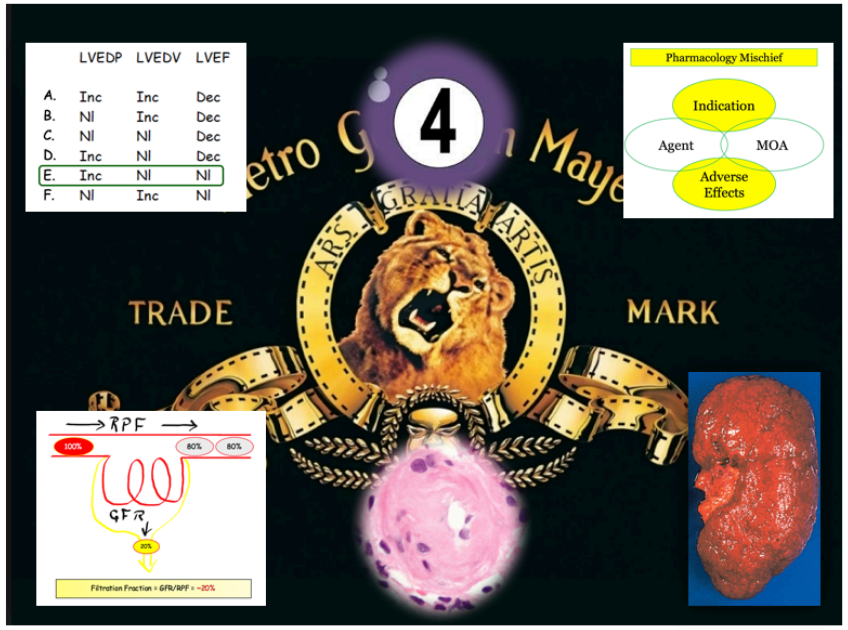
Renovascular Hypertension for the USMLE Step One Exam



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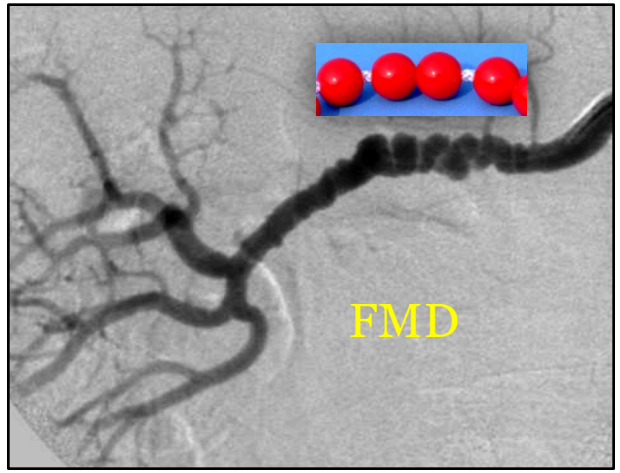
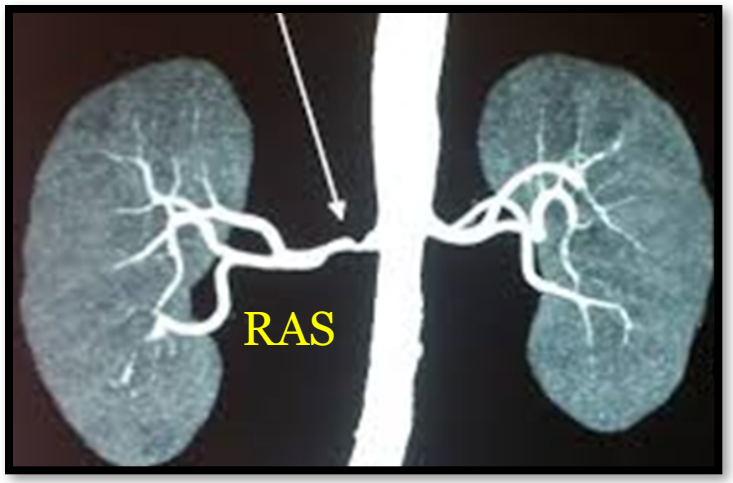
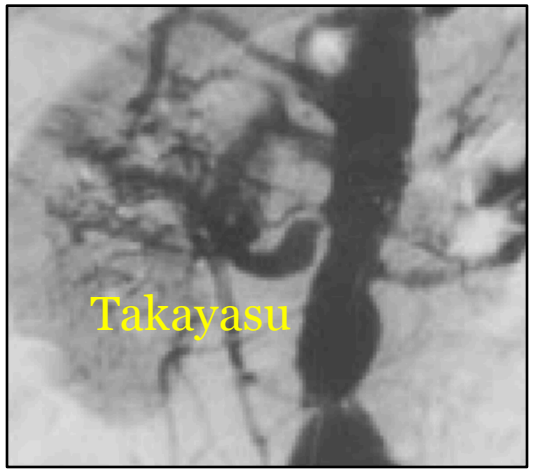




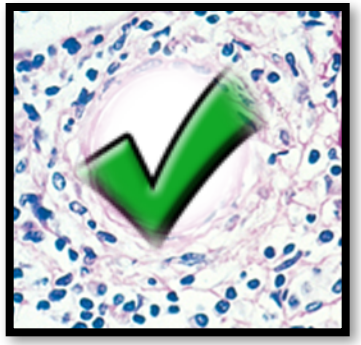


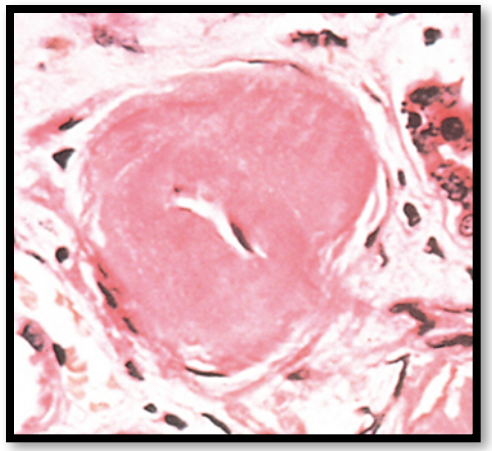
Stenosis Physiology and Related Pathology

The Key Players in *Reno-vascular* HTN

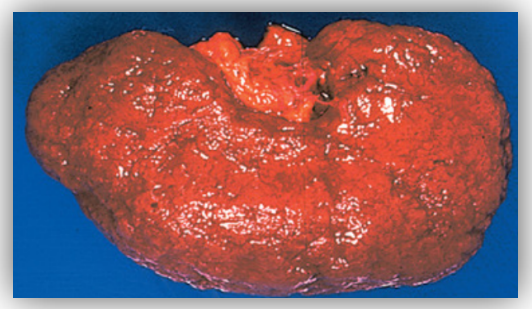
Vascular Pathology

Hyperplastic arteriolitis





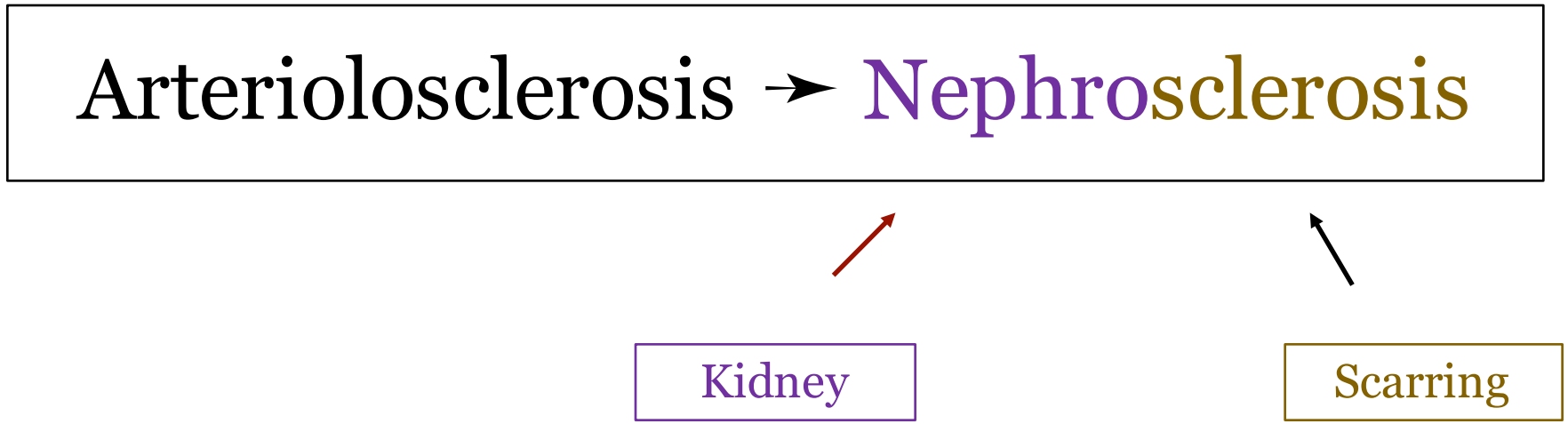
Arteriolar Hyalinosis

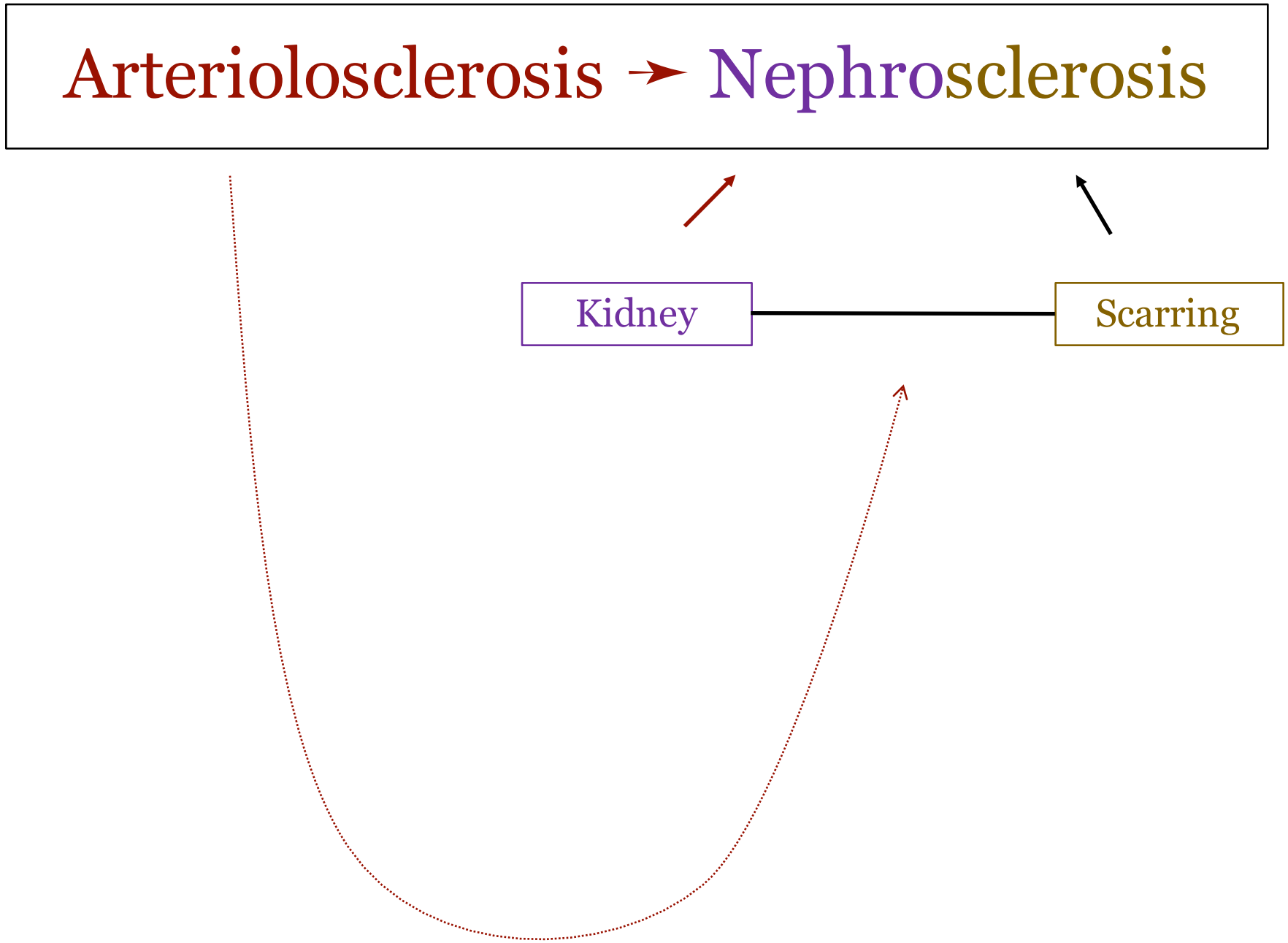


Nephrosclerosis

Renovascular Disorders (key derivative topics)

- Malignant HTN (physiology, pathology, pharmacology)
- *Arteriolosclerosis → Nephrosclerosis (pathology)*
- Renal Artery Stenosis (physiology and consequences)
  - *Fibromuscular Dysplasia (diagnostics, pathology)*
  - *Takayasu's Arteritis (pathology)*


Arteriolosclerosis → Nephrosclerosis
Kidney
Scarring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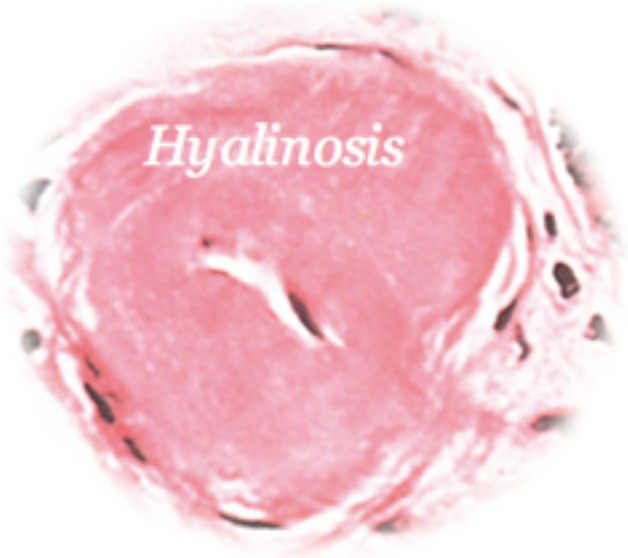
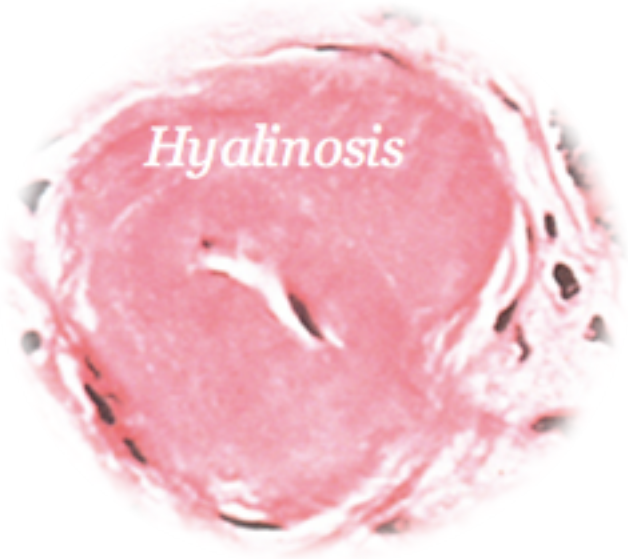
Arteriolosclerosis ➛ Nephrosclerosis



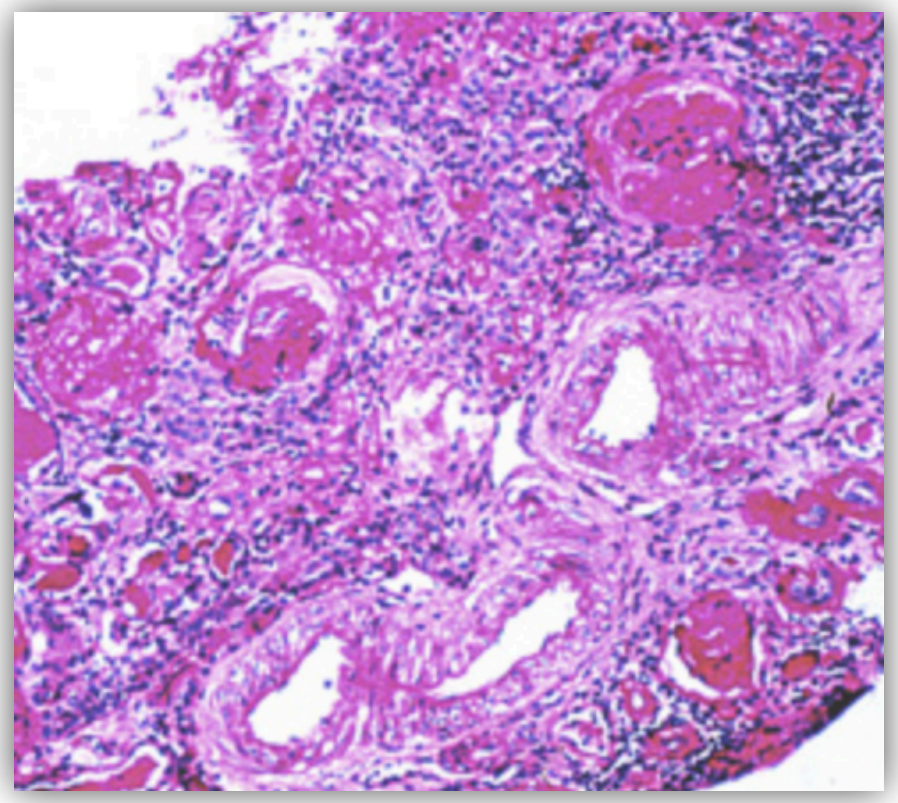
Arteriolosclerosis ➔ Nephrosclerosis



Outside

Granular
Cortical scarring

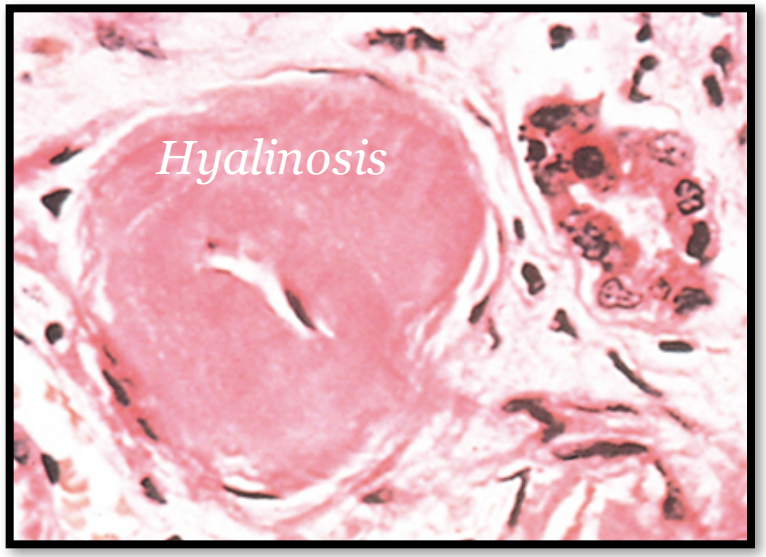
Inside (renal parenchyma)



Tubular atrophy, Interstitial fibrosis
Glomerulosclerosis

Arteriolosclerosis ➛ Nephrosclerosis

- Background
  - **Nephrosclerosis** is a pathologic diagnosis characterized by:
    - ➢ Reduction in renal function secondary to parenchymal ischemia
  - **<u>Primary Lesion</u>**: Hyalinosis typically as a result of HTN and DM
  - <u>Presentation</u>: HTN/DM with reduced GFR (+/- *mild* proteinuria).
    - *In the clinic*: 'Longstanding diabetic/HTN with CKD ***presumably*** 2° to nephrosclerosis'



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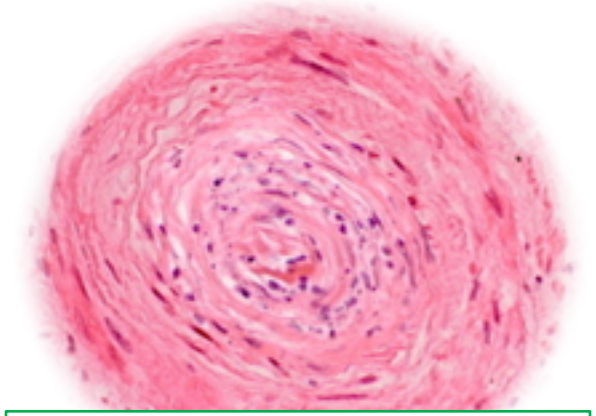
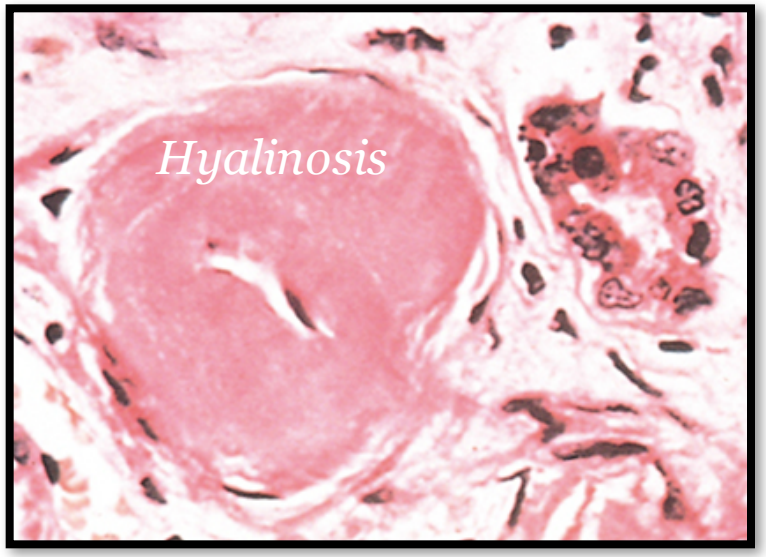
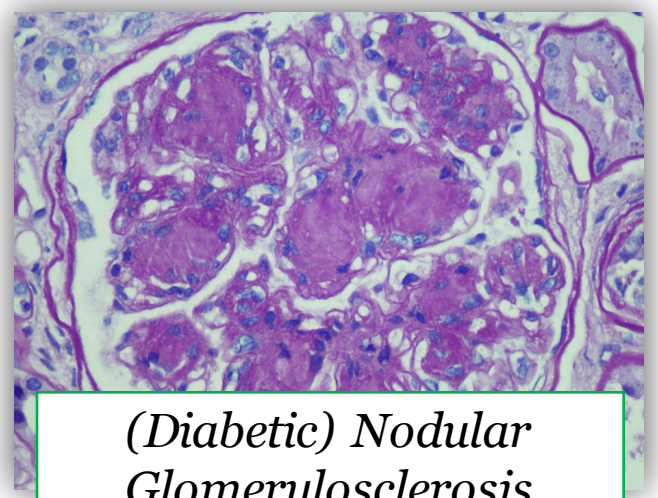


Malignant ➛ HTN Hyperplastic arteriolitis





(Diabetic) Nodular Glomerulosclerosis

Thickening → Narrowing of lumen
(*obliterative arteriopathy*)
Result: *Parenchymla Ischemia*

**AGE: advanced glycated end products*

- Pathogenesis
  - Small arteries: medial and intimal thickening related to hemodynamic injury. Lumen becomes narrow ➛ focal parenchymal ischemia with reduction in functional renal mass.

Thickening → Narrowing of lumen
(*obliterative arteriopathy*)
Result: *Parenchymla Ischemia*

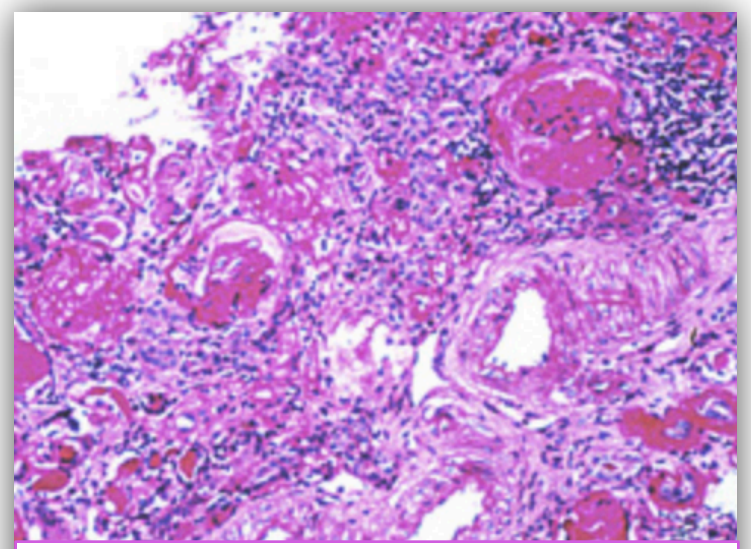
**AGE: advanced glycated end products*

- Pathogenesis
  - Small arteries: medial and intimal thickening related to hemodynamic injury. Lumen becomes narrow ➛ focal parenchymal ischemia with reduction in functional renal mass.

  - Hyalinization (*due endothelial injury*): extravasation of proteins (AGE) and increased deposition of BM matrix (*elaborated by smooth mm cells*)

*AGE: advanced glycated end products

Thickening → Narrowing of lumen
(*obliterative arteriopathy*)
Result: *Parenchymla Ischemia*



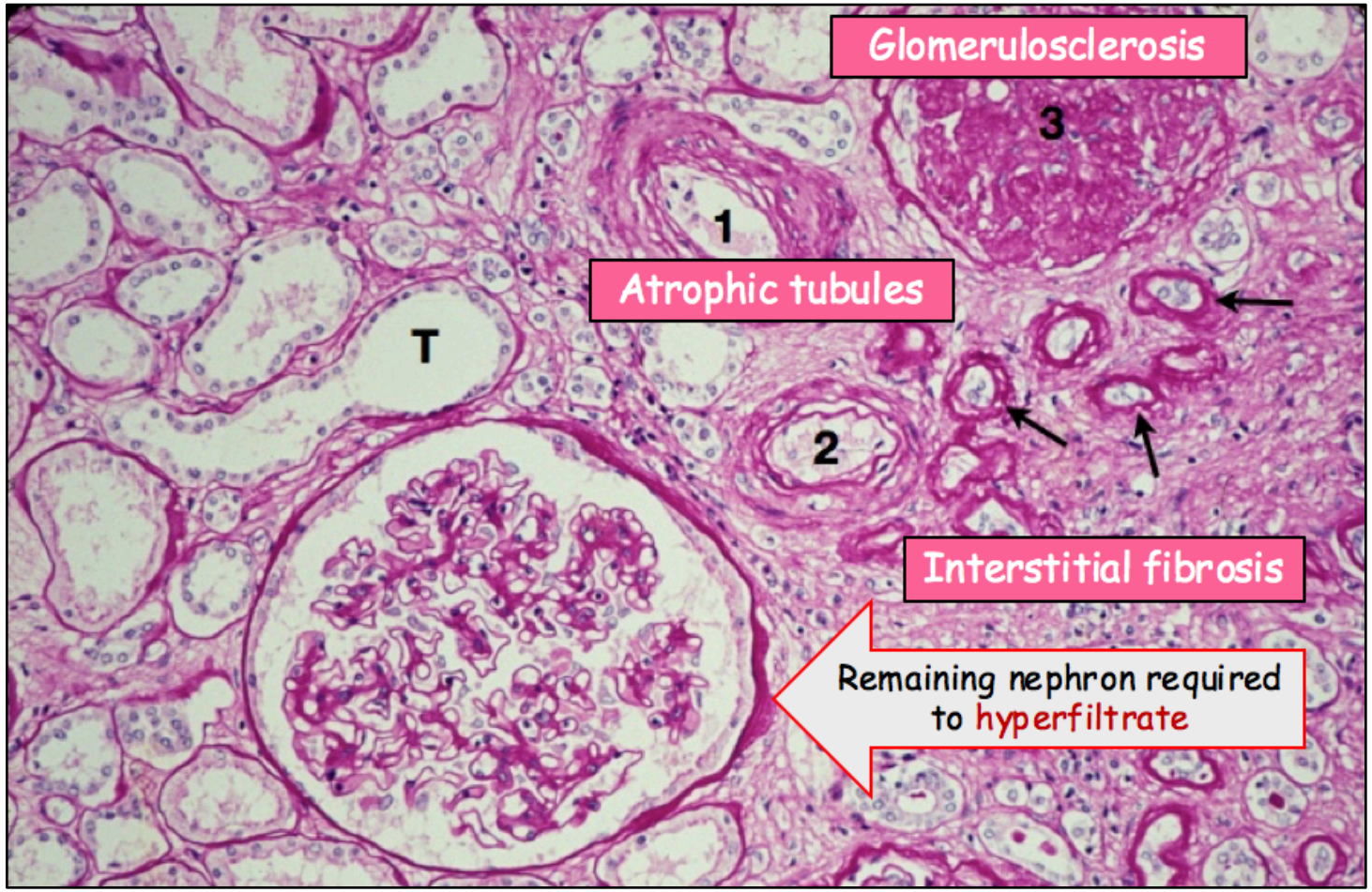
Glomerular sclerosis
Tubular atrophy
Interstitial fibrosis

- Pathology
  - Artery: homogenous, acellular thickening of vessel wall
  - Kidney: Tubular atrophy, interstitial fibrosis, glomerular sclerosis

Macroscopic

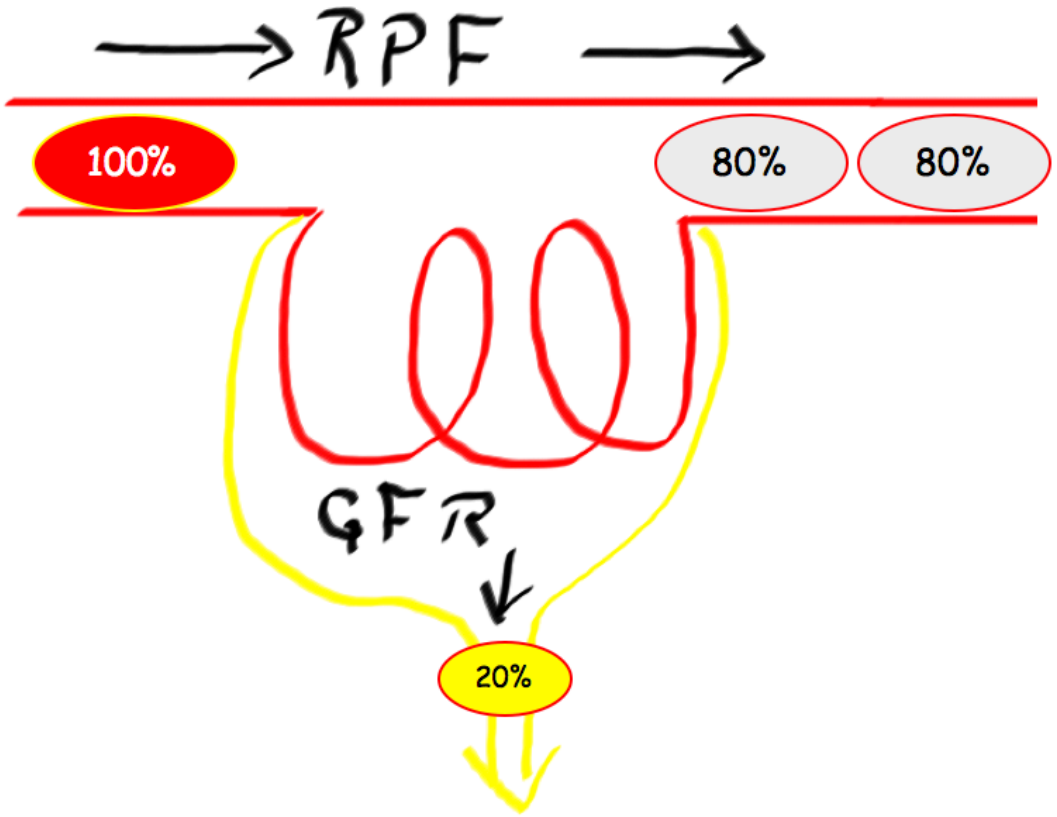
Nephrosclerosis
Reduced size, cortical scarring and a ***granular appearance***

Microscopic
(nonspecific reflecting chronic vascular injury)



Arteriolosclerosis ➛ Nephrosclerosis

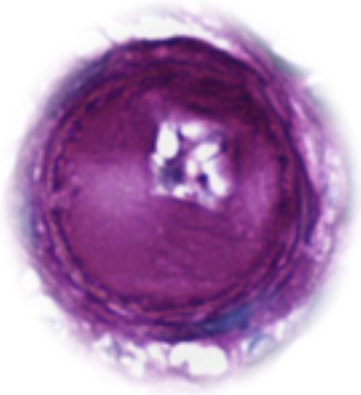
Physiology derivative: Filtration Fraction



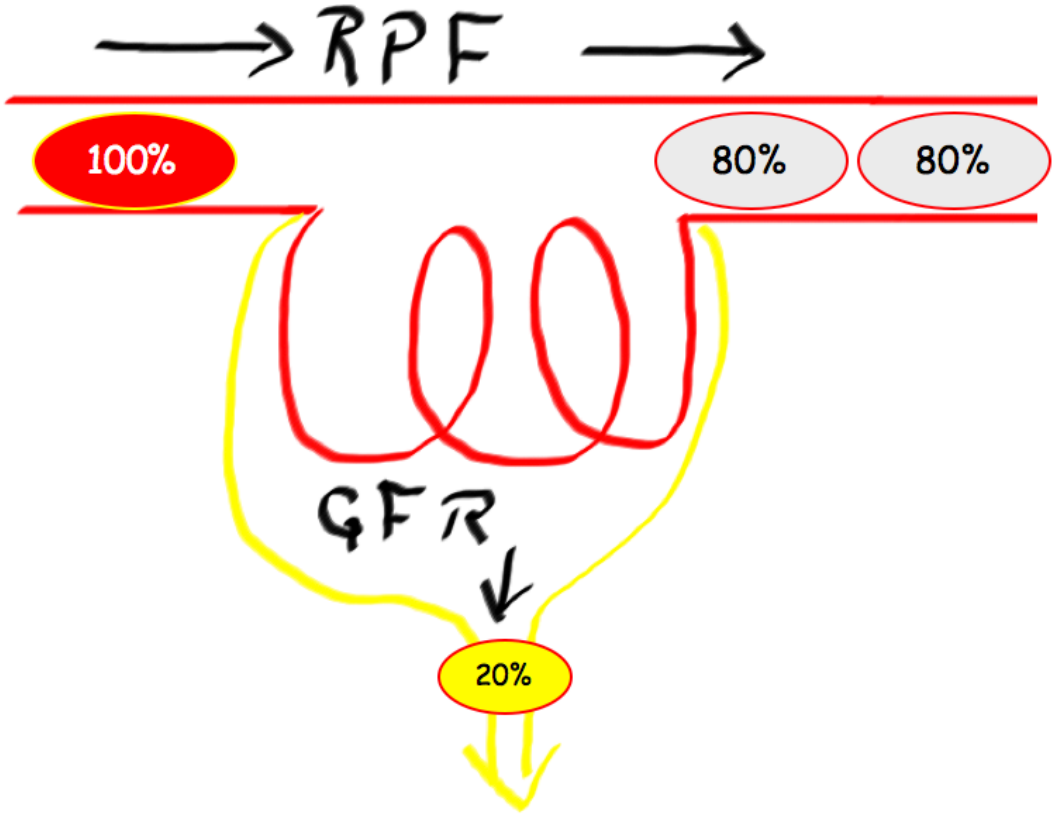
Filtration Fraction = GFR/RPF = ~20%

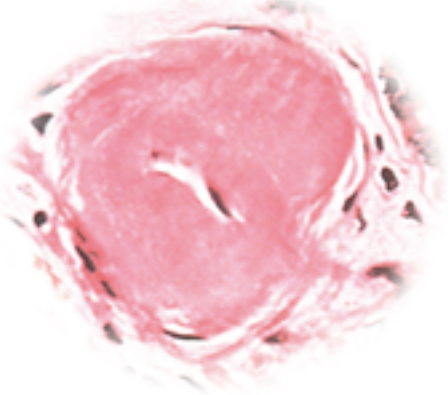
Arteriolosclerosis ➛ Nephrosclerosis

Physiology derivative: Filtration Fraction



HTN
DM



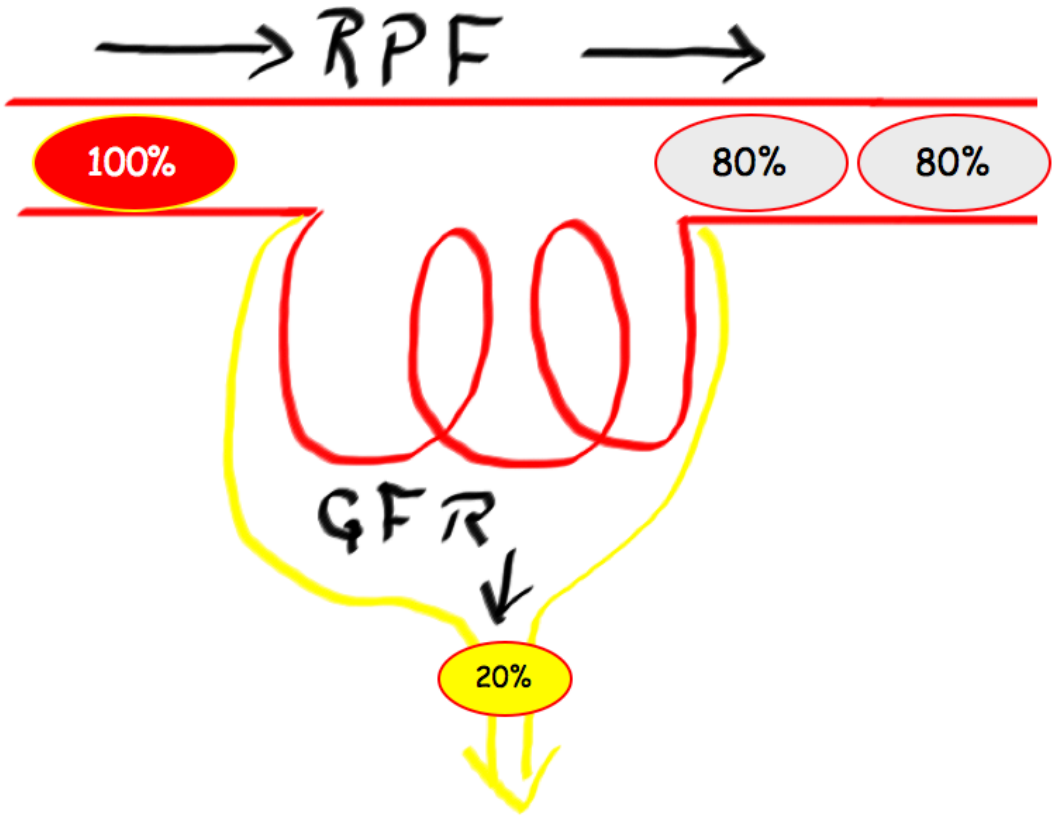


DM

Filtration Fraction = GFR/RPF = ~20%

Arteriolosclerosis ➛ Nephrosclerosis

Physiology derivative: Filtration Fraction



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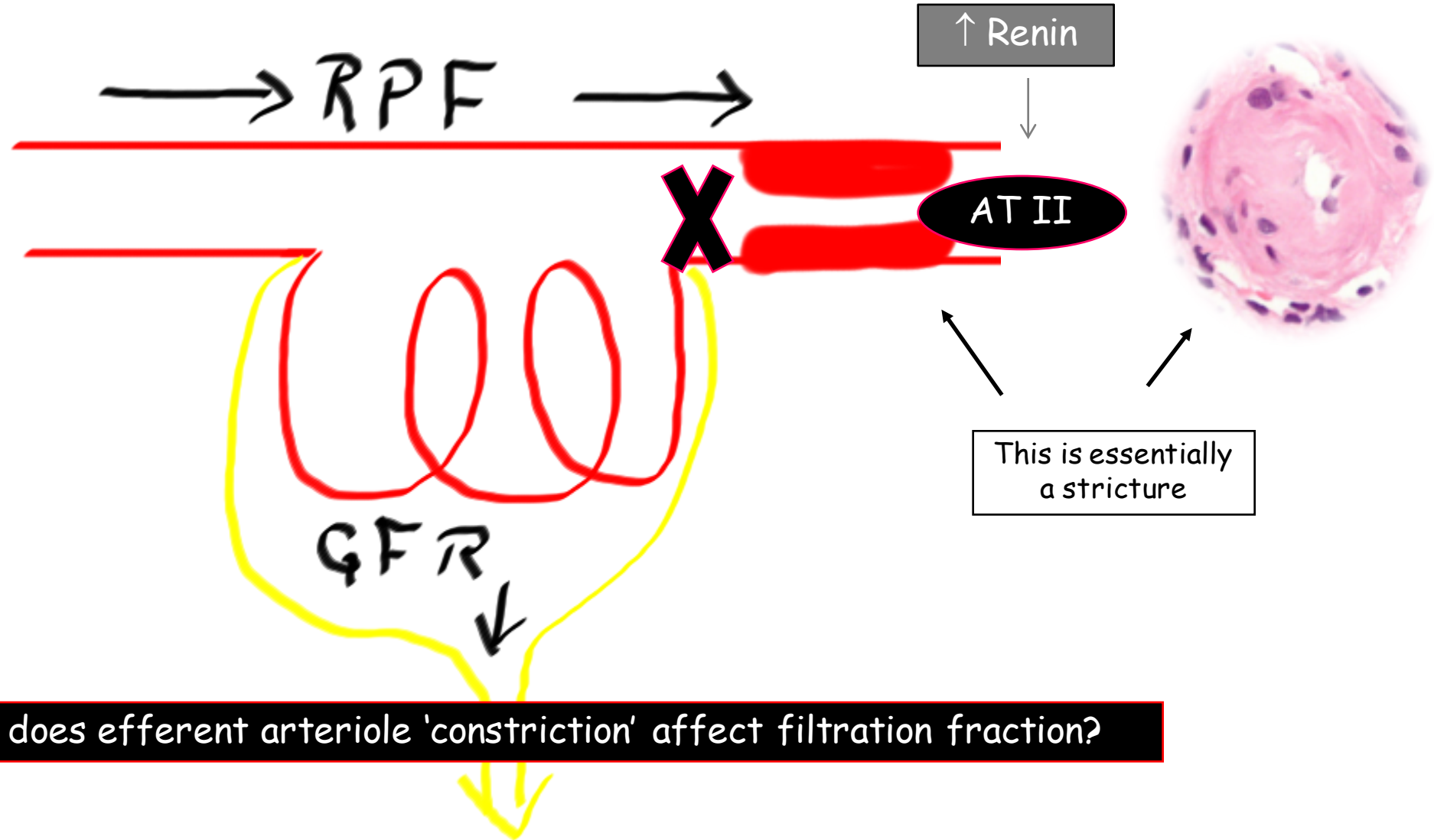
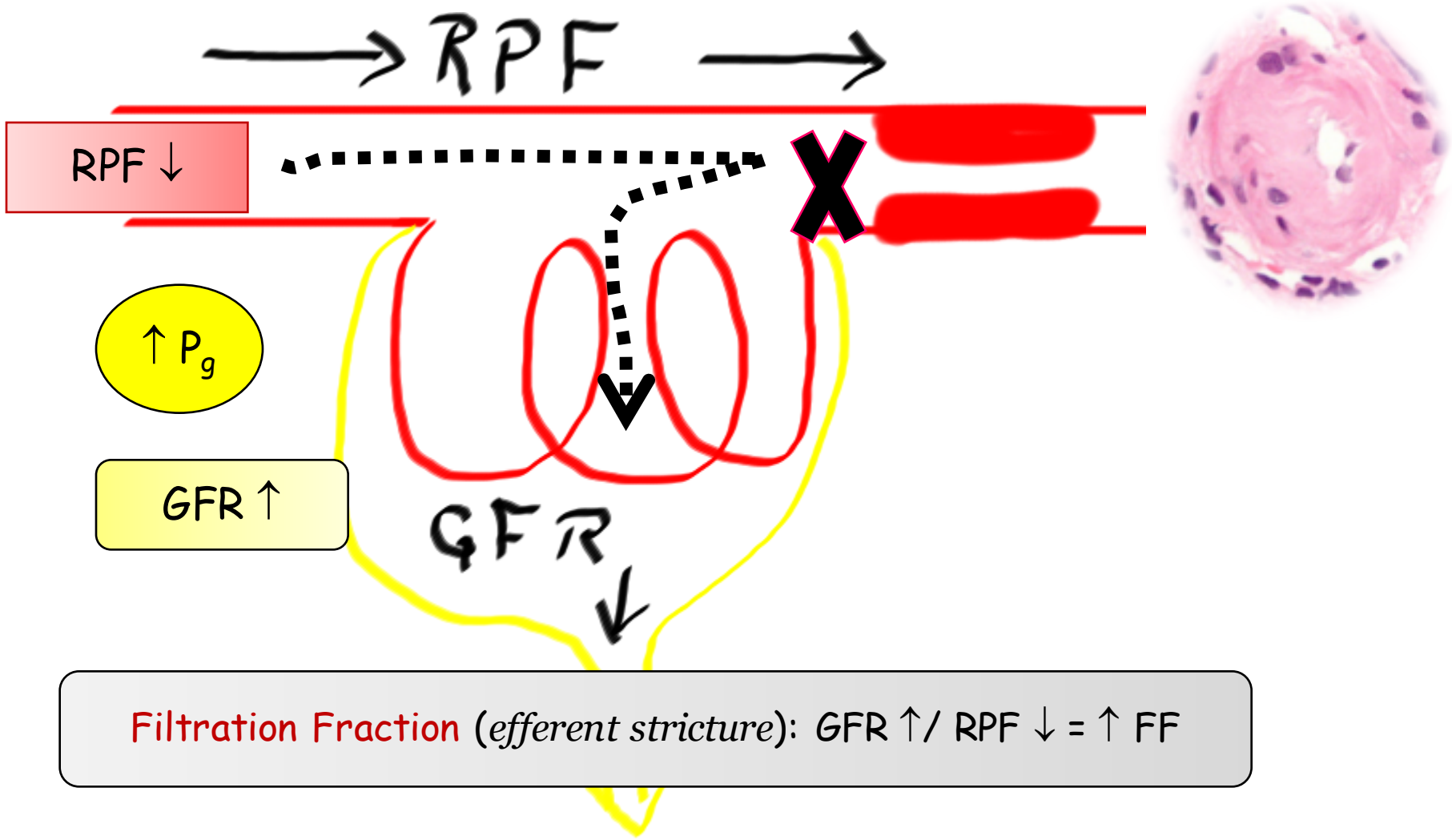
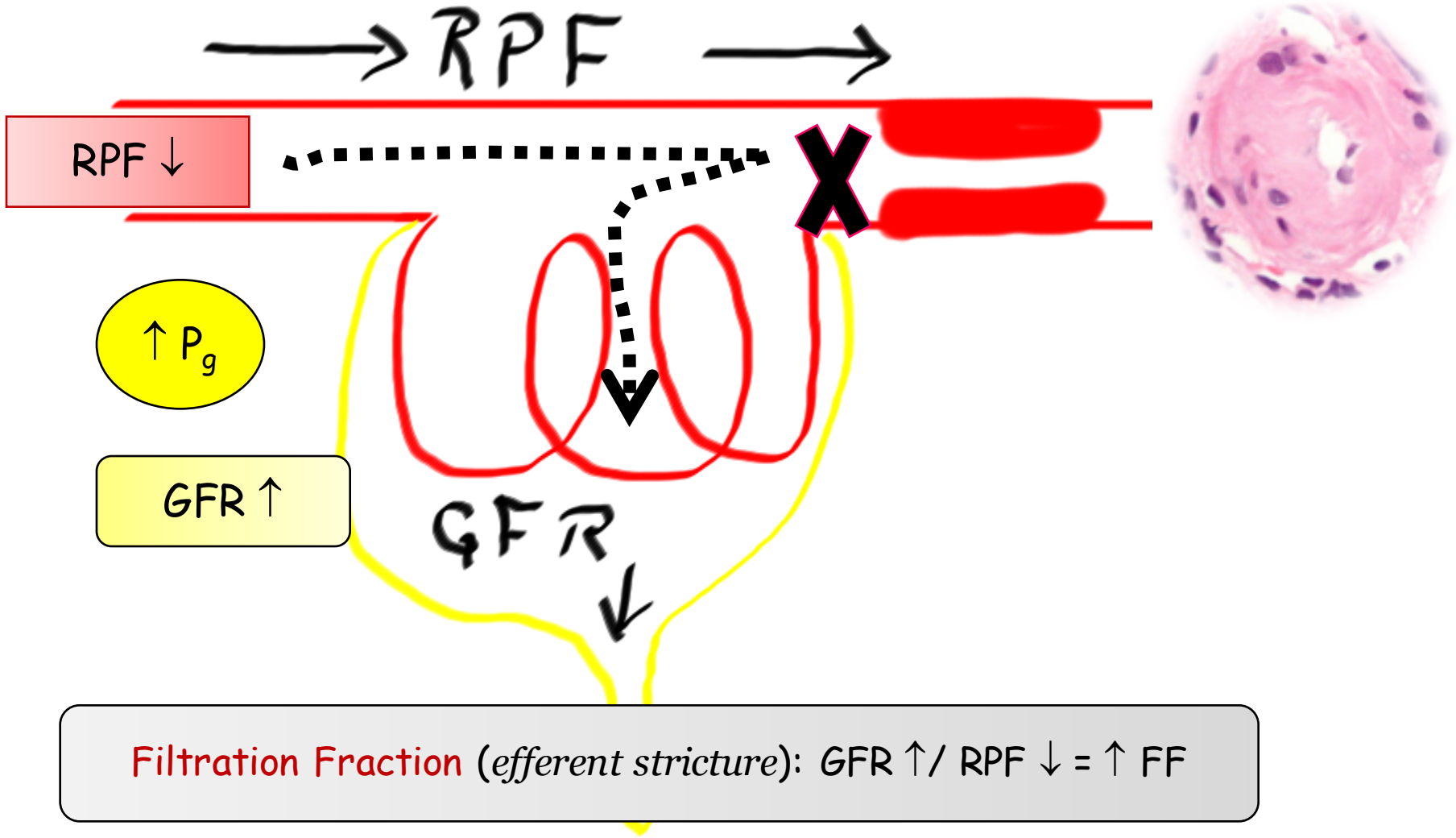


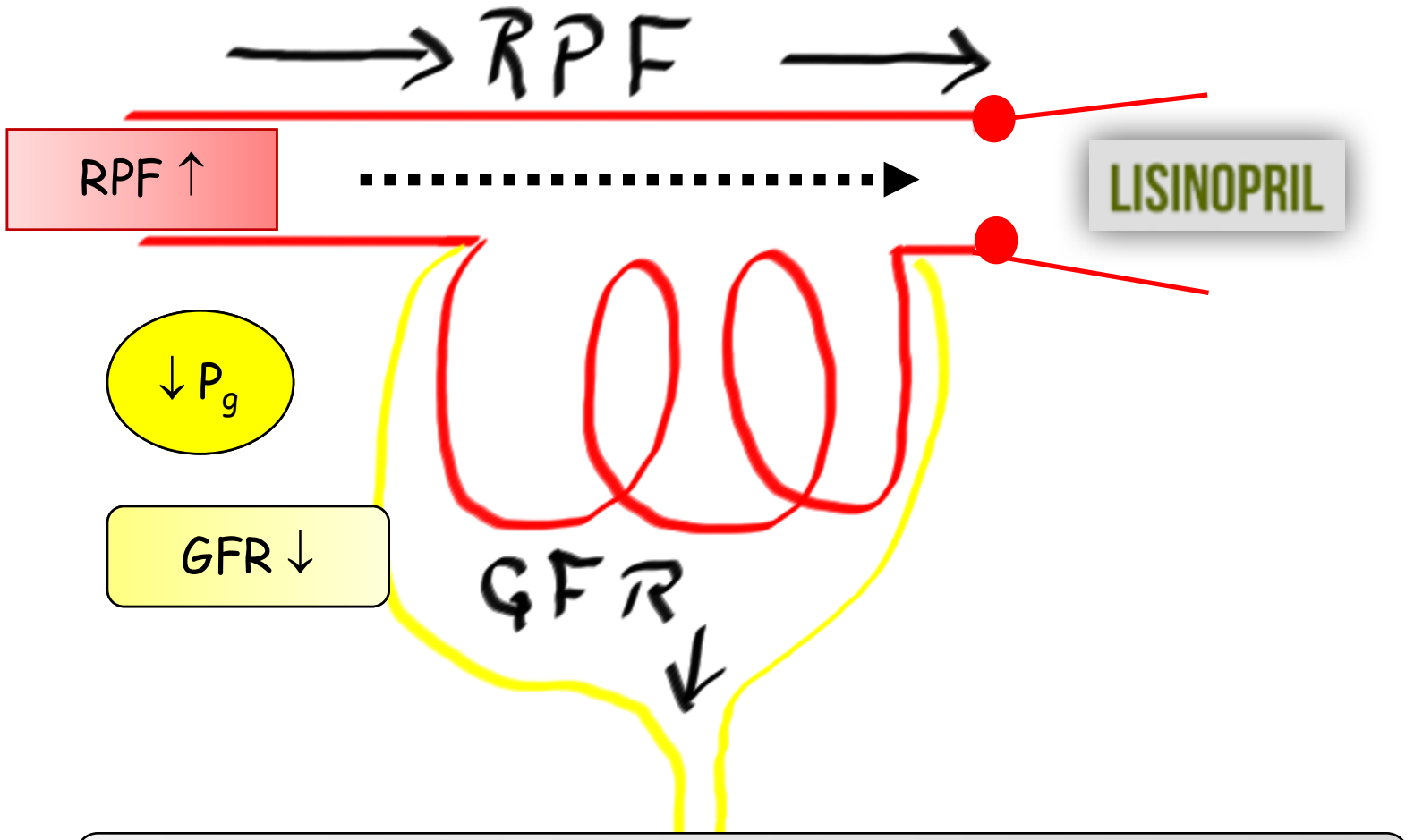
How does efferent arteriole 'constriction' affect filtration fraction?


RPF
RPF ↓
↑ P_g
GFR ↑
GFR
Filtration Fraction (*efferent stricture*): GFR ↑/ RPF ↓ = ↑ FF

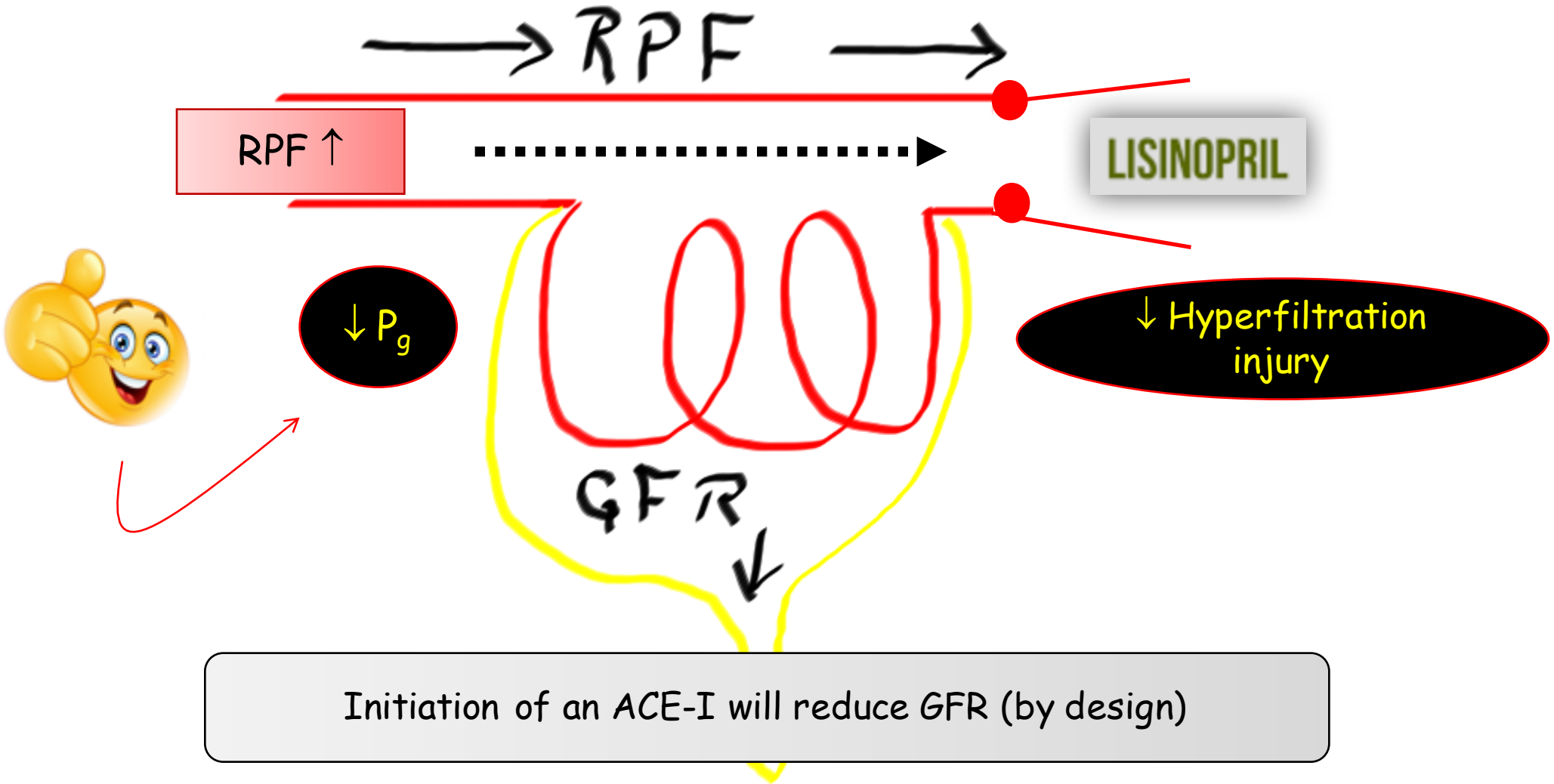


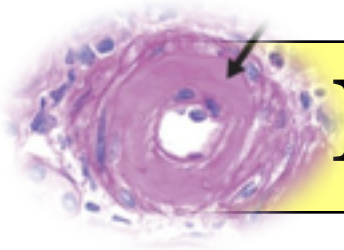
Filtration Fraction (*efferent stricture*): GFR ↑/ RPF ↓ = ↑ FF

What happens to filtration fraction if you relieve the 'stricture' with an ACE-I?

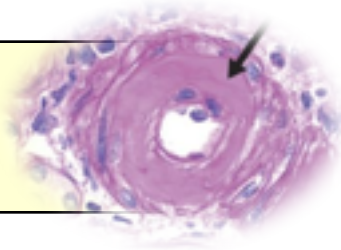


Filtration Fraction (*efferent stricture*): GFR ↓/↑ RPF = ↓ FF


RPF
RPF ↑
LISINOPRIL
↓ P_g
↓ Hyperfiltration injury
GFR
Initiation of an ACE-I will reduce GFR (by design)



Hypertensive (DM) Nephrosclerosis



- Background
  - Ischemic parenchymal injury 2° to *hemodynamic injury* (typically in setting of *HTN/DM*)
- Pathogenesis
  - Elaboration of *extracellular matrix* and/or *advanced glycation end products* (DM) by vascular smooth mm cells
- Pathology
  - Micro: Efferent arteriole hyalinosis (acellular, homogenous thickening) resulting in *tubulointerstitial fibrosis* and *glomerulosclerosis*
  - Macro: *Cortical scarring* with granular appearance and reduction in renal mass.
- Physiology Derivative
  - Impact on GFR and renal plasma flow (= *filtration fraction* with and without ACE-I)

Primary (Essential) Hypertension for the Boards

Older patient with diastolic heart disease

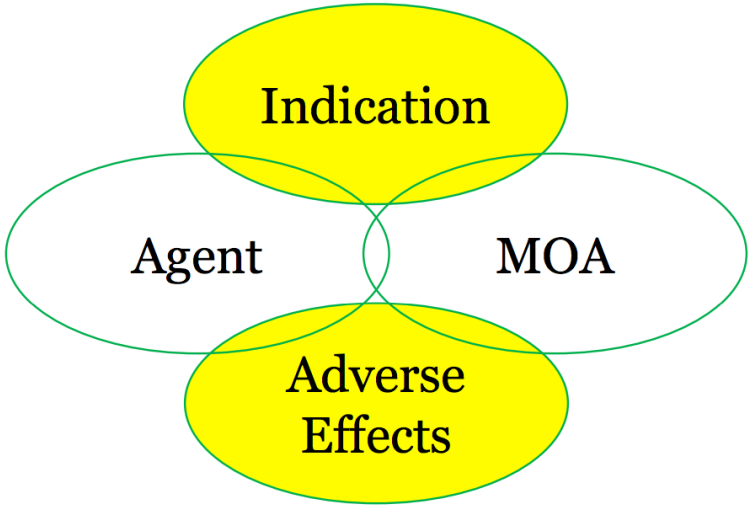
	LVEDP	LVEDV	LVEF
A.	Inc	Inc	Dec
B.	Nl	Inc	Dec
C.	Nl	Nl	Dec
D.	Inc	Nl	Dec
E.	Inc	Nl	Nl
F.	Nl	Inc	Nl

'...an extra pre-systolic heart sound is heard at the apex

Atrium contracting against a poorly compliant ventricle (at limit of compliance)

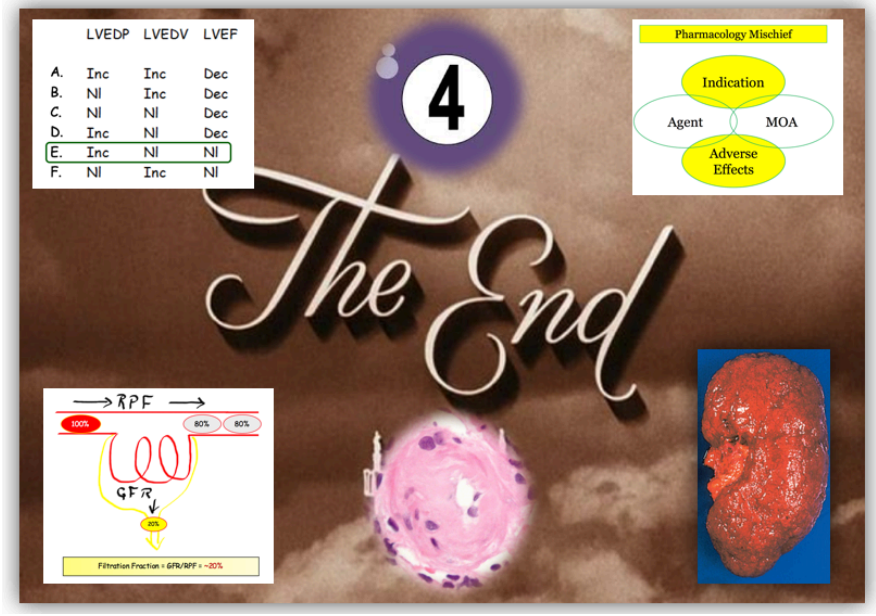
'Patient with HTN is started on which of the following agents...'

Pharmacology Mischief



Primary (Essential) Hypertension for the Boards

Renovascular Hypertension for the USMLE Step One Exam



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