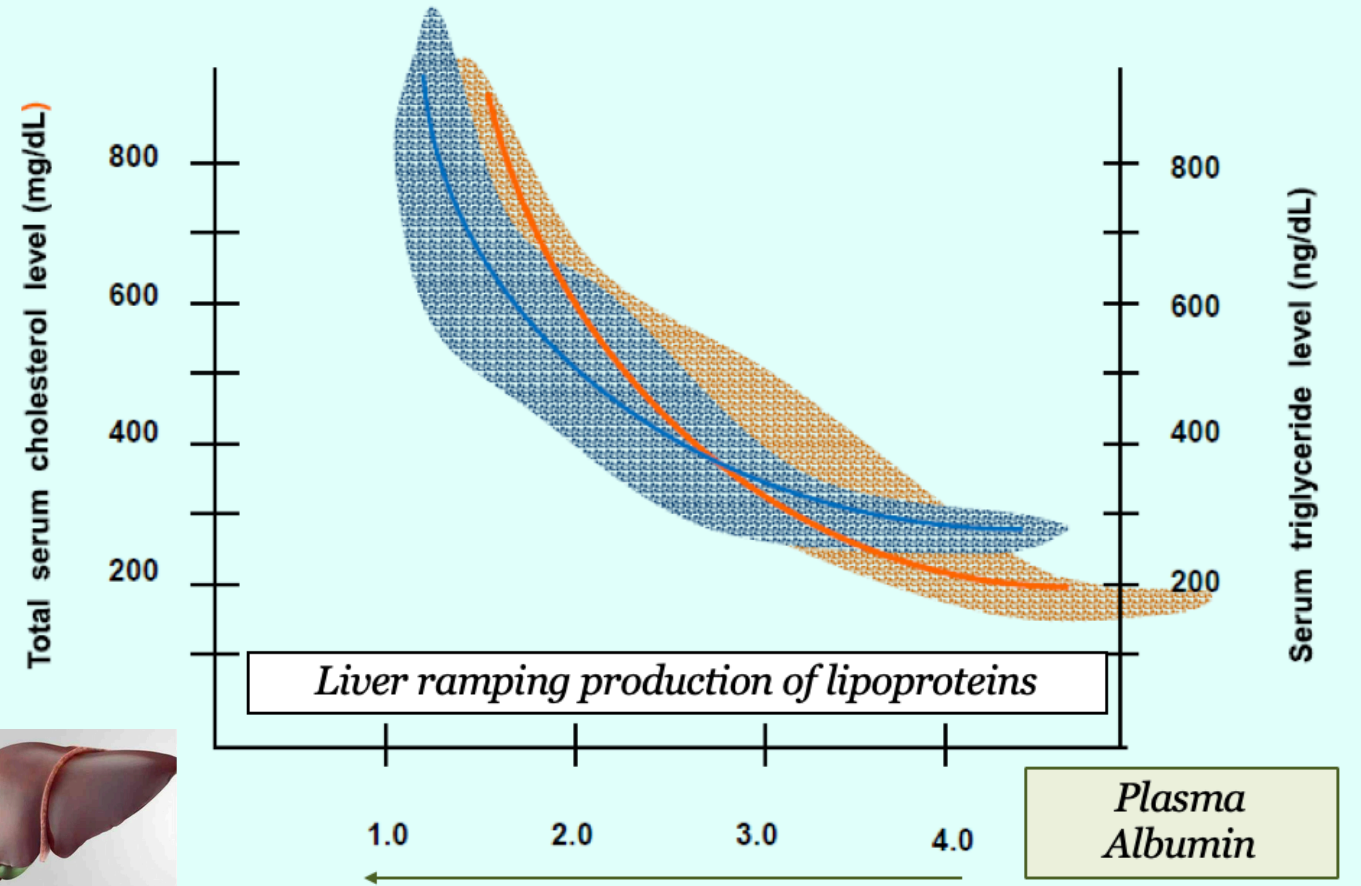
Loss: *ATIII, plasminogen, C, S*
Gain: *fibrinogen*

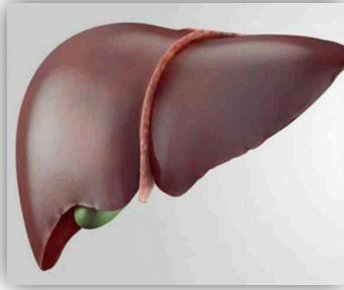
Liver

↑ (Lipo-)protein synthesis



HYPERLIPIDEMIA IN THE NEPHROTIC SYNDROME





Albuminuria
Lipiduria

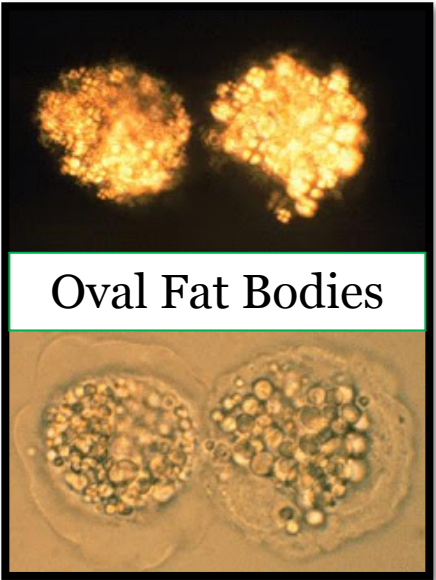
Edema
↓ Oncotic mm Hg

Frothy urine 2° albuminuria

Thrombosis
Loss: *ATIII, plasminogen, C, S*
Gain: *fibrinogen*



Liver
↑ (Lipo-)protein synthesis



Oval Fat Bodies



Maltese Cross
(cholesterol esters viewed under polarized lens)

Fatty Cast

Lipoproteins taken up by sloughed epithelium cells

Glomerulopathies

the Language of the Nephrotic Syndromes (Minimal Change, FSGS, Membranous)

Edema

↓ Oncotic mm Hg

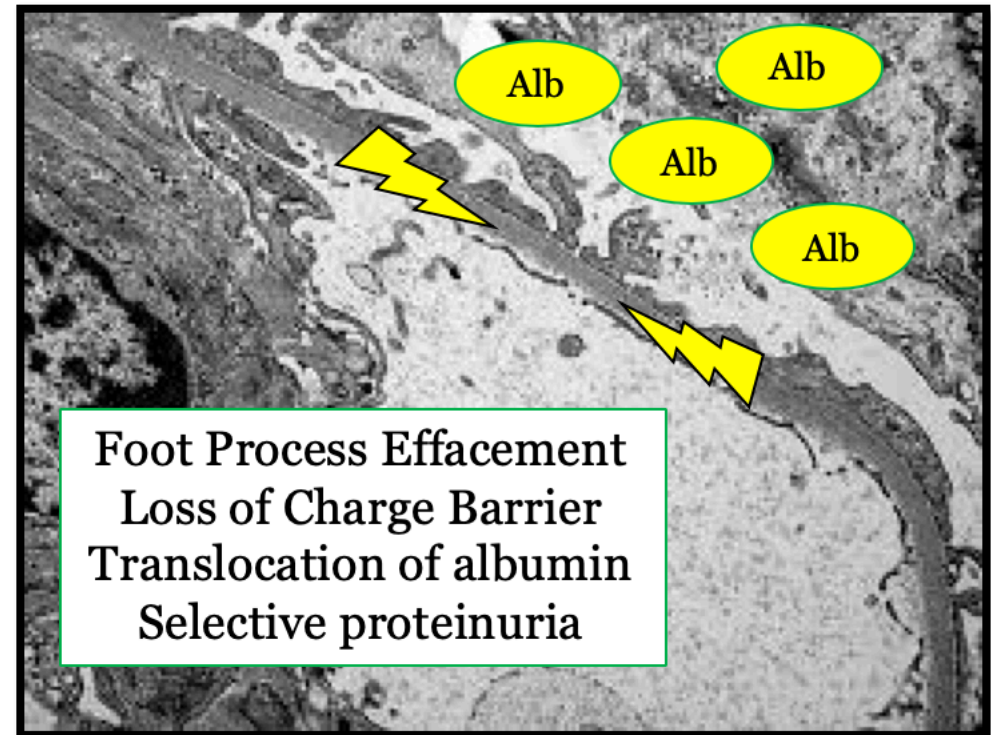
Thrombosis

Loss: *ATIII, plasminogen, C, S*
Gain: *fibrinogen*

Liver

↑ (Lipo-)protein synthesis

- Hyperlipidemia
- Frothy urine
- Fatty cast, Oval Fat Boy, Maltese Cross



Foot Process Effacement
Loss of Charge Barrier
Translocation of albumin
Selective proteinuria

Glomerulopathies

Nephrotic

Proteinuria (>3.5 g/day)

Nephritic

RBC Casts (or hematuria)

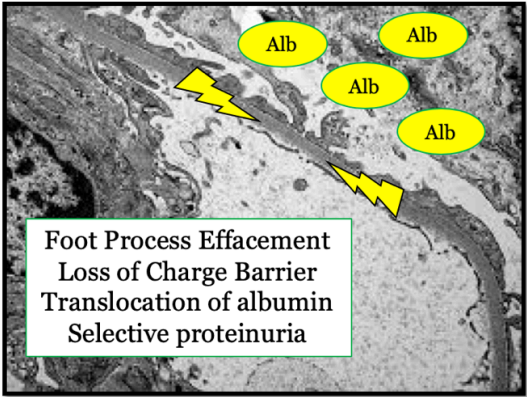
the Language of the Nephrotic Syndromes (Minimal Change, FSGS, Membranous)

Edema
↓ Oncotic mm Hg

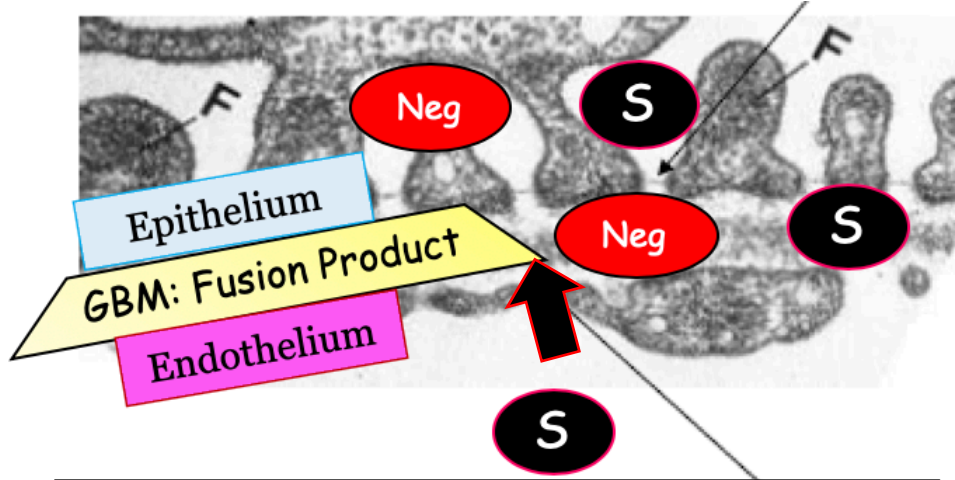
Thrombosis
Loss: *ATIII, plasminogen, C, S*
Gain: *fibrinogen*

Liver
↑ (Lipo-)protein synthesis

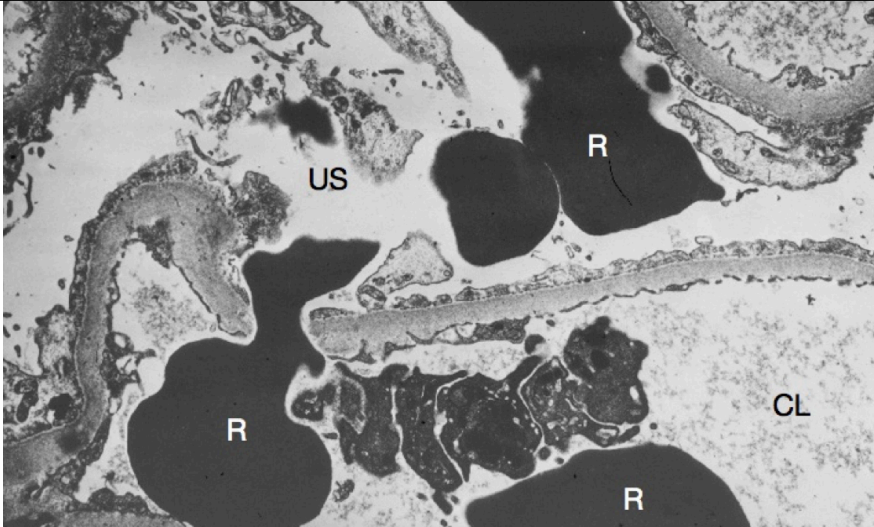
- Hyperlipidemia
- Frothy urine
- Fatty cast, Oval Fat Boy, Maltese Cross



Glomerulopathies



'Broken GBM'

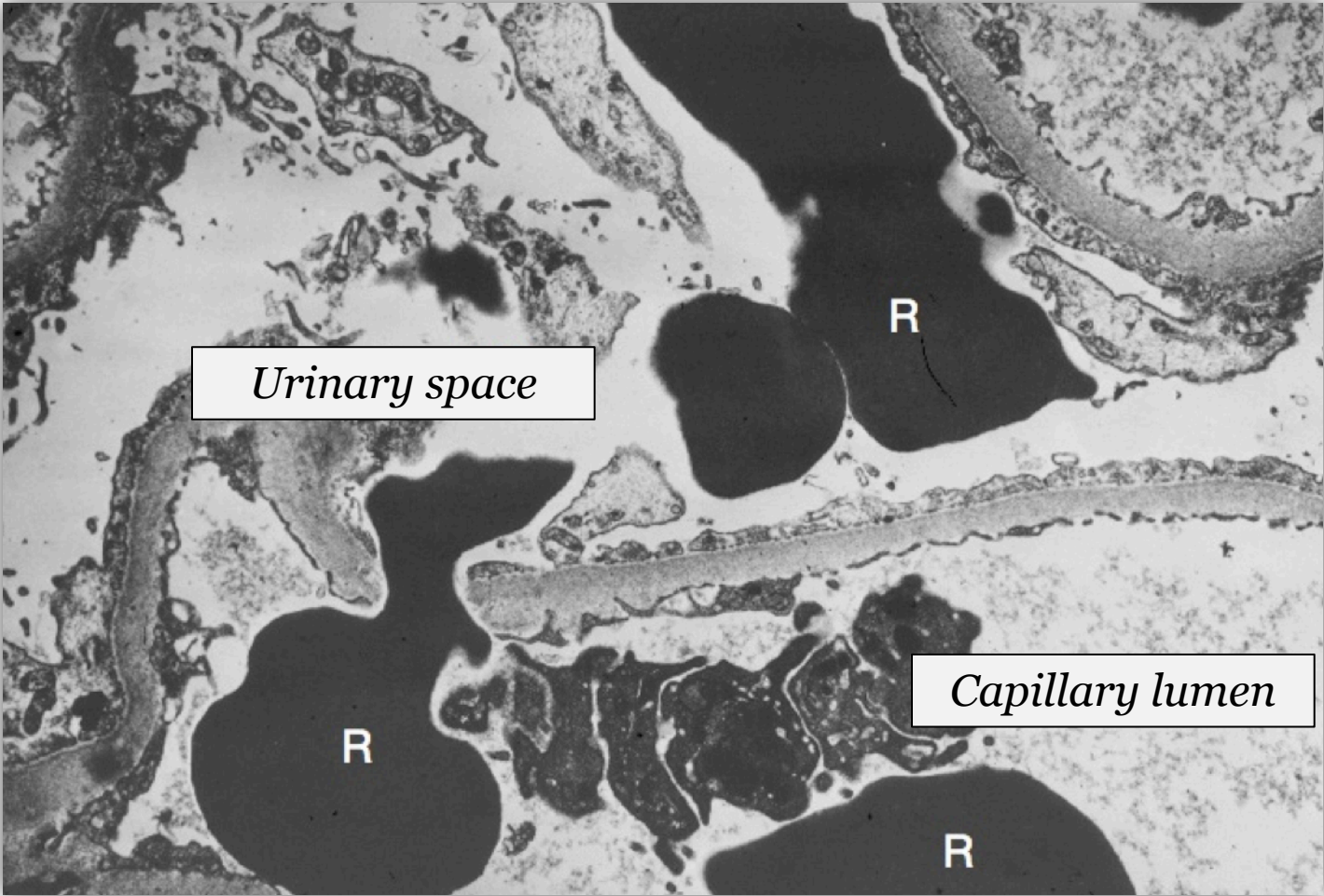


Nephritic

RBC Casts (or hematuria)



Glomerulopathies



Nephritic

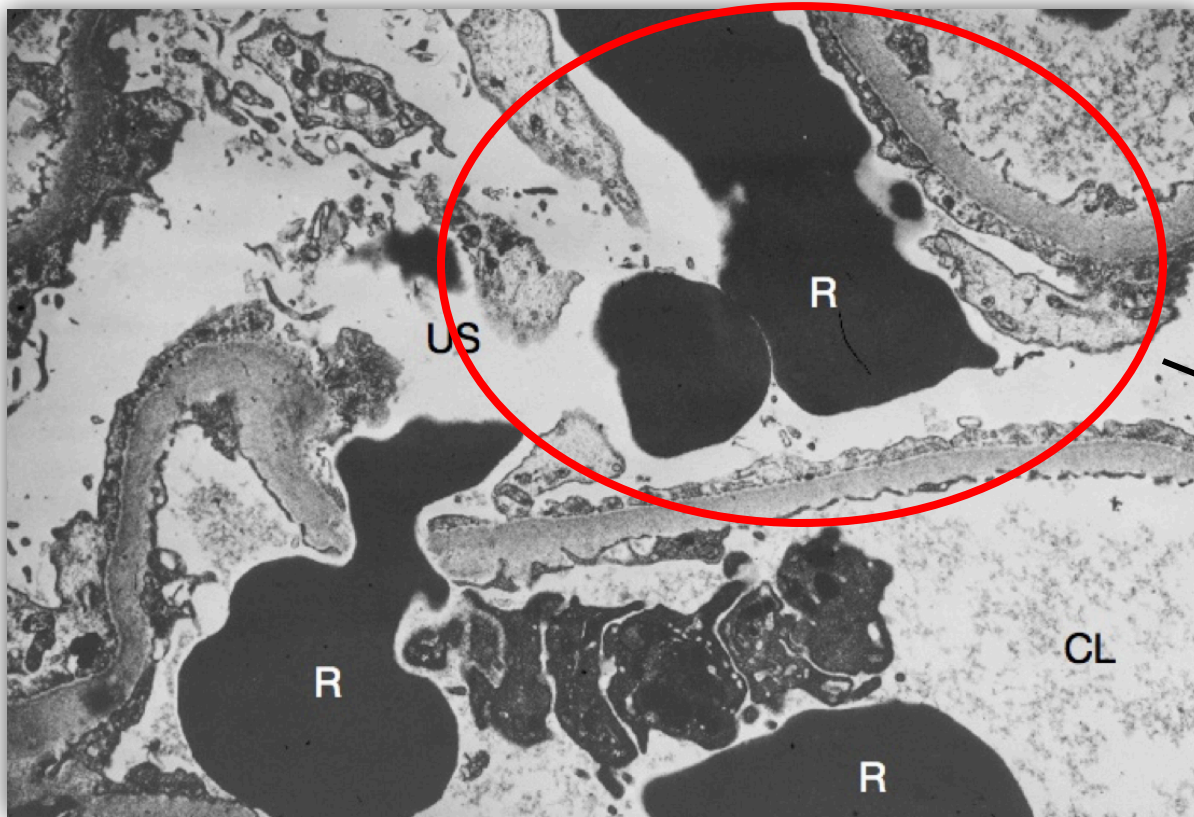
RBC Casts (or *hematuria*)



Cola, Rust or Dark-Colored

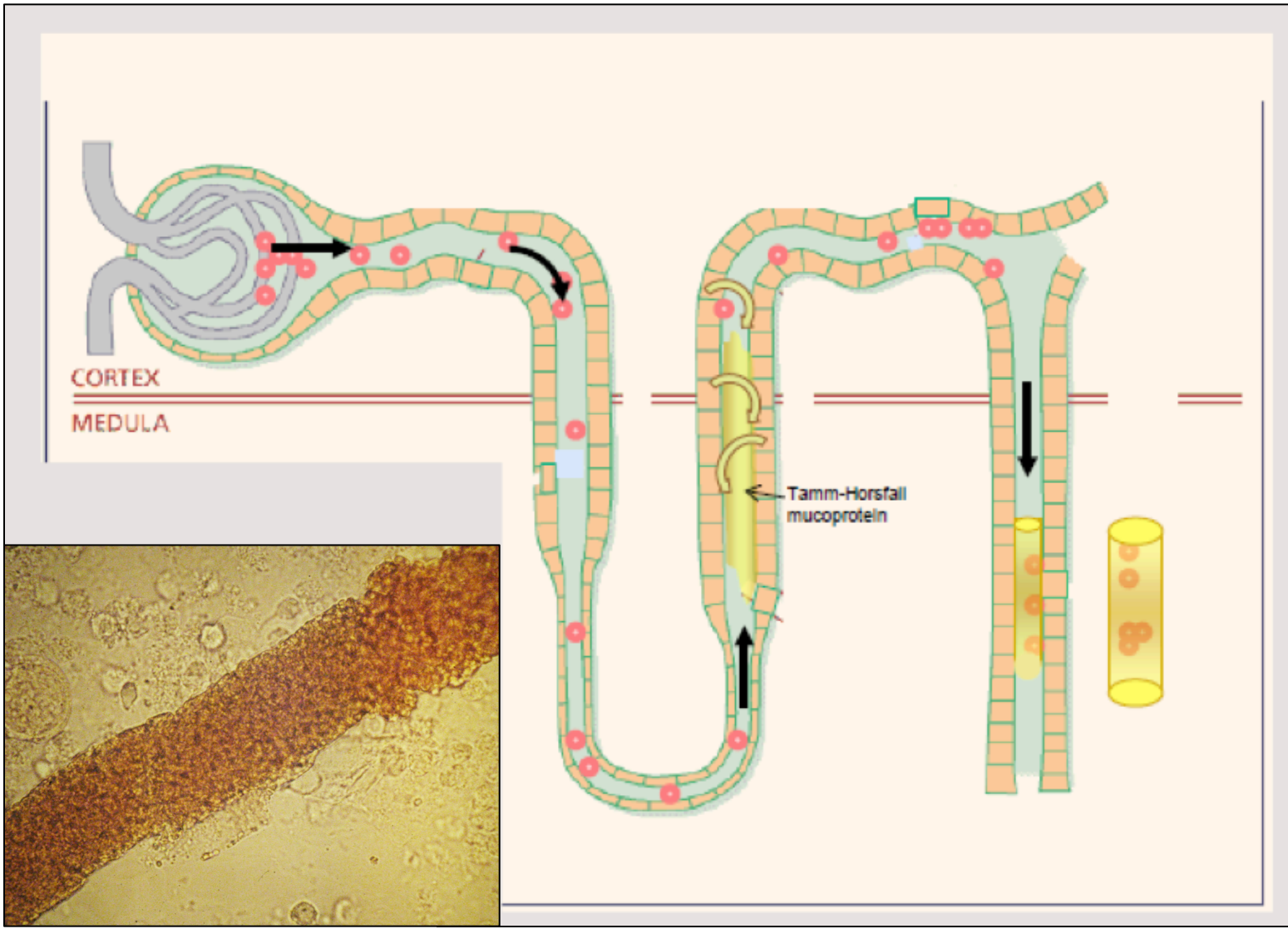
Nephritic

RBC Casts (or *hematuria*)



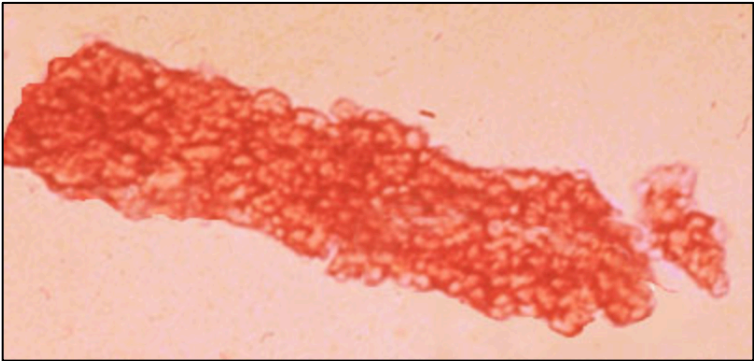
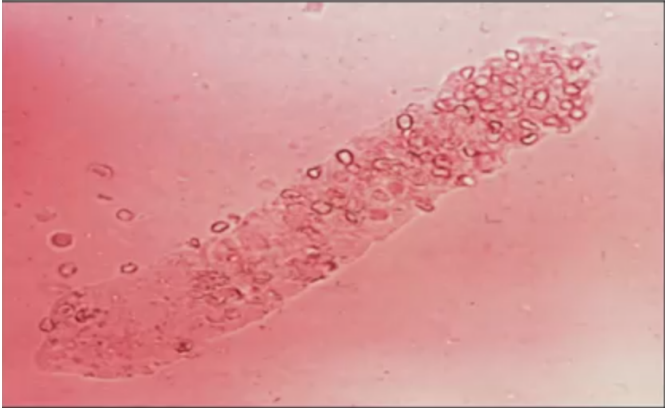
Crenated or Dysmorphic RBC



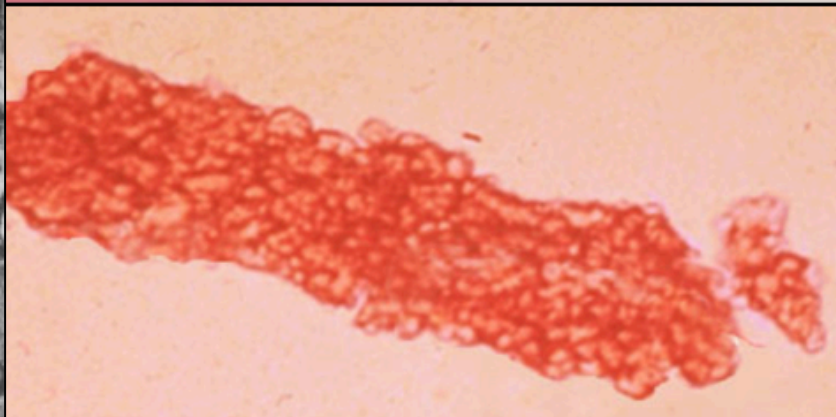
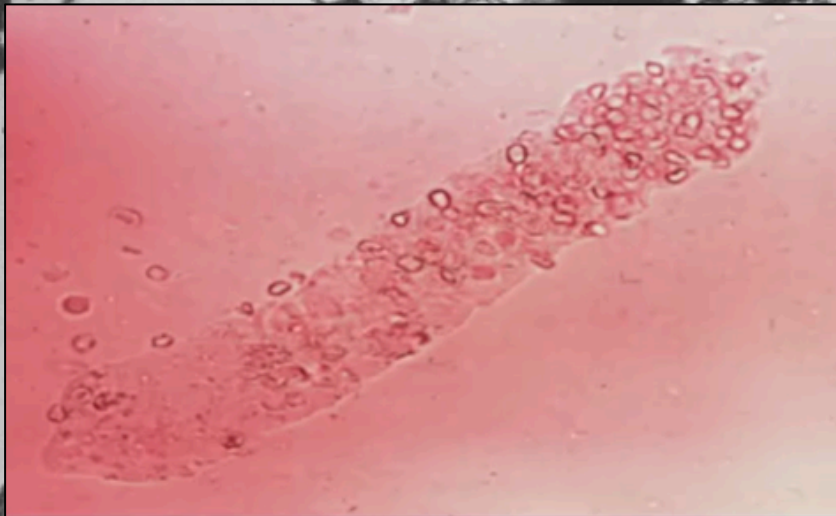


Nephritic

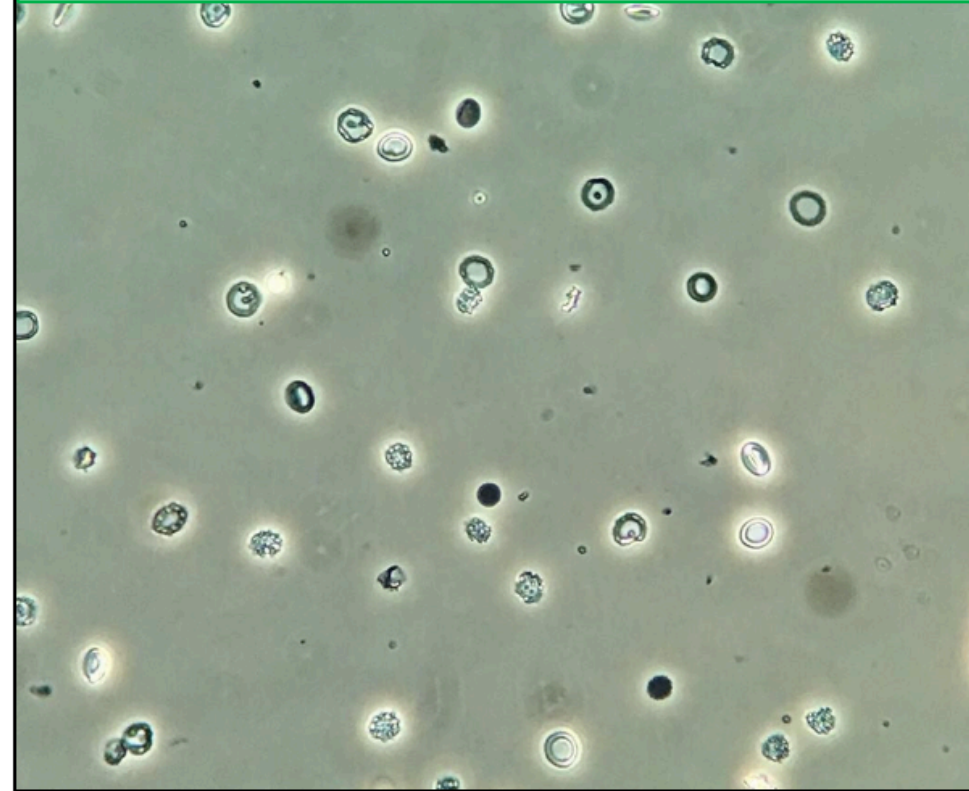
RBC Casts (or hematuria)



The mention (or image) of a single *RBC cast* or *Dysmorphic RBC* (in the urine) is **pathognomonic** of *Nephritic Syndrome*



Crenated or Dysmorphic RBC

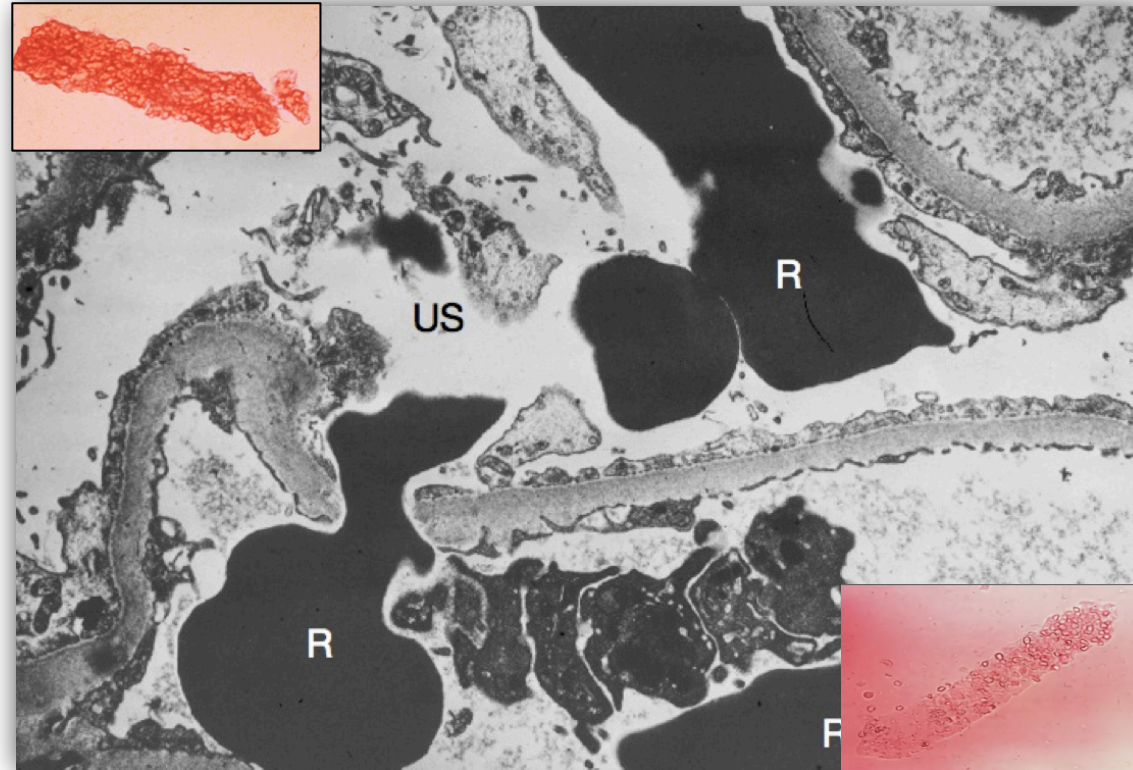


Nephritic Syndromes: **Renal Injury** → **Loss of Functioning Renal Mass**

Proteinuria, mild

Renal Injury:
Elevated Creatinine
HTN (RAA)
Edema, mild (↓ GFR)

Clinico-Pathology
RPGN*
Crescents



the Key Syndromes

IgA Nephropathy
PSGN

Wegener's (GPA)
Goodpasture's

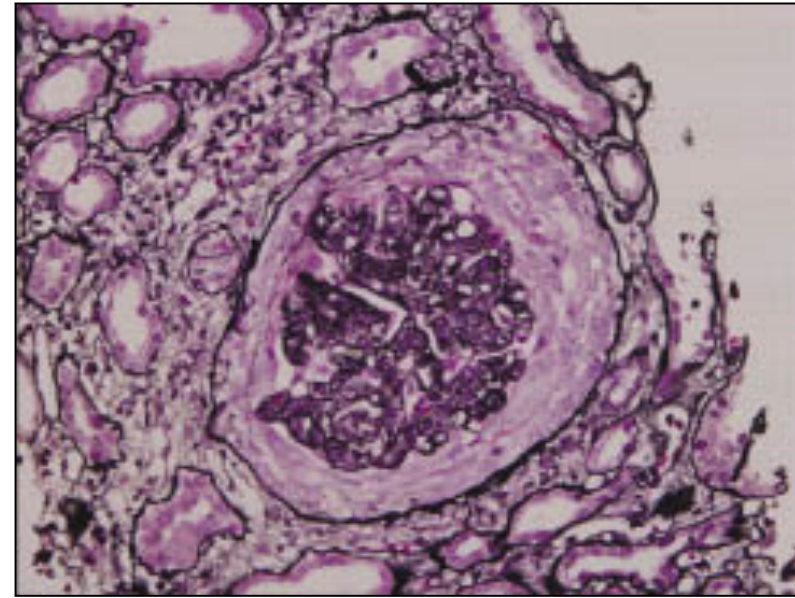
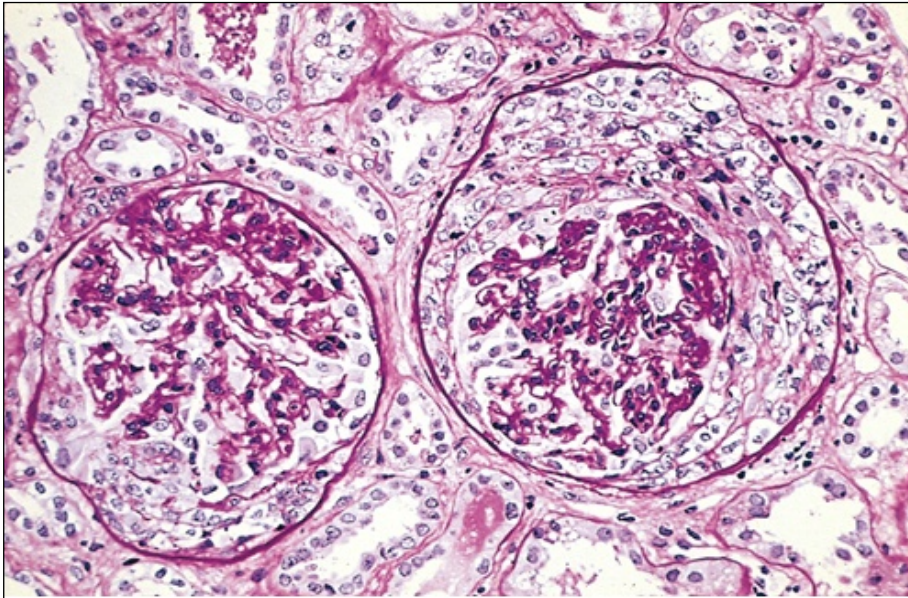
*Rapidly Progressive Glomerulonephritis

Nephritic Syndromes: **Renal Injury** → **Loss of Functioning Renal Mass**

Clinico-Pathology

RPGN*: elevated Cr (*normal Cr* → *exclude all causes of RPGN*)

Crescents/Crescentic (RPGN): parietal epithelium, inflammatory cells and fibrin



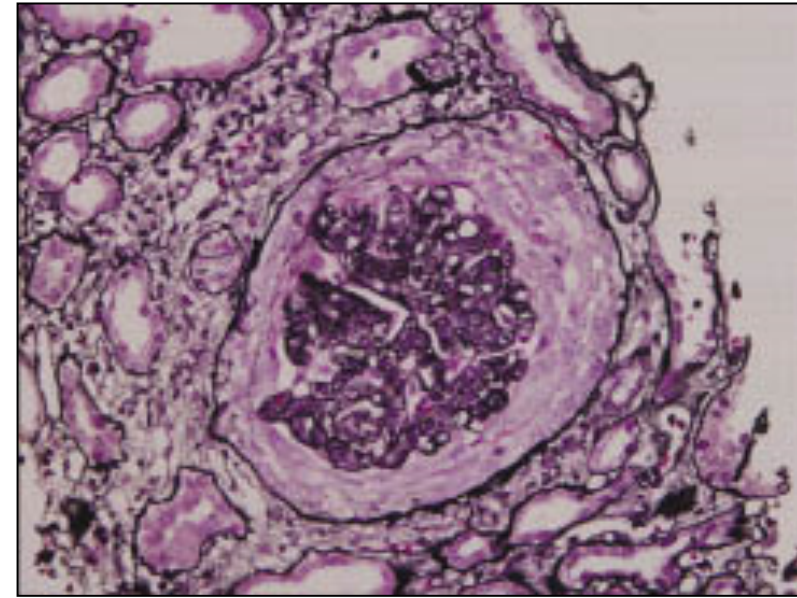
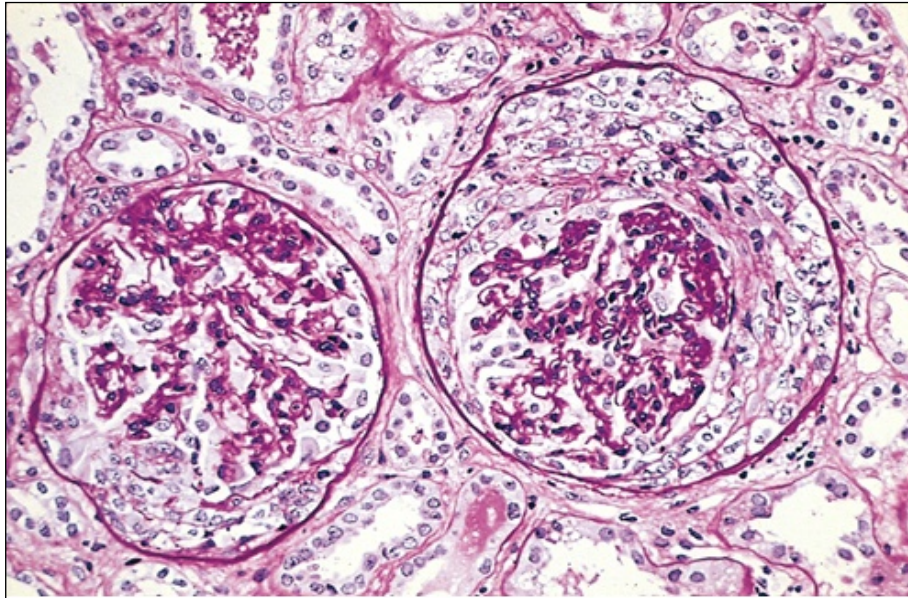
*Rapidly Progressive Glomerulonephritis

Nephritic Syndromes: **Renal Injury** → **Loss of Functioning Renal Mass**

Clinico-Pathology

RPGN*: elevated Cr (*normal Cr* → *exclude all causes of RPGN*)

Crescents/Crescentic (RPGN): parietal epithelium, inflammatory cells and fibrin



Crescents Located in Bowman's Space

**Rapidly Progressive Glomerulonephritis*

Glomerulopathies

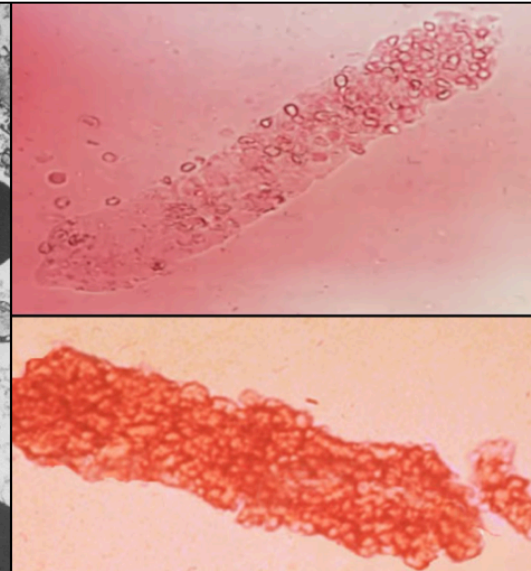
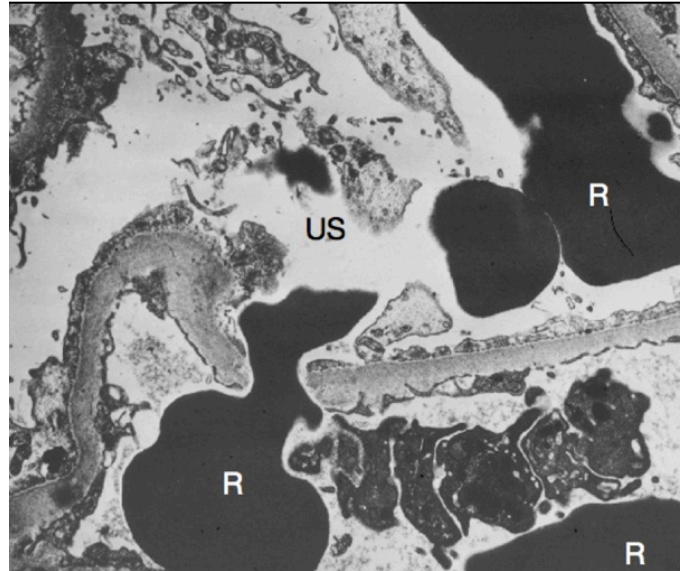
the Language of the Nephritic Syndromes

Hematuria



Cola, Rust or Dark-Colored

RBC Casts



Glomerulopathies

the Language of the Nephritic Syndromes

AKI/Elevated Cr

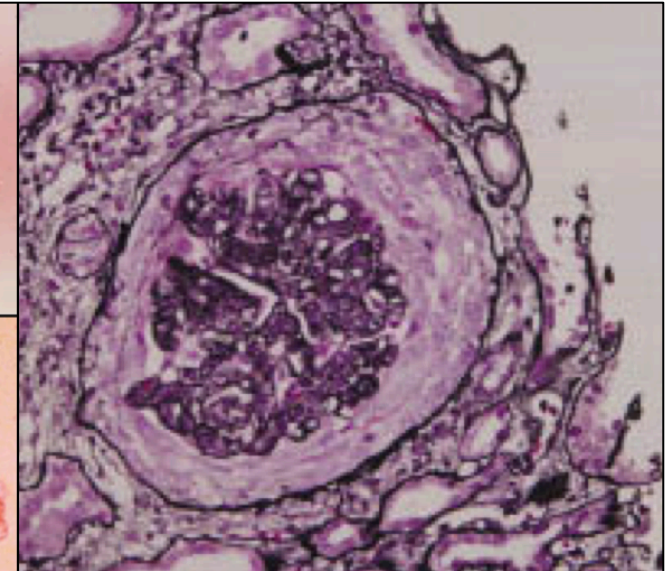
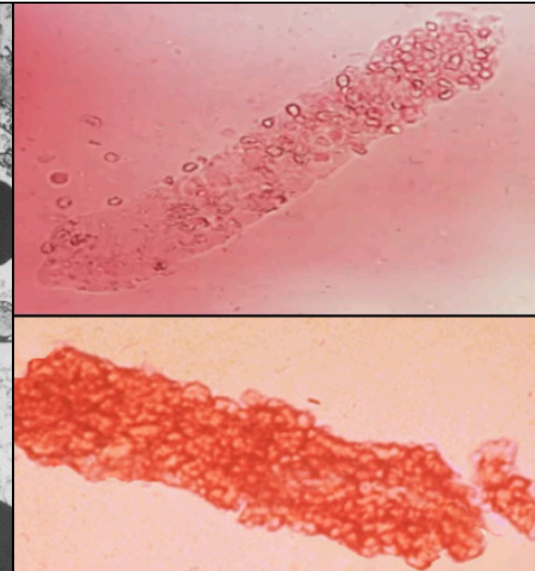
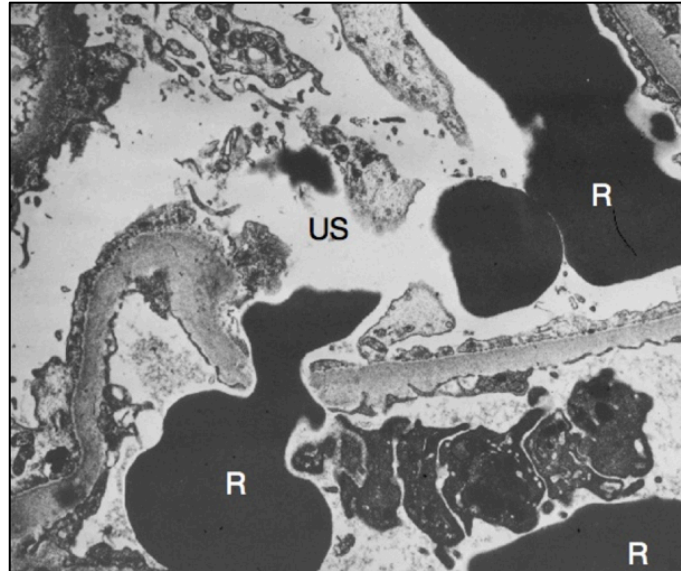
RBC Casts

RPGN/Crescents

Proteinuria, mild

Renal Injury:
Elevated Creatinine
HTN
Edema, mild (\downarrow GFR)

Clinico-Pathology
RPGN*
Crescents



The Players:

IgA Nephropathy
PSGN

Wegener's (GPA)
Anti-GBM (Goodpasture's)

Glomerulopathies

Nephrotic

Nephritic

Minimal Change



FSGS

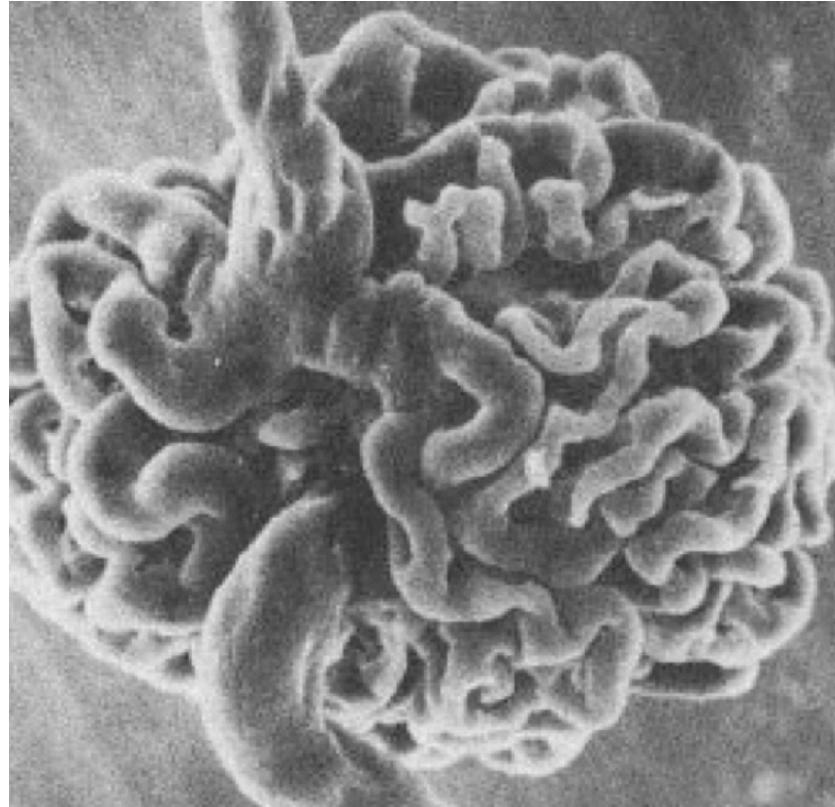
IgA Nephropathy
PSGN

Wegener's (GPA)
Goodpasture's

Membranous



Part 1. Glomerular Disorders for USMLE Step One



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