MRI of the renal arteries

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Disclosures

Off-label use: gadolinium enhanced MRI of the blood vessels

Screening for Renal Artery Stenosis:

- low morbidity - no contrast reactions
- rapid exam - 15 minutes
- low nephrotoxicity compared to iodine agents

3D Gadolinium Renal MRA

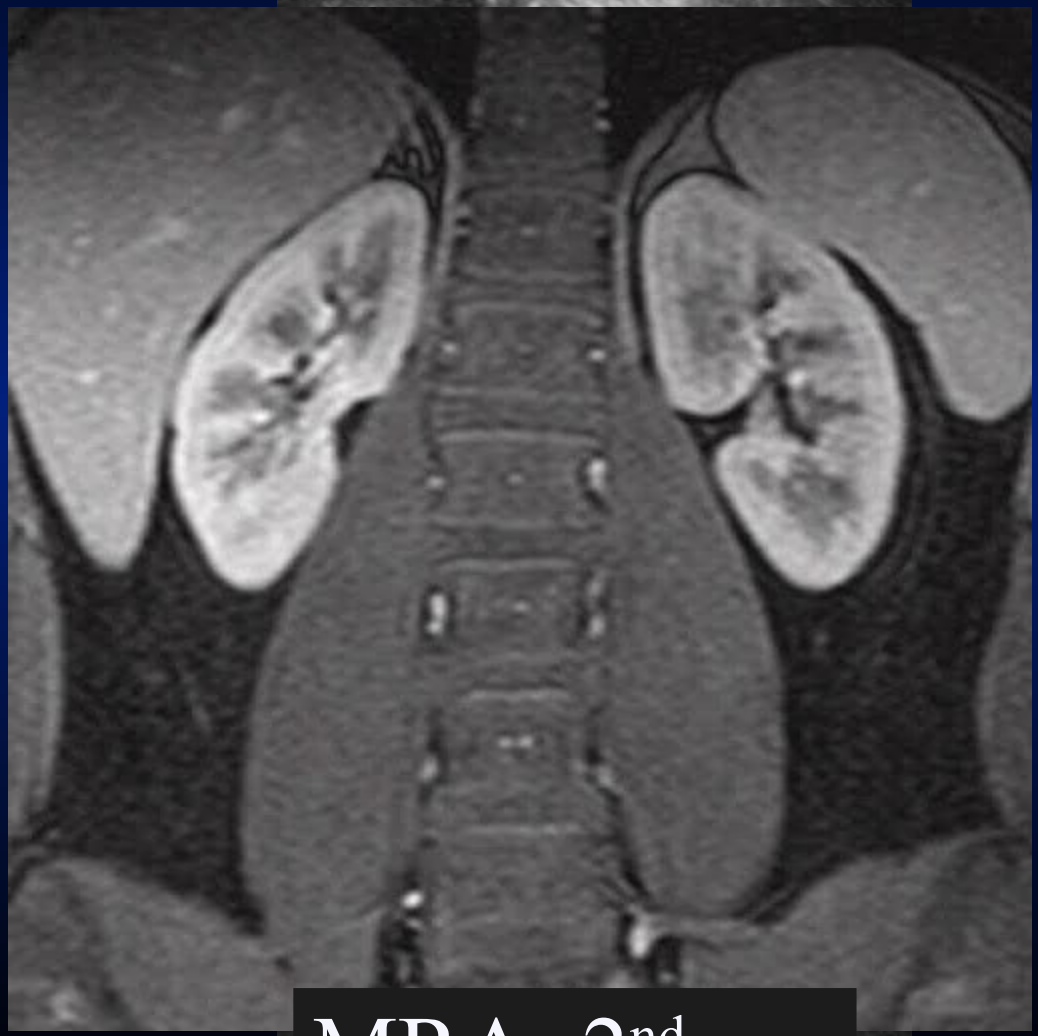
Study	Yr	# arteries	Sens.	Spec.
Korst et al.	‘00	92	100%	85%
De Cobelli	‘00	103	94%	93%
Thornton	‘99	87	100%	98%
Thornton	‘99	138	88%	92%
Hany	‘98	235	93%	90%
Bakker	‘98	121	97%	92%
De Cobelli	‘97	105	100%	97%
Postma	‘97	74	100%	96%
Hany	‘97	78	93%	98%

Fluoroscopic MRA trigger

Fluoroscopic MRA trigger

MRA: Venous phase

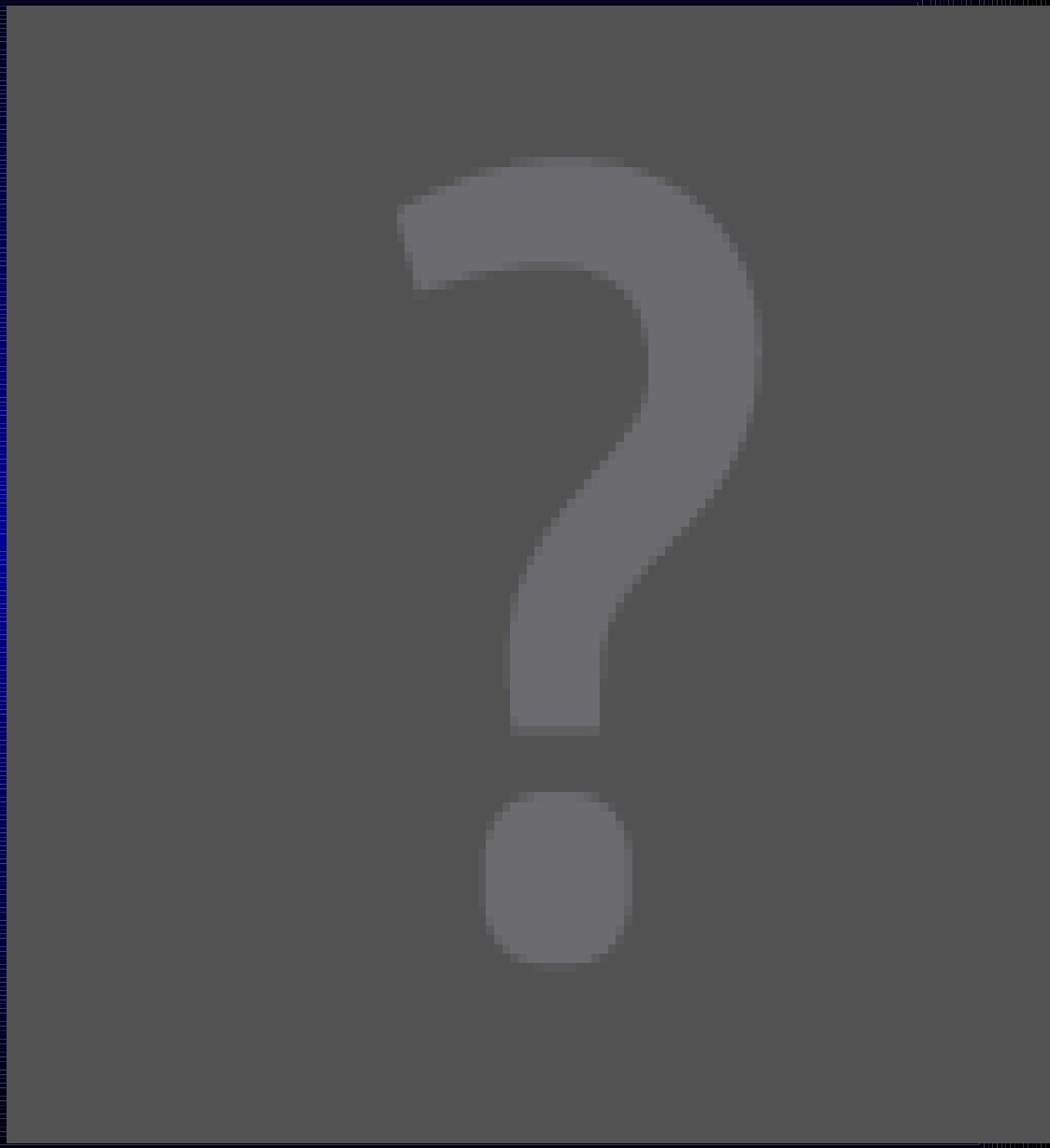
3d VIBE, SPGR



MRA: 2nd run

MRA - Aorta

- 3D aquisition, 2mm slice thickness
- 0.15 mmol/kg gad @ 2ml/sec
- Automated timing bolus
- 15 sec breath-hold



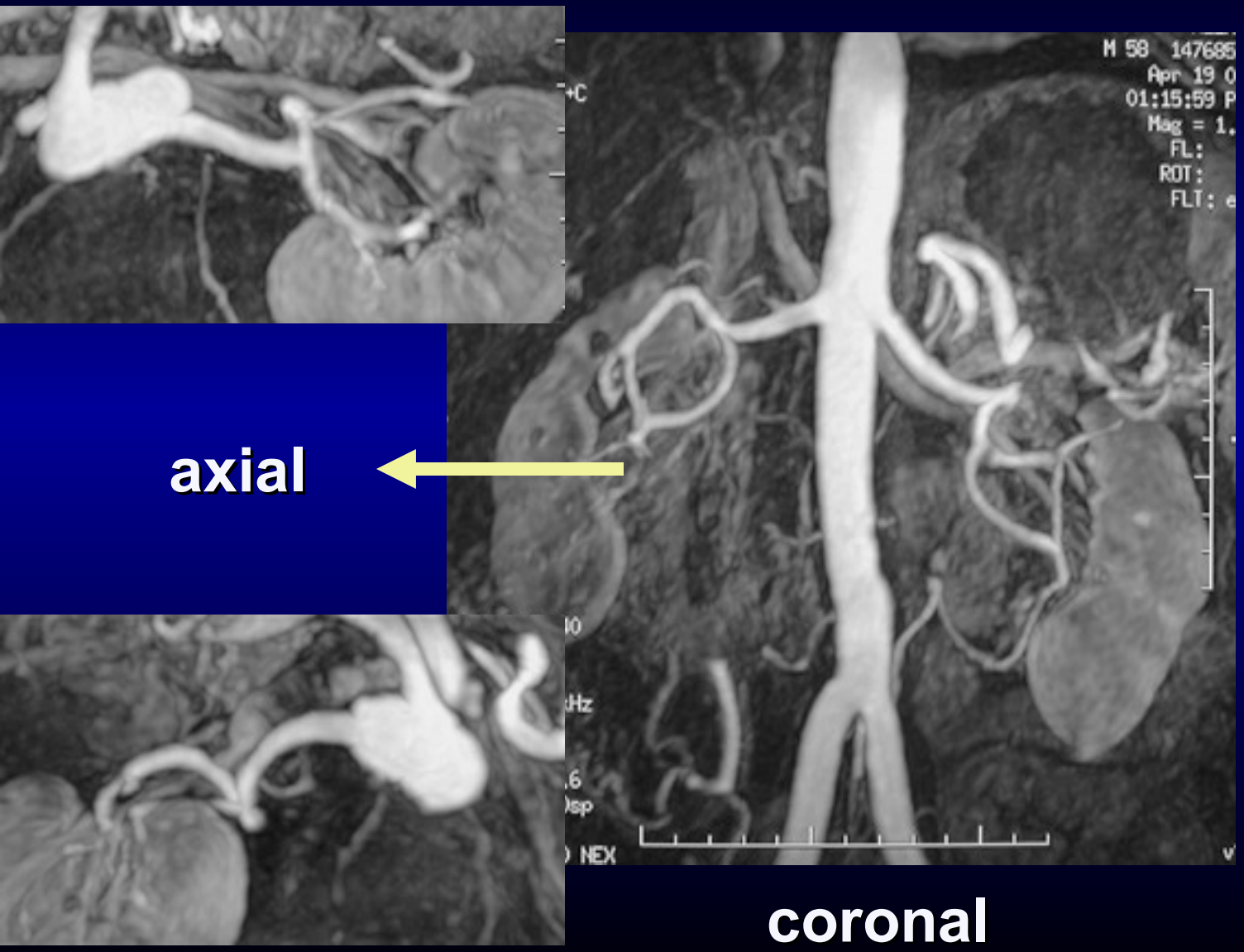
Renal MRA ?

Renal MRA

Renal MRA: data analysis

- MIP image
- most common “data reduction” method

MRA - reformat



MRA - reformat

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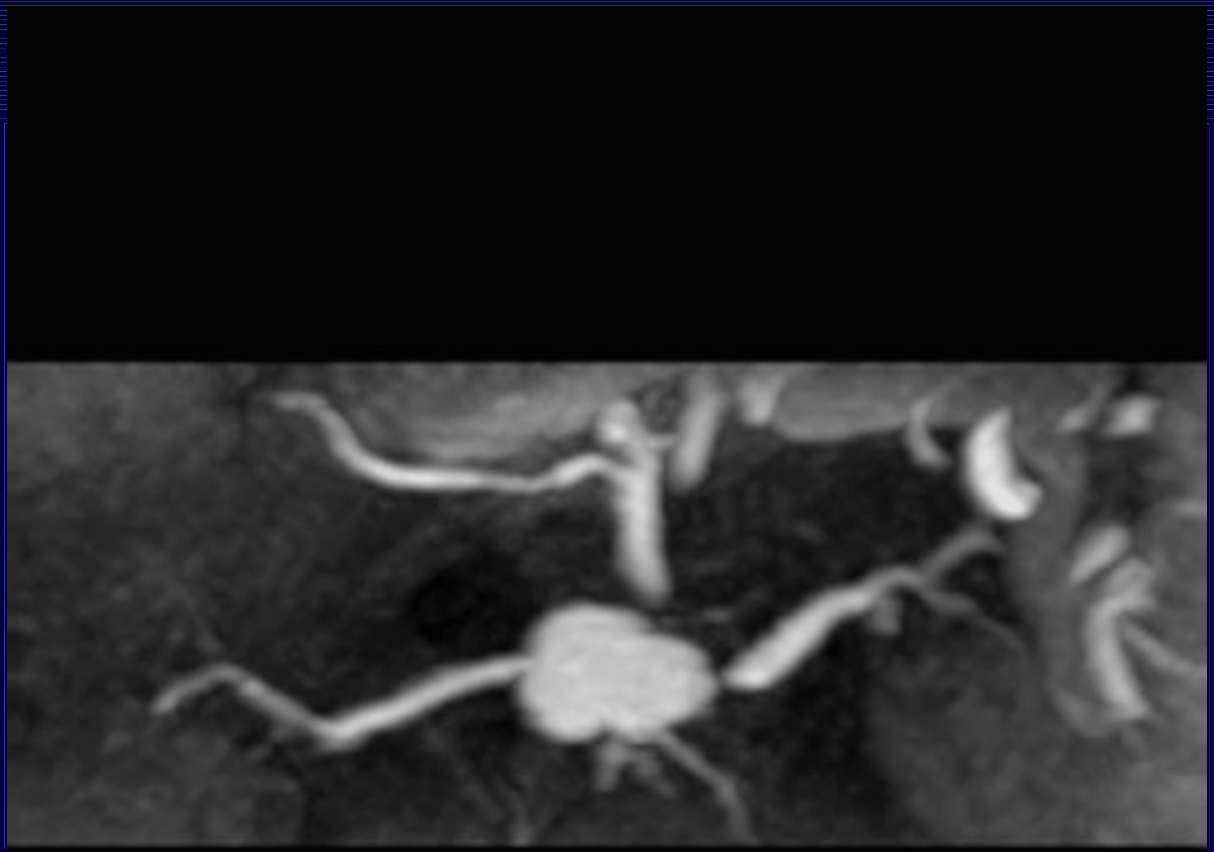
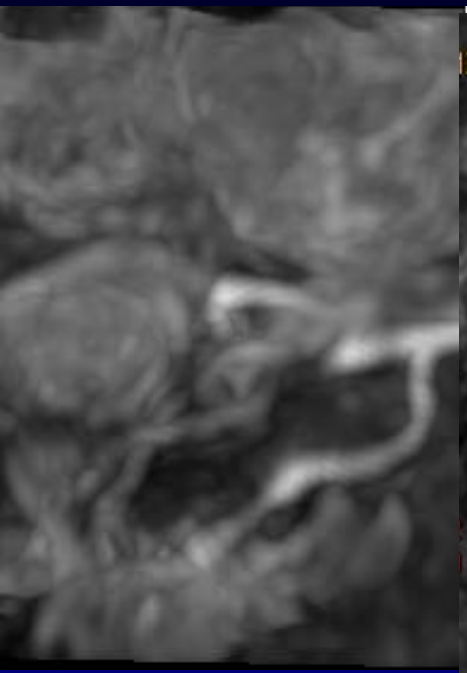
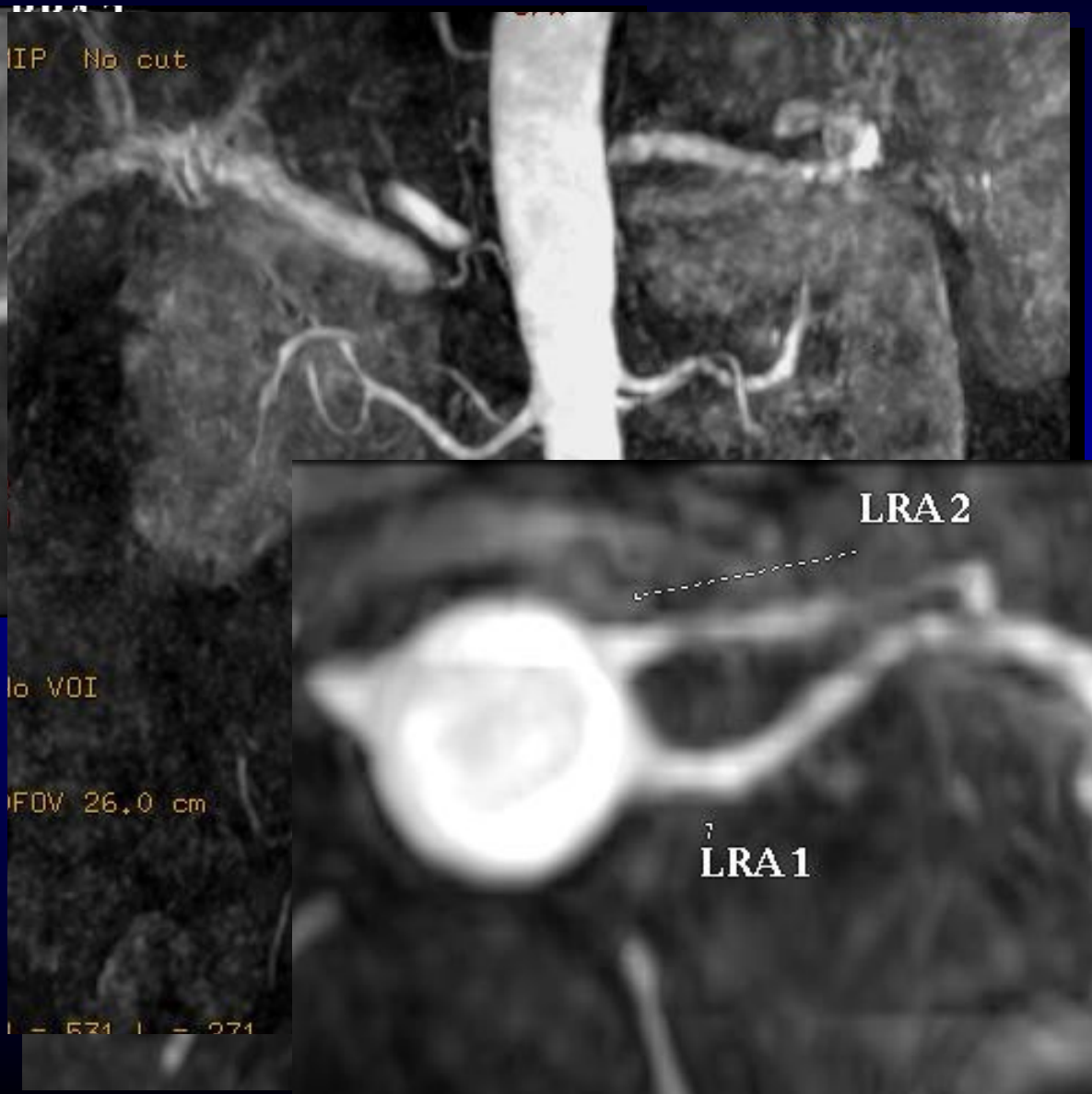


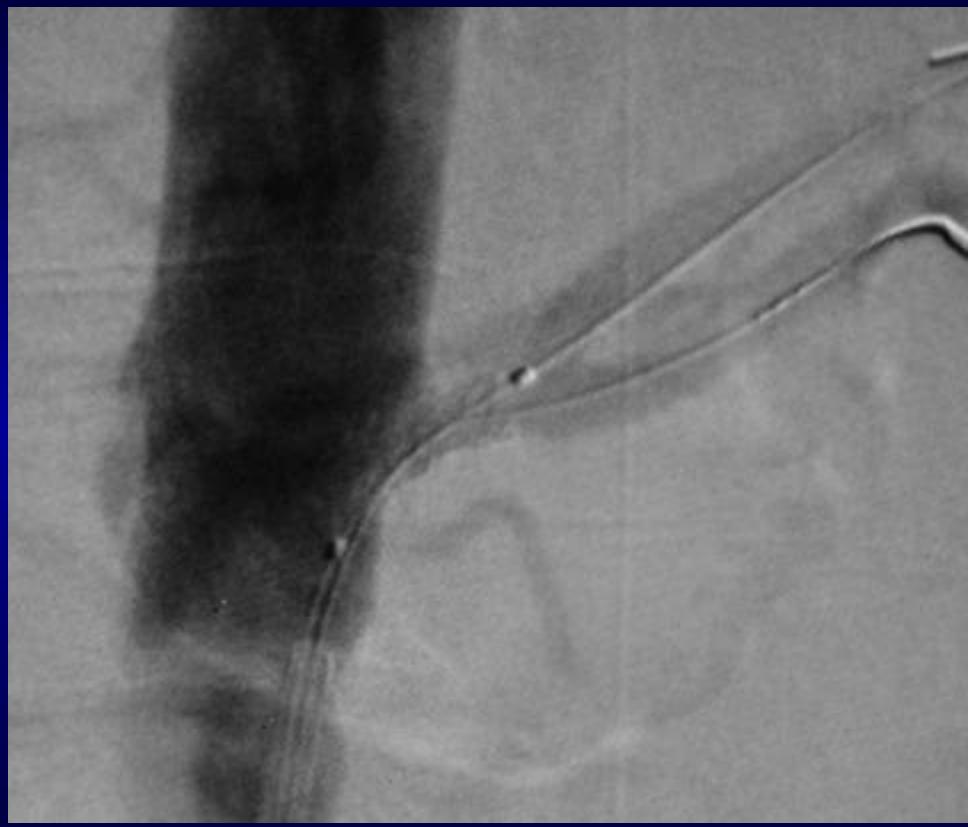
3T Renal MRA

3T Renal MRA





MRA - reformat



Eccentric plaque - MIP pitfall

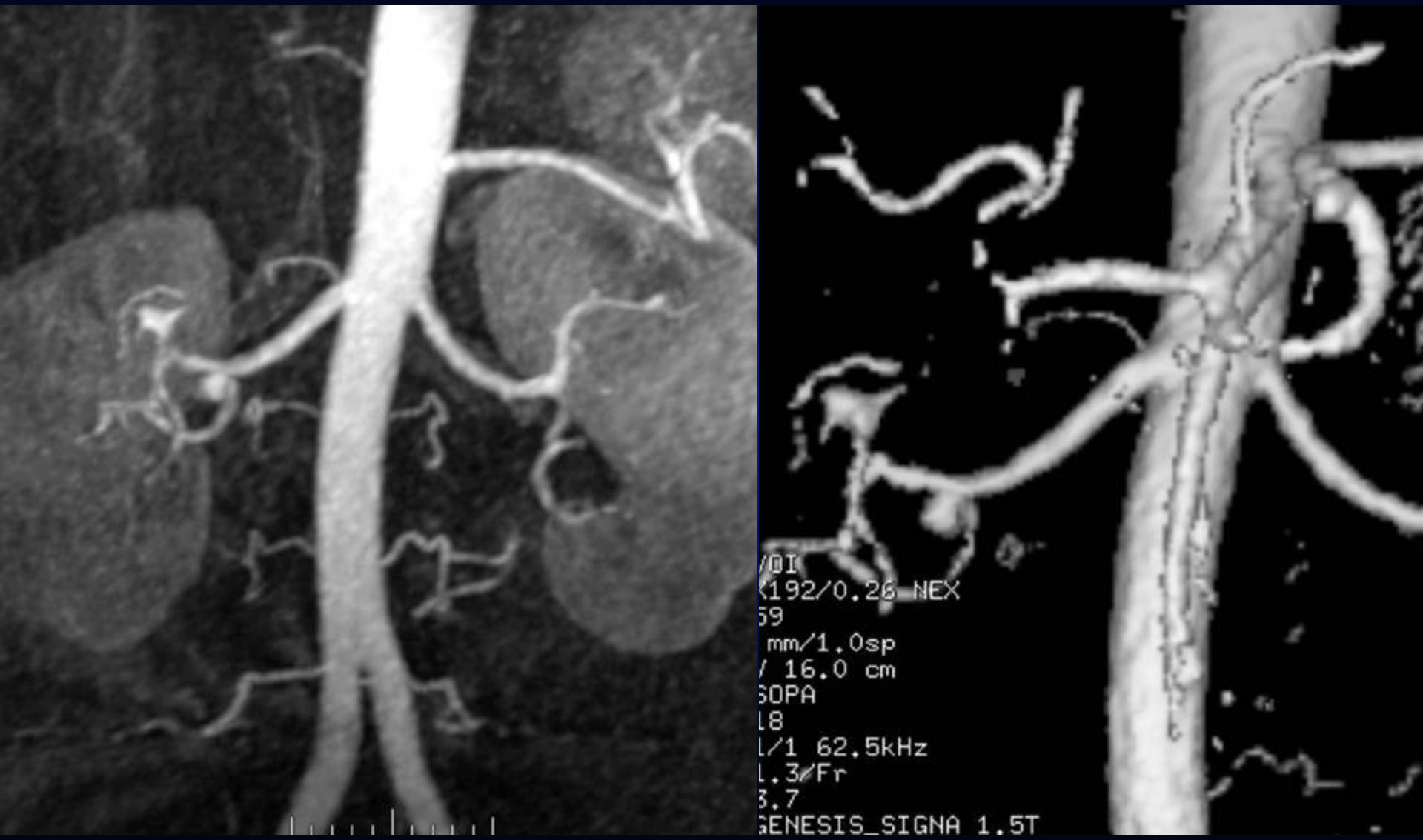
Volume Rendering

- retains “3d” information

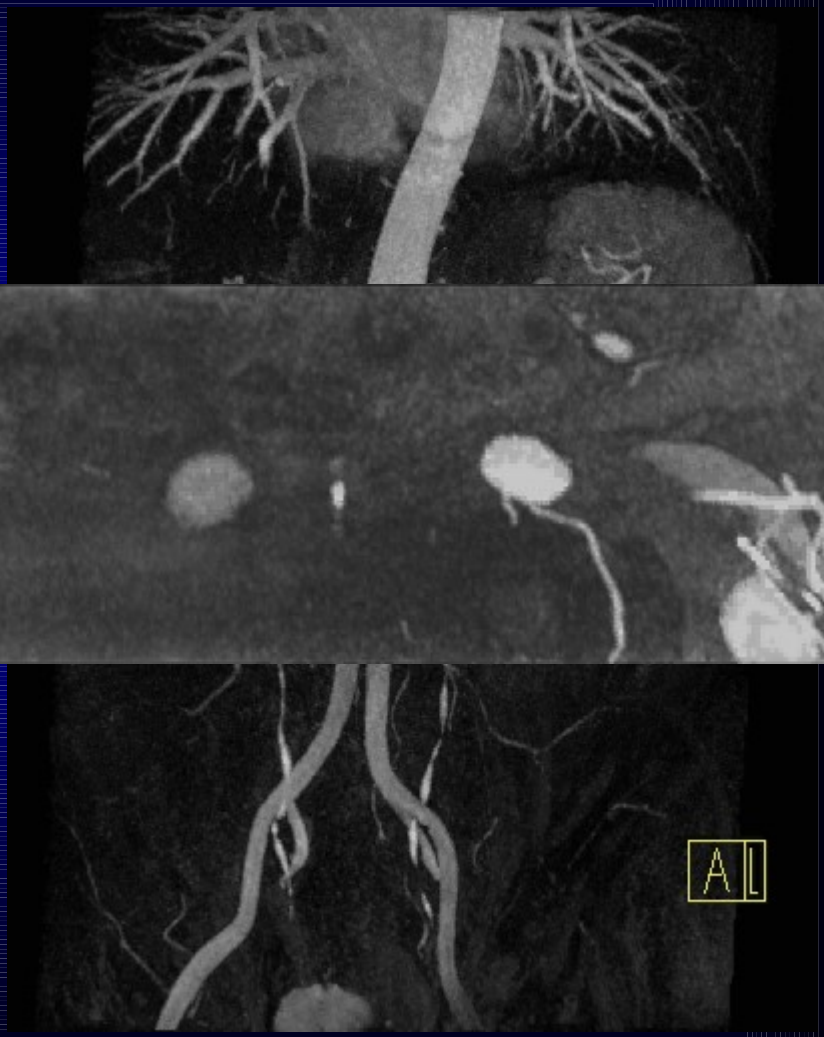
MR angiogram: accurate/ rapid anatomy

Maximum intensity projection and surface displays

Aorto-enteric fistula repair, aneurysm


/DI
192/0.26 NEX
59
mm/1.0sp
/ 16.0 cm
SOPA
18
1/1 62.5kHz
1.3/Fr
3.7
GENESIS_SIGNA 1.5T

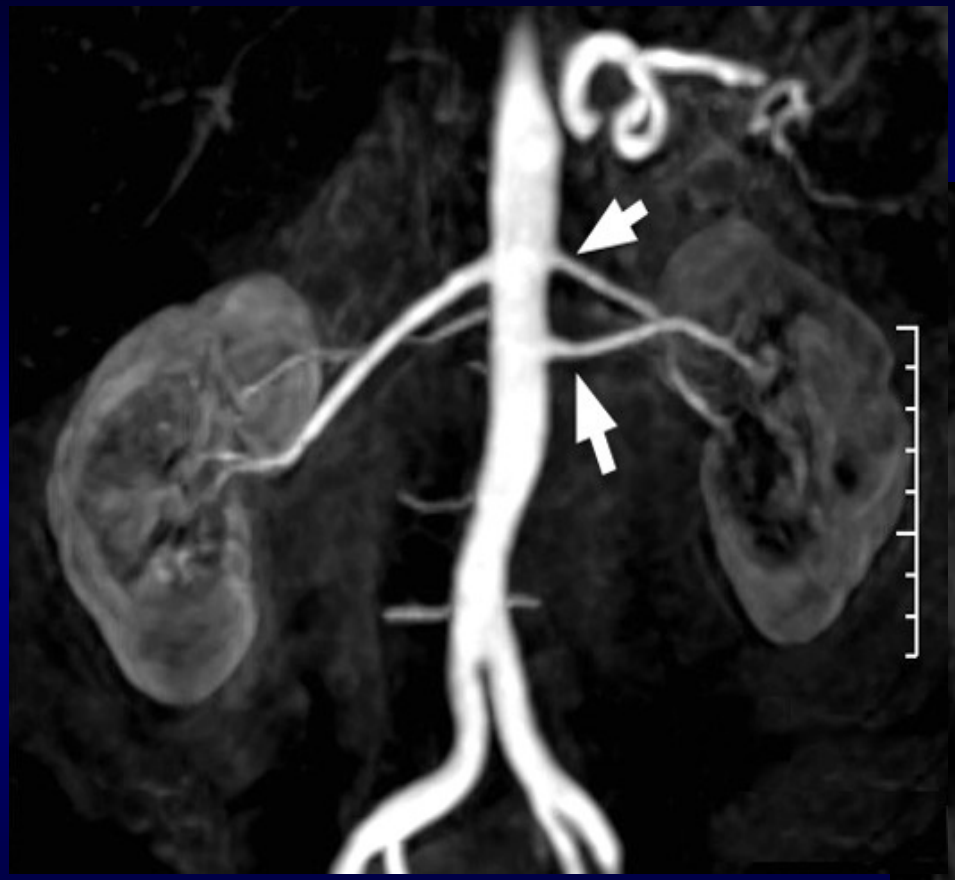
Renal MRA: Aneurysm



Dynamic MRA (TREAT)

Courtesy of Paul Finn, UCLA

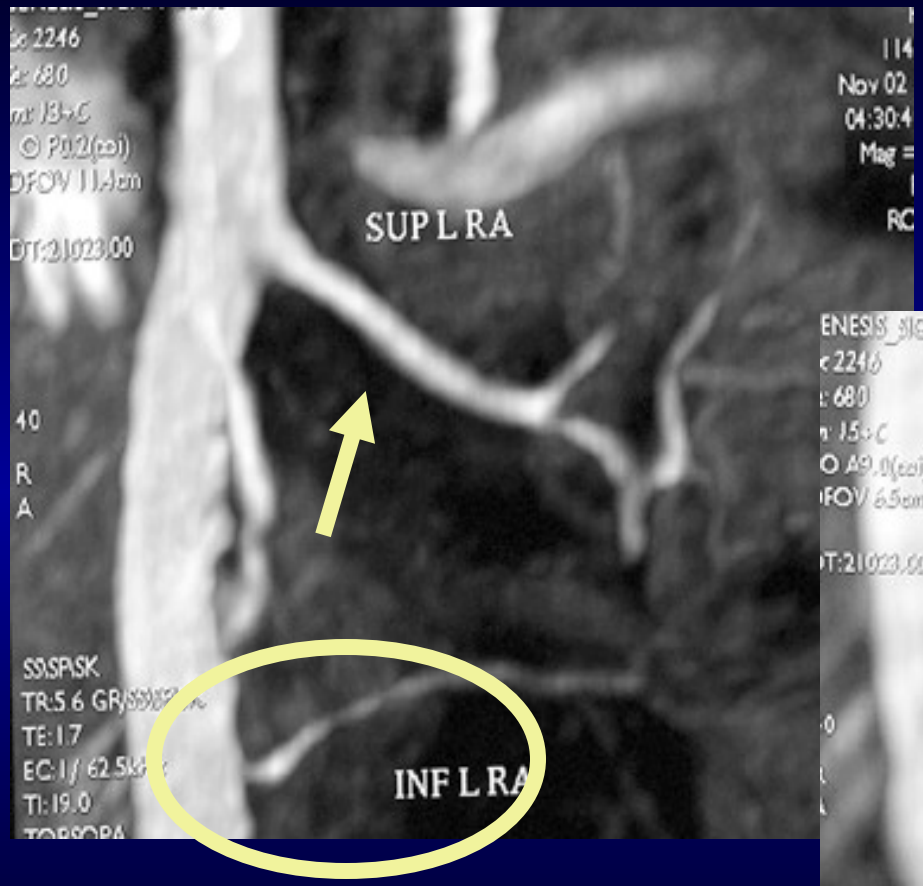
MRA - variant anatomy

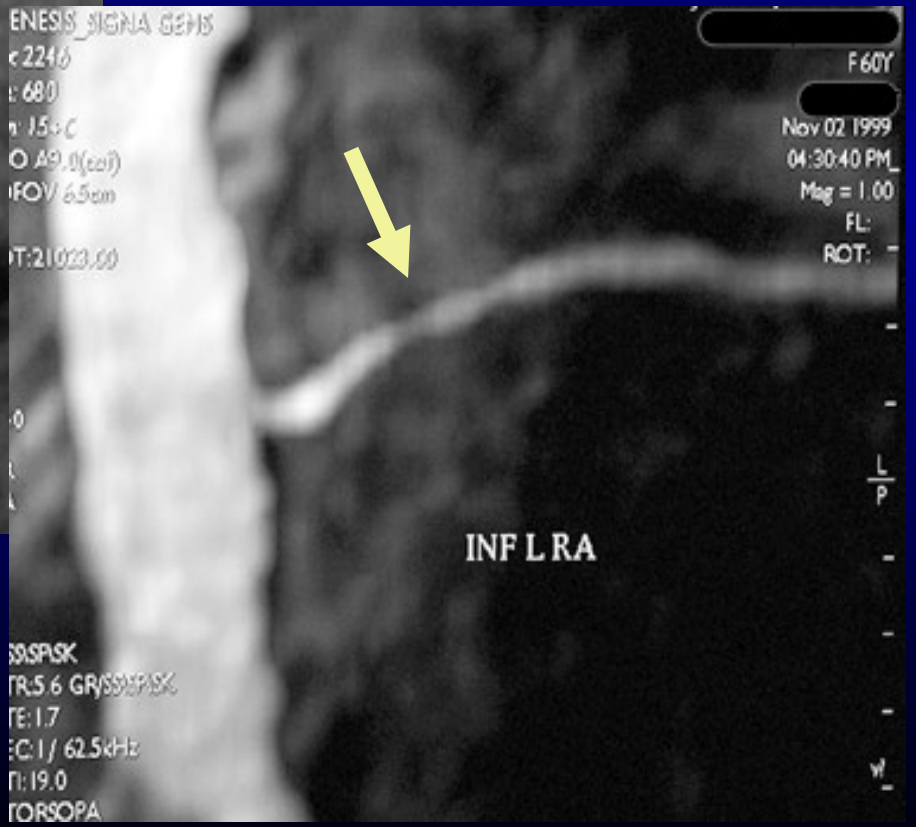


MRA - document variant anatomy

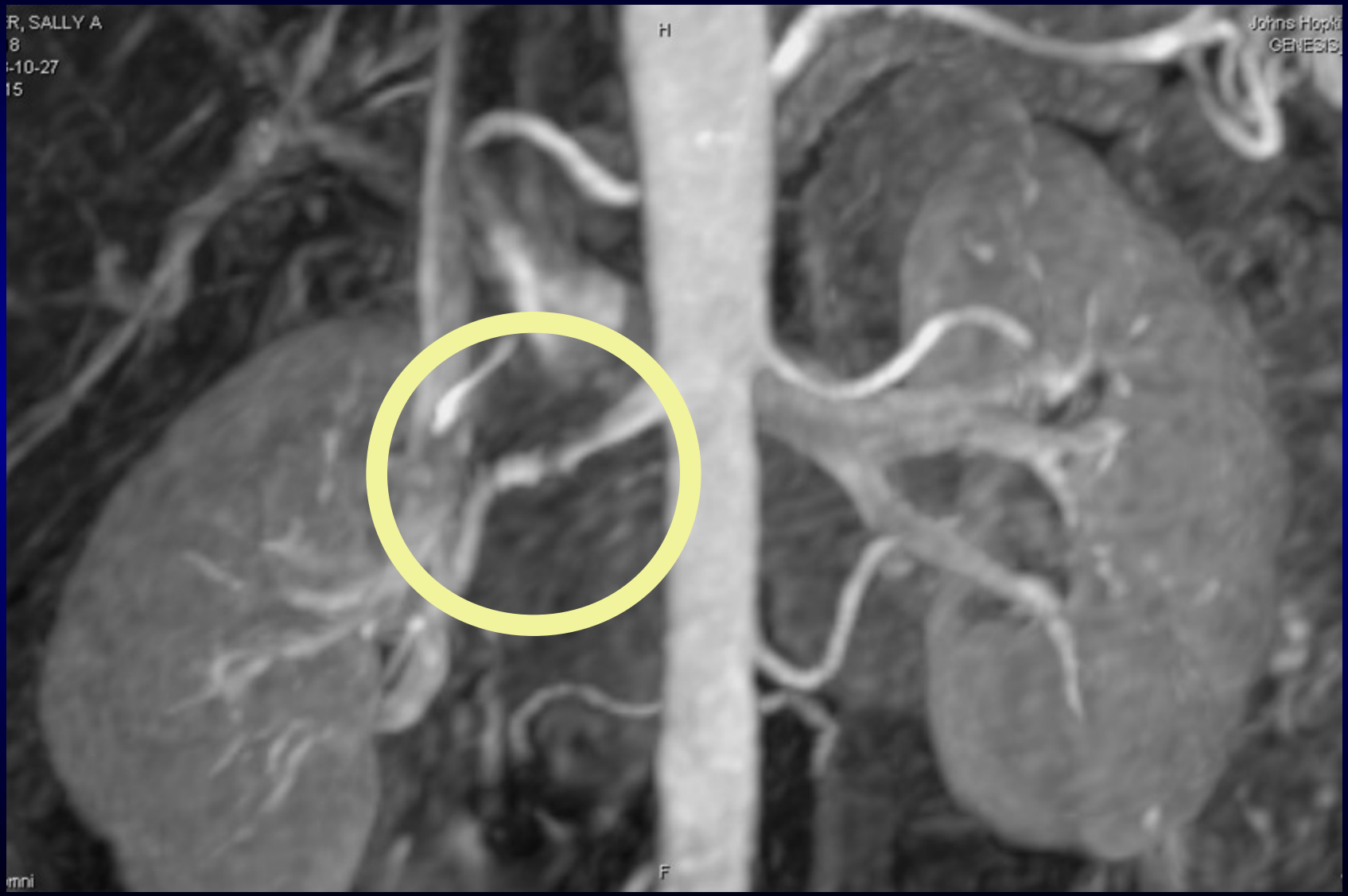
- Early arterial branching

MRA: variant anatomy

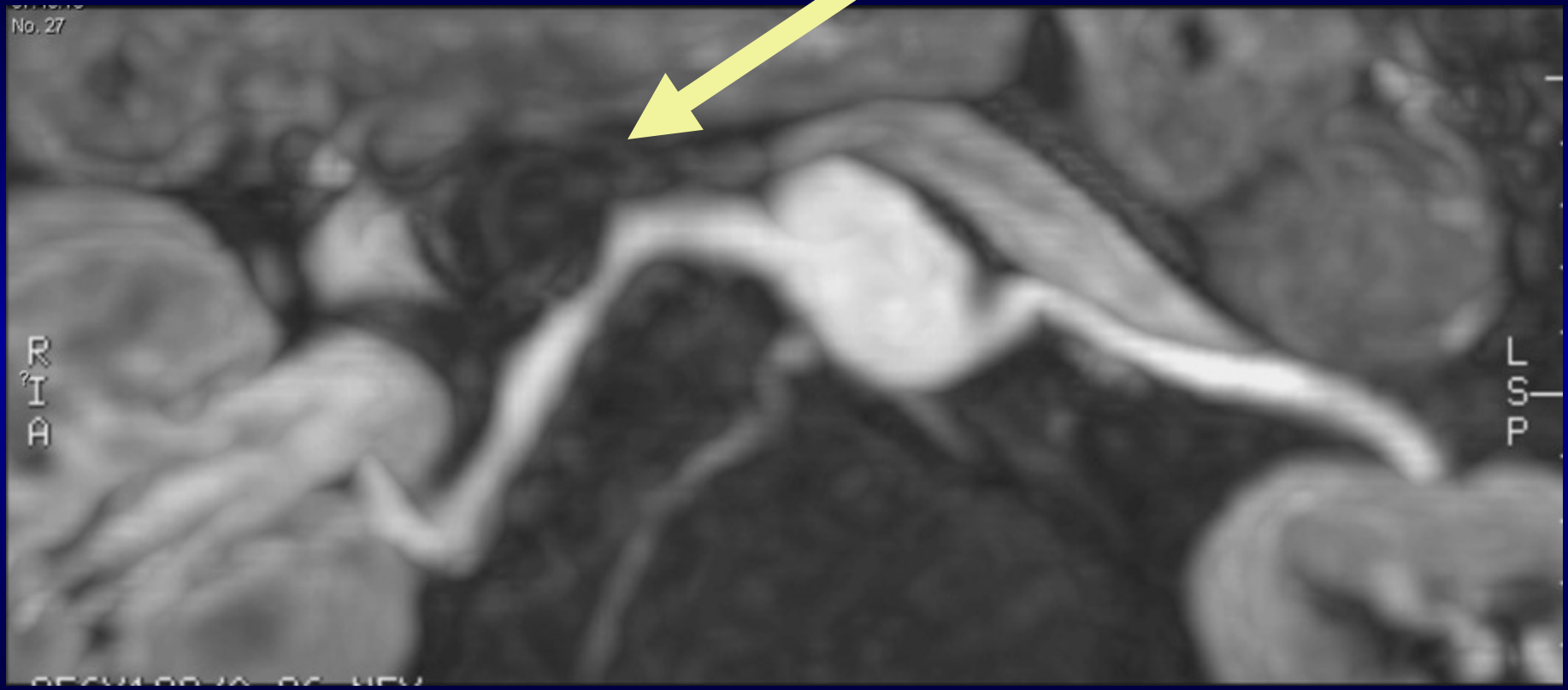




Pitfall



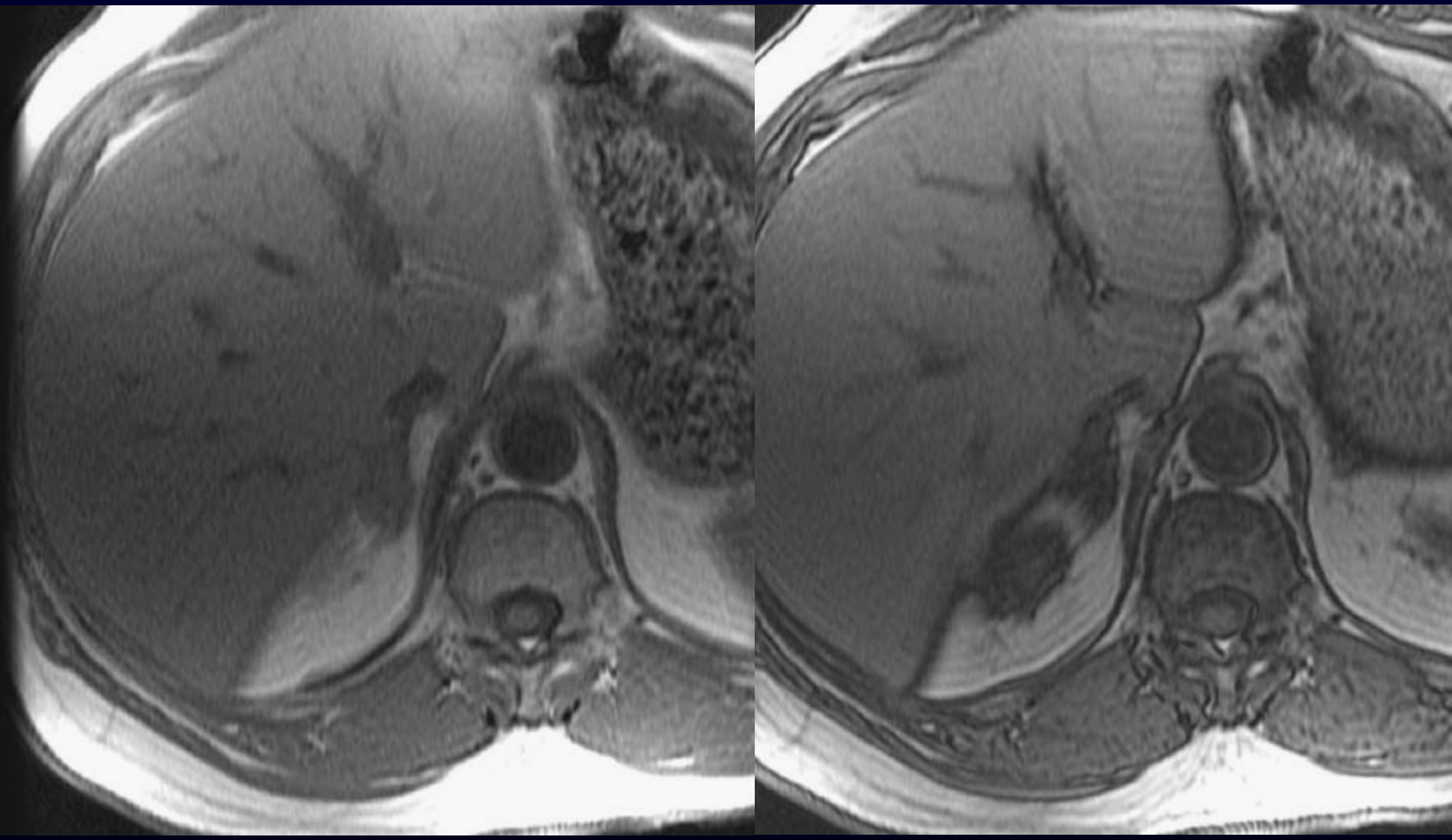
Pitfall - susceptibility



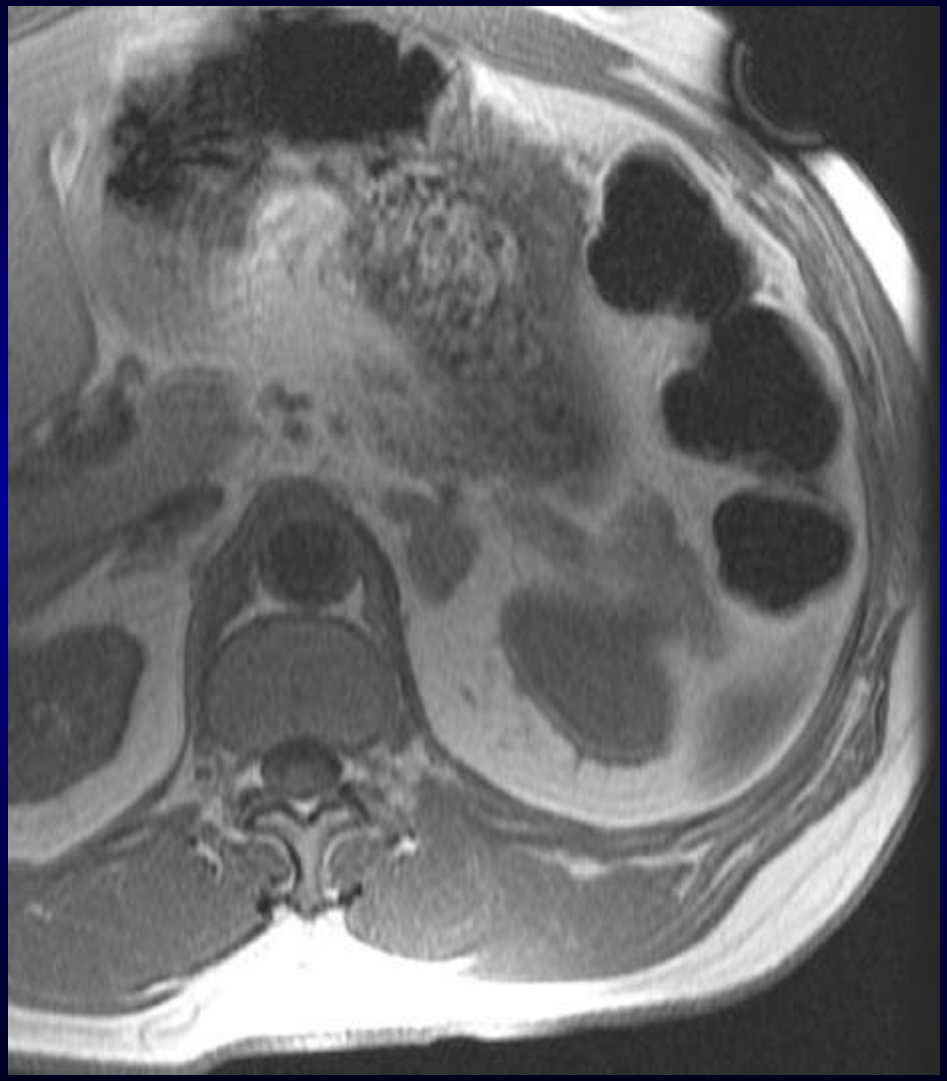
Pitfall - stent

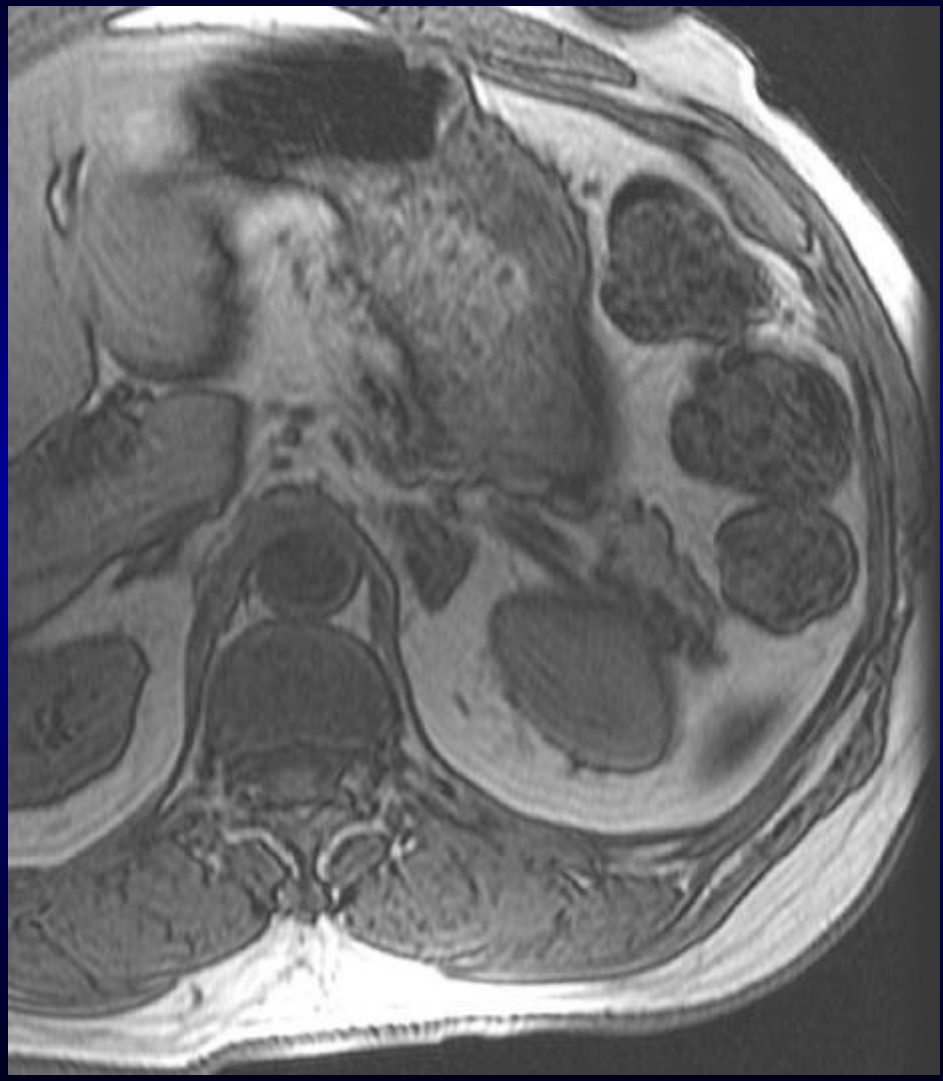
Pitfall: adenoma

Pitfall: adenoma



Pitfall: adenoma





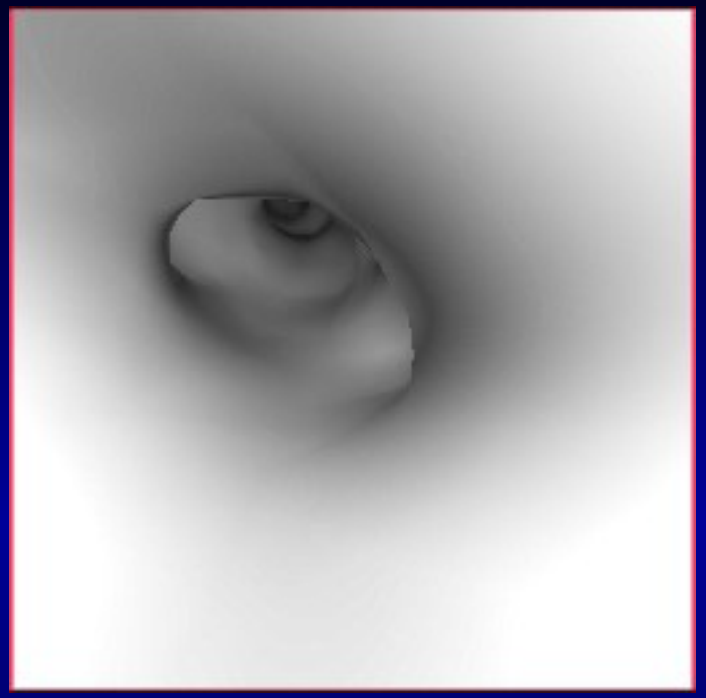
Renal MRA: size matters

- 3D renal size
- Is there sufficient renal mass for revascular-ization?
- > 1 cm L/R renal size difference

Renal Artery MRA: disadvantages?

- tendency to overestimate (calcification, turbulence)

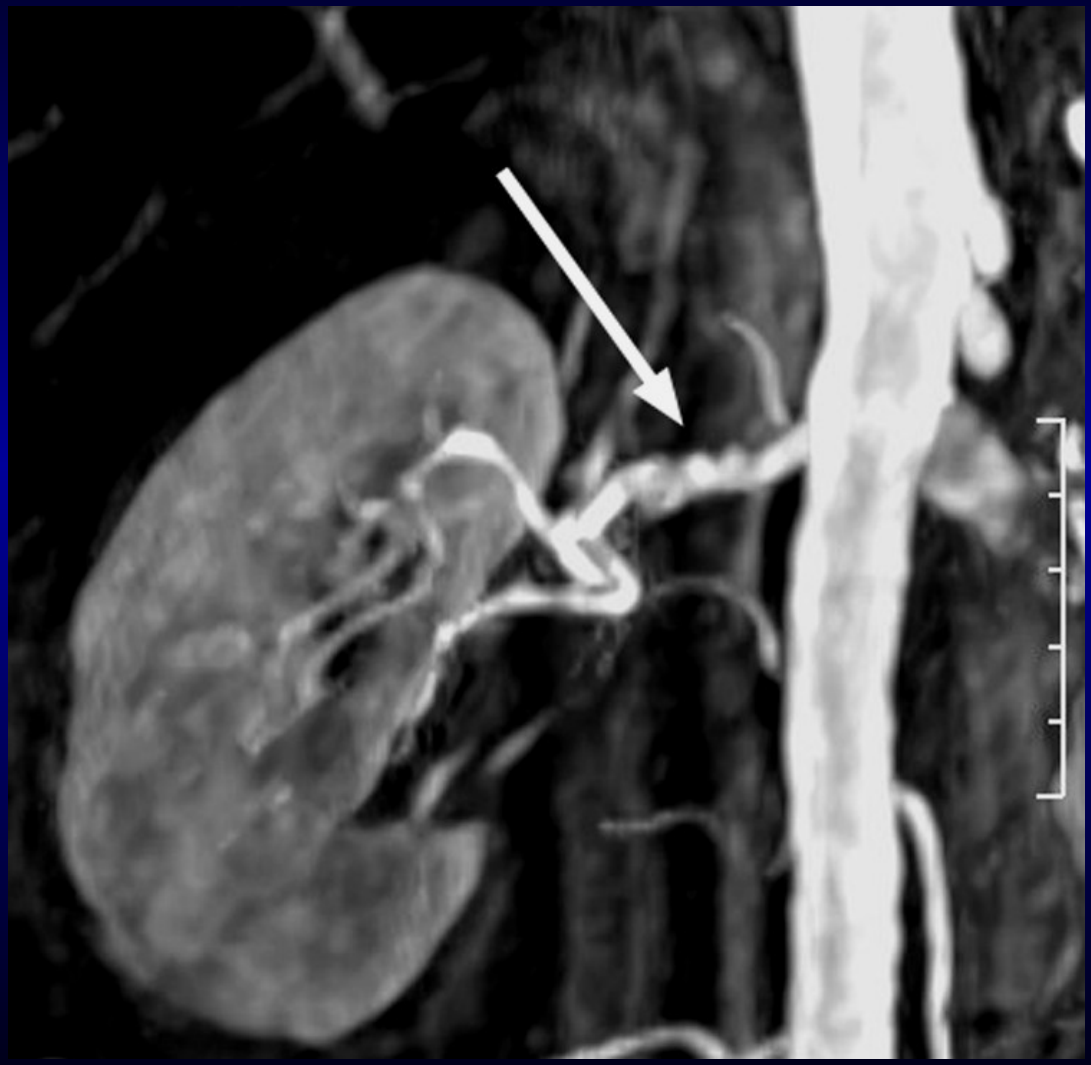
Female, long standing hypertension



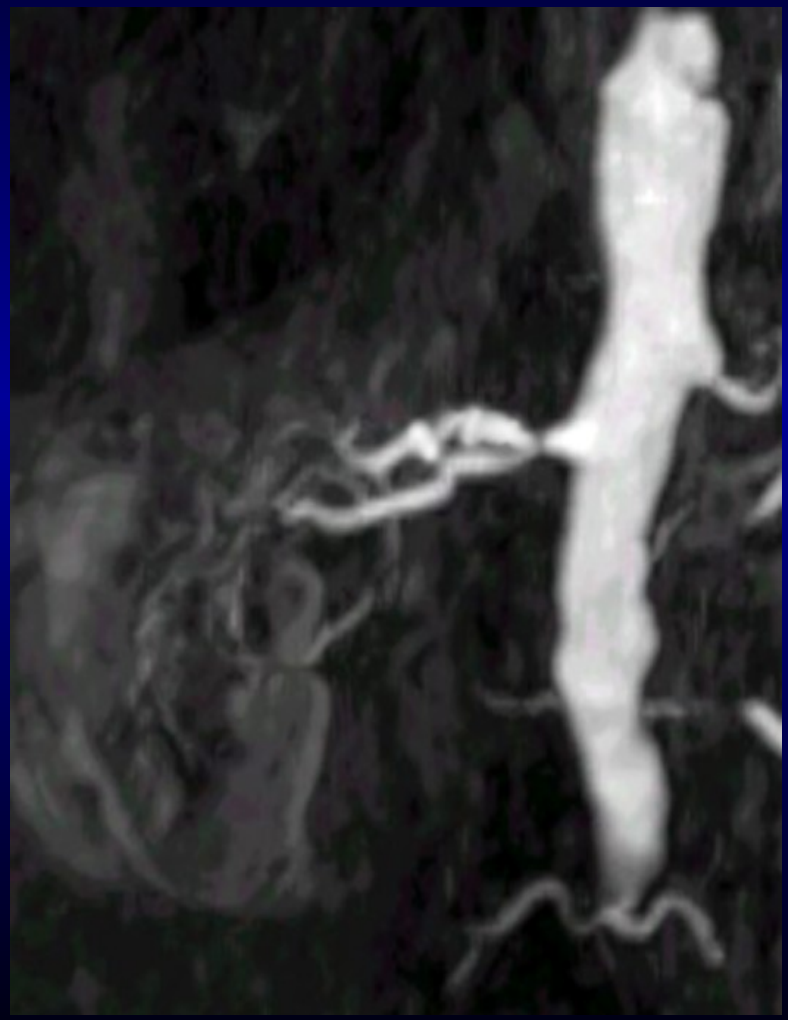
“Hypertension”

Fibromuscular

dysplasia



Fibromuscular dysplasia



MRA

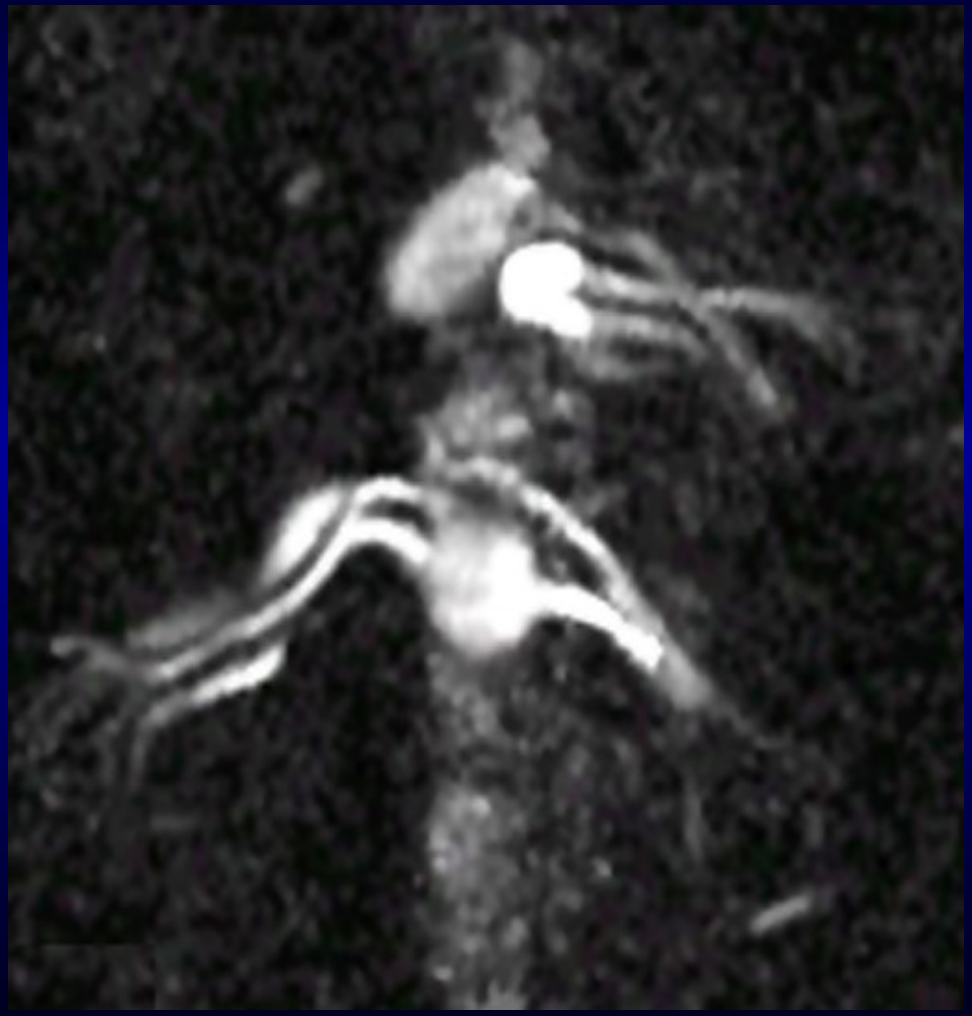
CA

Pressure gradient

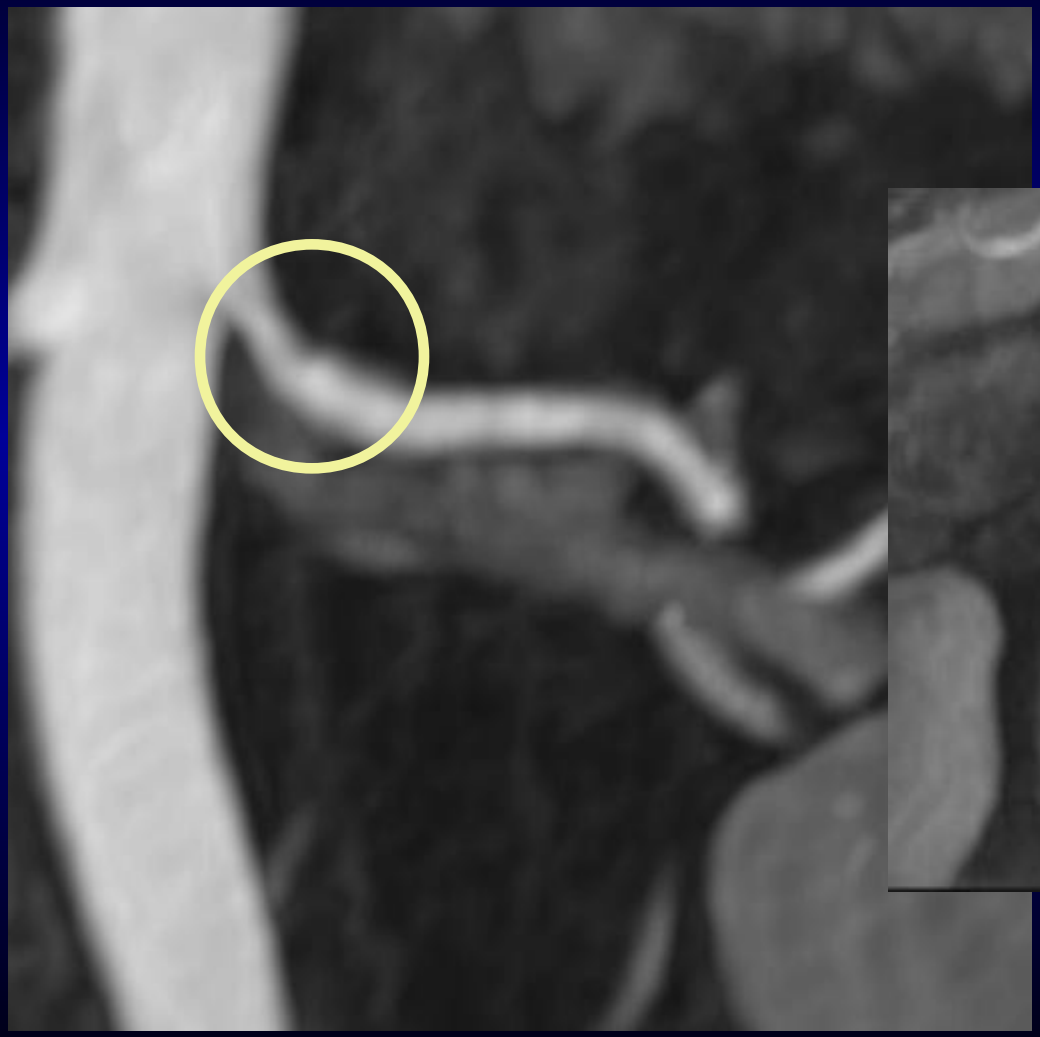
- By convention, 50% stenosis "physiologically significant"
- Experimentally, 70-80% required for a pressure gradient

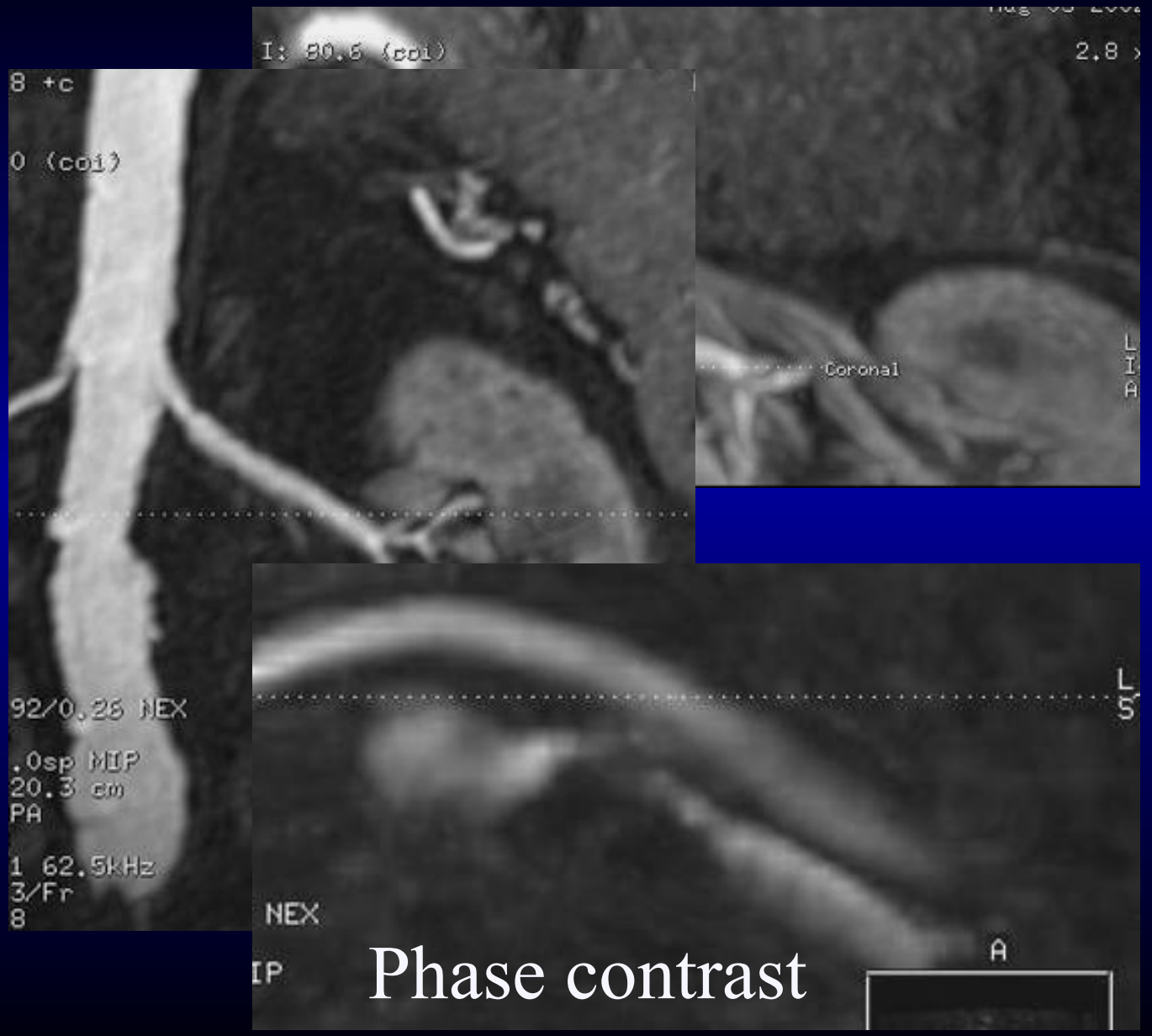
MRA: Phase contrast

- Improved specificity for stenosis detection
- *After* 3D MRA

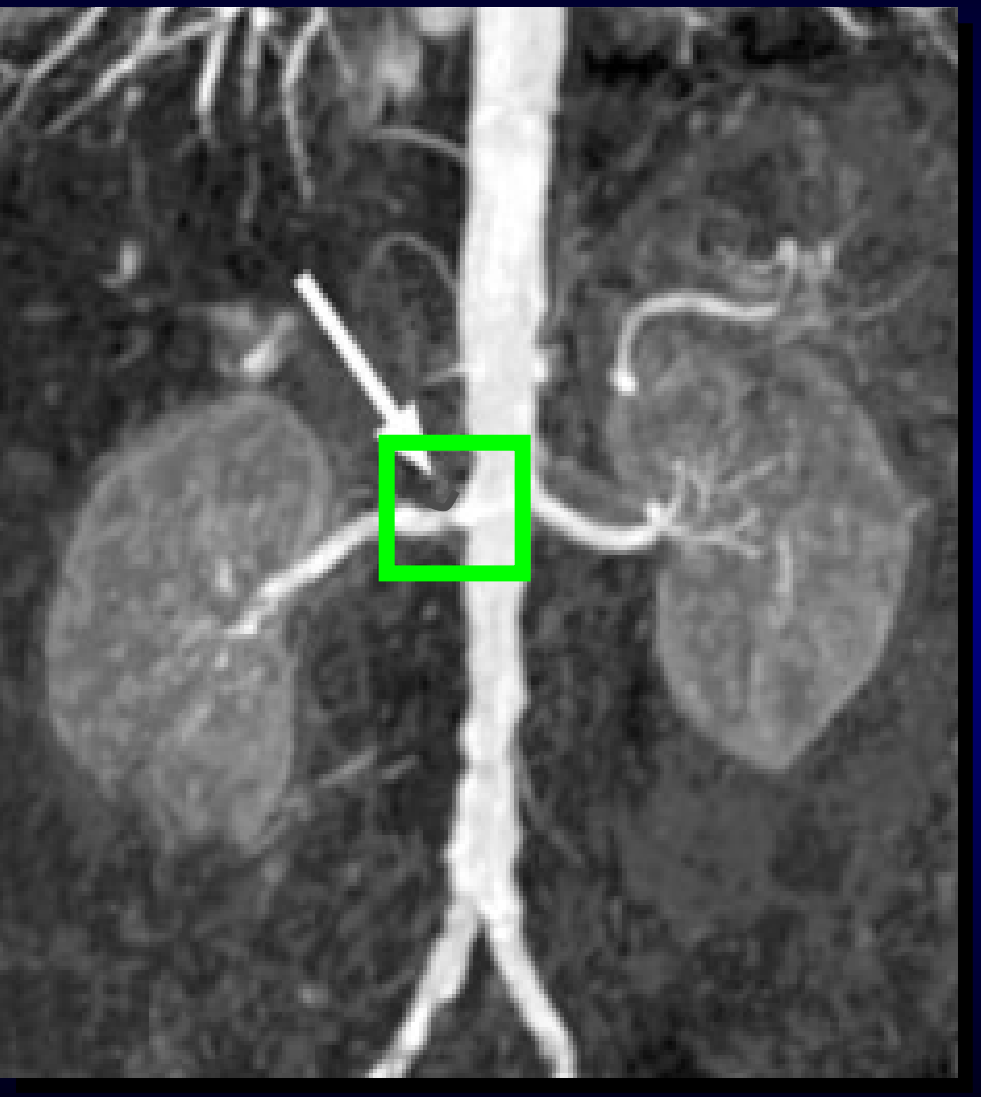


Eccentric plaque - MIP pitfall




I: 80.6 (coi)
2.8
8 +c
0 (coi)
Coronal
92/0.26 NEX
.0sp MIP
20.3 cm
PA
1 62.5kHz
3/Fr
8
NEX
A
Phase contrast

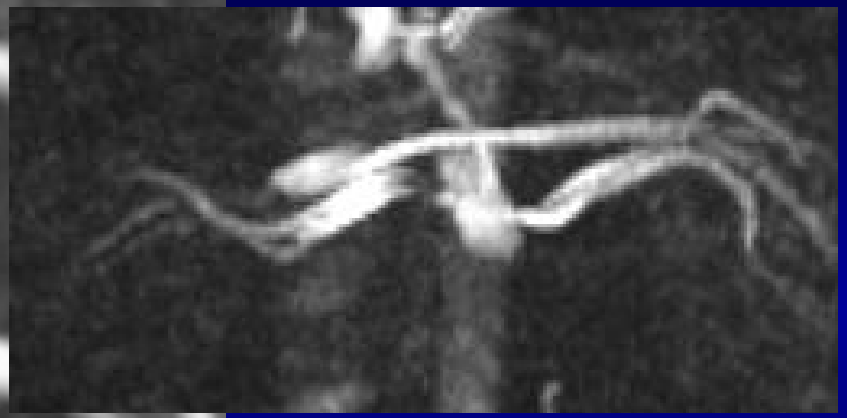
Renal MRA: phase contrast



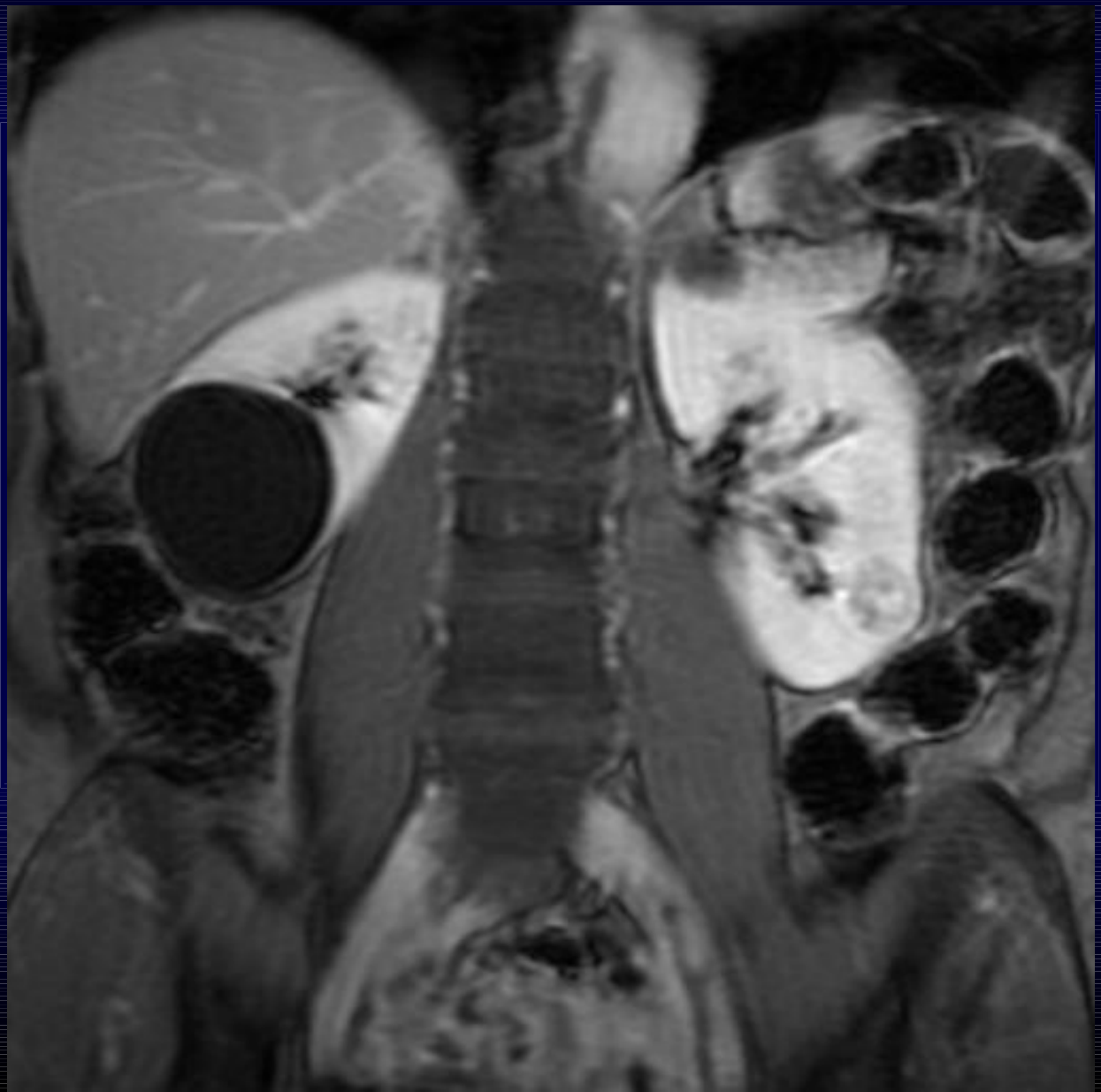
Mild stenosis

phase contrast

3T Renal MRA: phase contrast



3T Renal abnormality

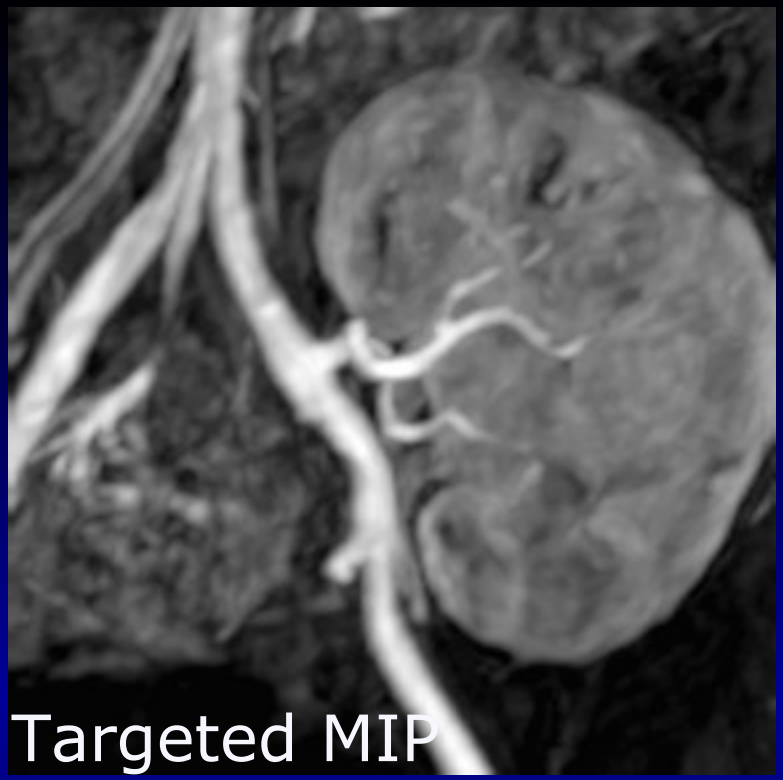


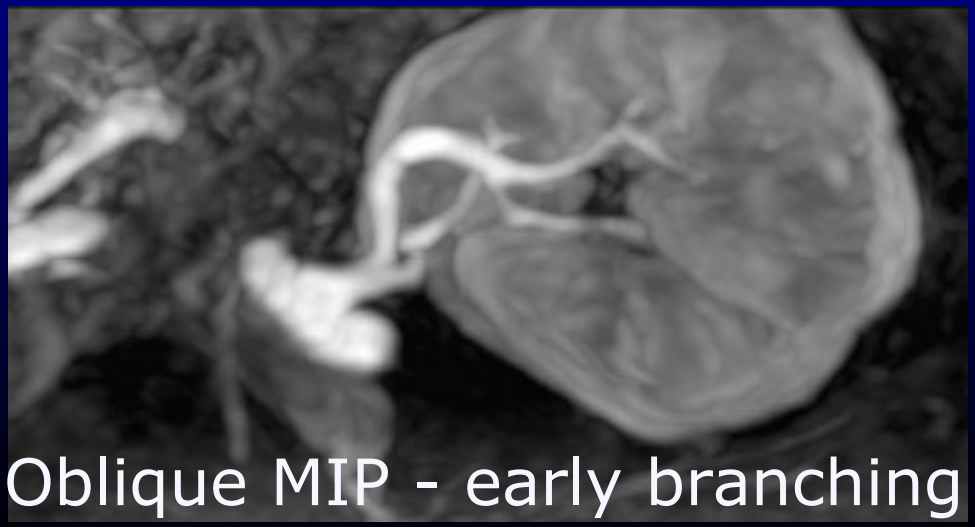
Renal transplant

Increasing creatinine:

- Vascular insufficiency?
- Rejection?
- Concern for NSF

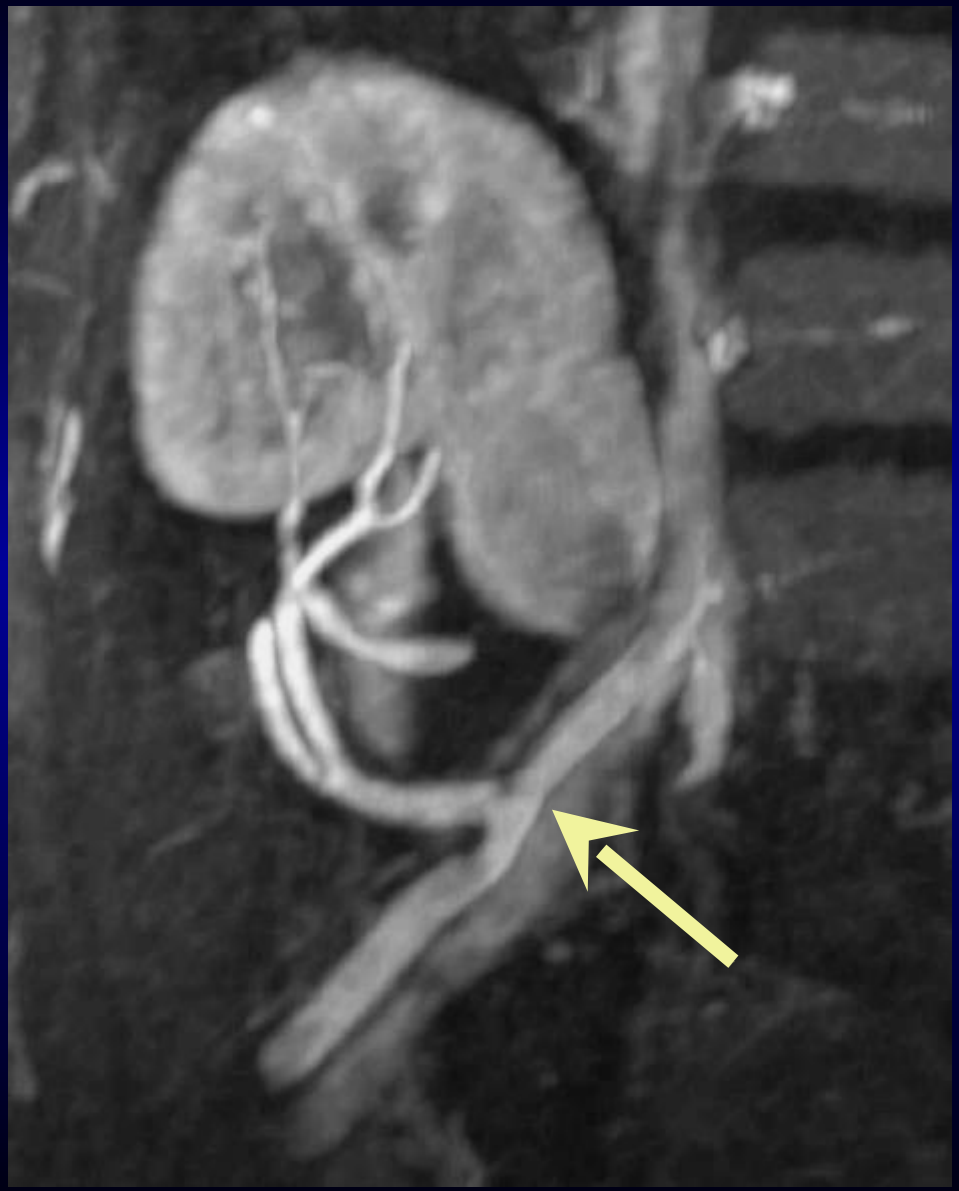
Renal transplant-multiple reformations





Renal transplant

"Normal" anastomotic narrowing



Associations with NSF

- Prior gadolinium administration
- Severe renal failure, dialysis

Stage	GFR	Description
1	90+	Normal kidney function but urine or other abnormalities point to kidney disease
2	60-89	Mildly reduced kidney function, urine or other abnormalities point to kidney disease
3	30-59	Moderately reduced kidney function

Associations with NSF

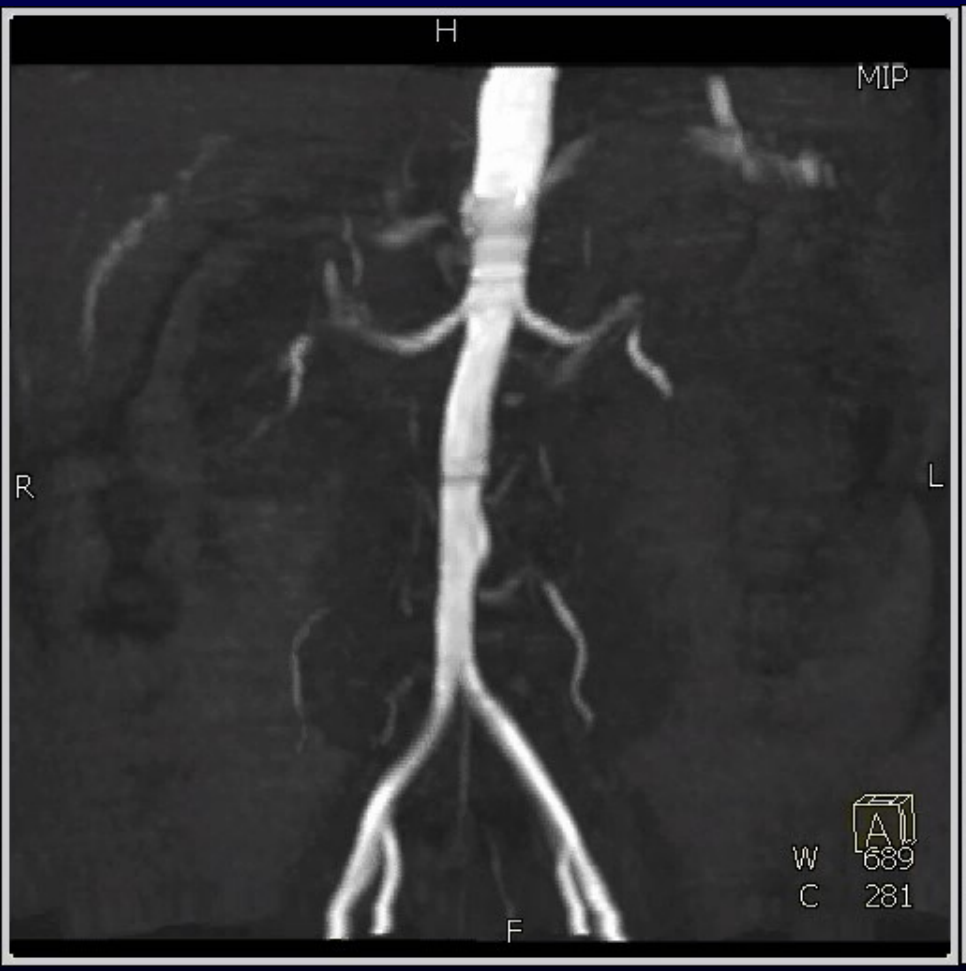
- Prior gadolinium administration
- Severe renal failure, dialysis

- Pro-inflammatory events
  - surgery
  - infection
  - trauma

Gadolinium MRA: options in at risk patients

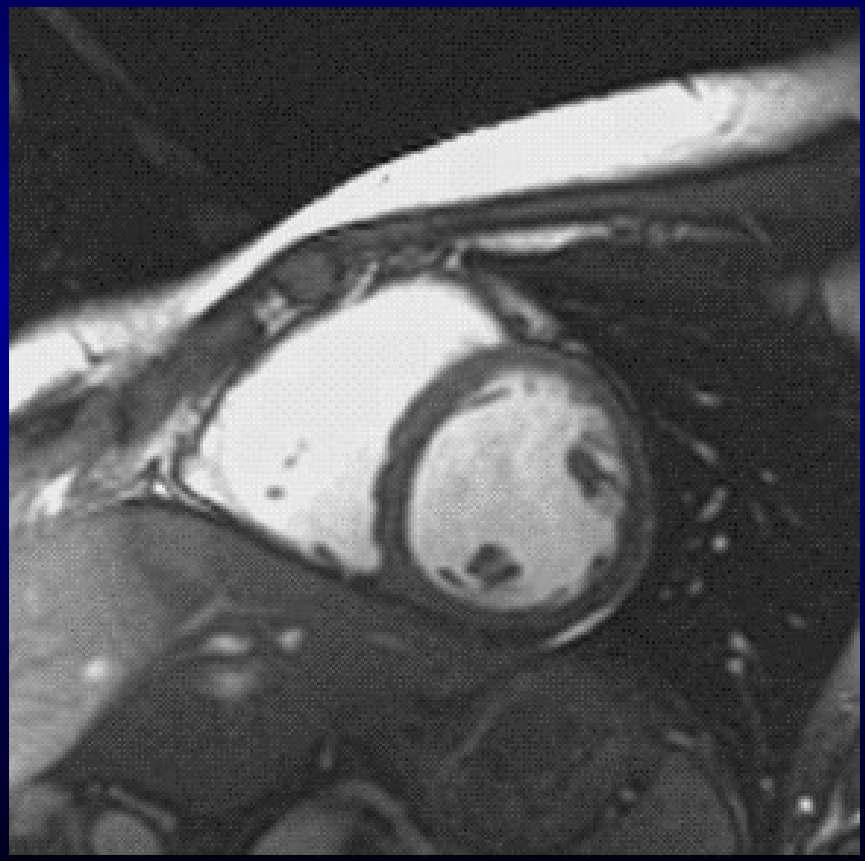
1. Noncontrast time of flight MRA
2. 3T MRA: 50% reduction of contrast dose
3. Contrast agent with increased relaxivity (Multihance); allows dose reduction
4. both (2) and (3)

Gadolinium MRA: Time of Flight



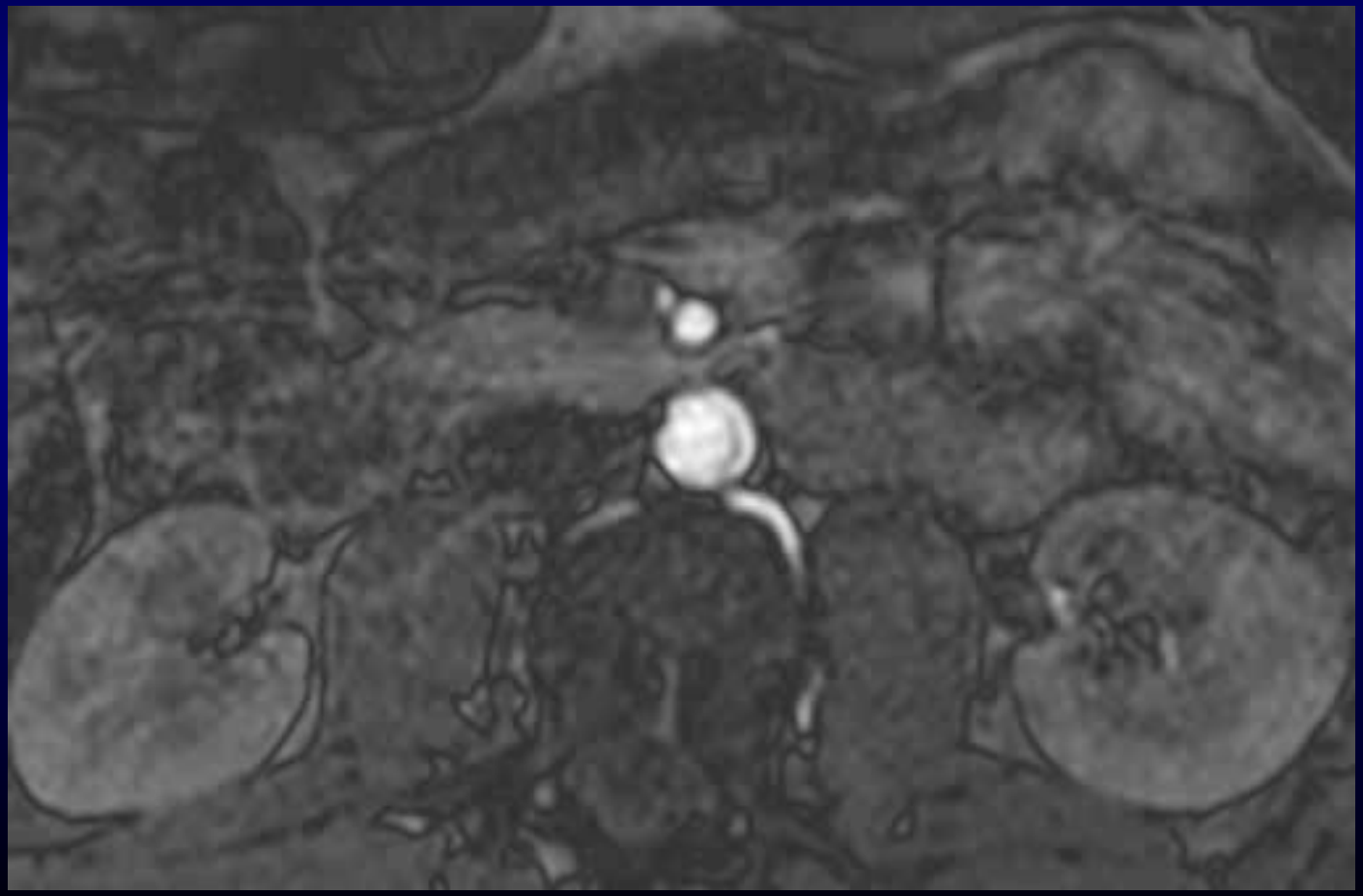
Steady State Free Precession (SSFP) TrueFISP, NATIVE

- Blood is imaged as a fluid (long T2* time) using a balanced GRE sequence
- ECG and navigator gated

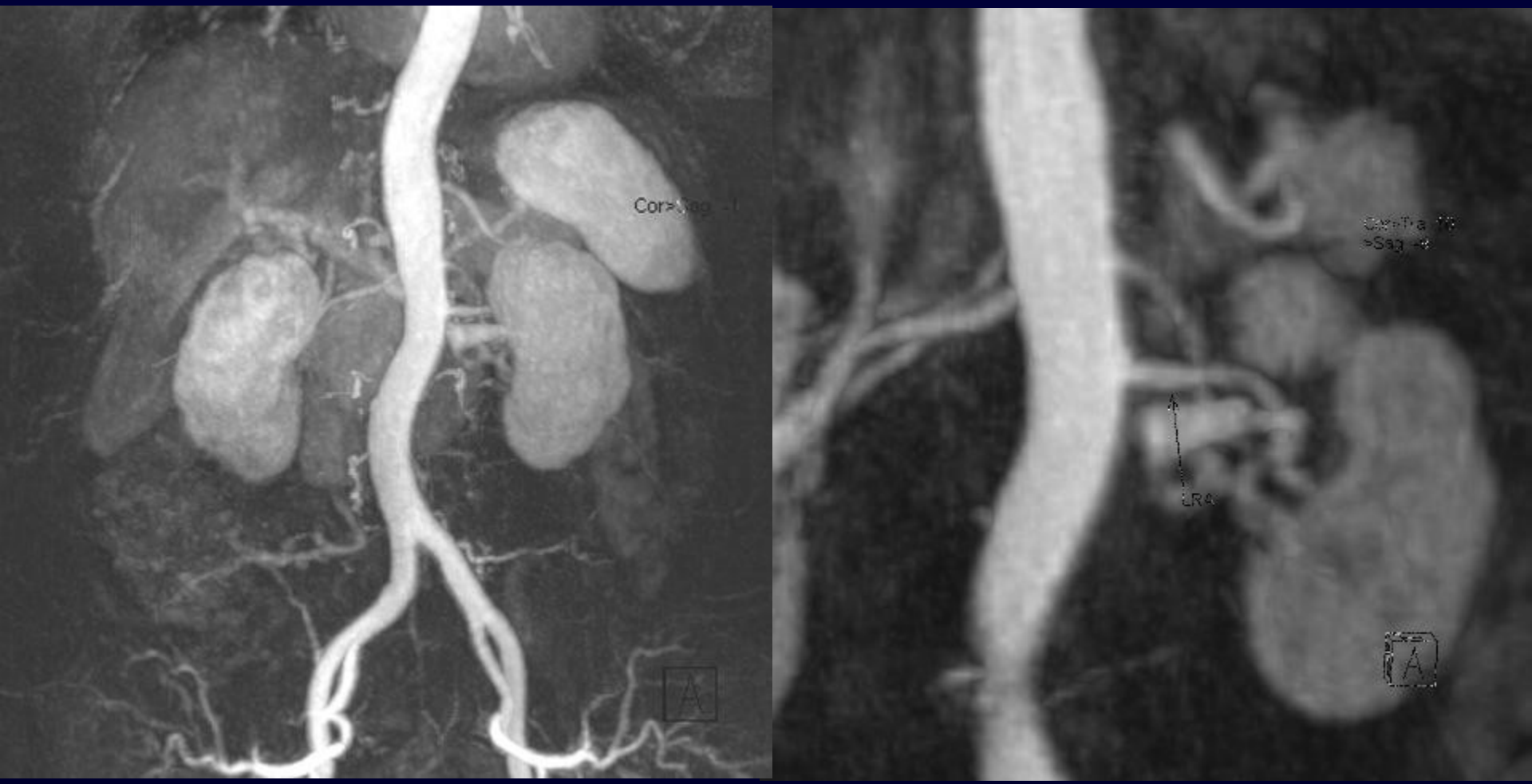


Steady State Free Precession (SSFP): TrueFISP, NATIVE

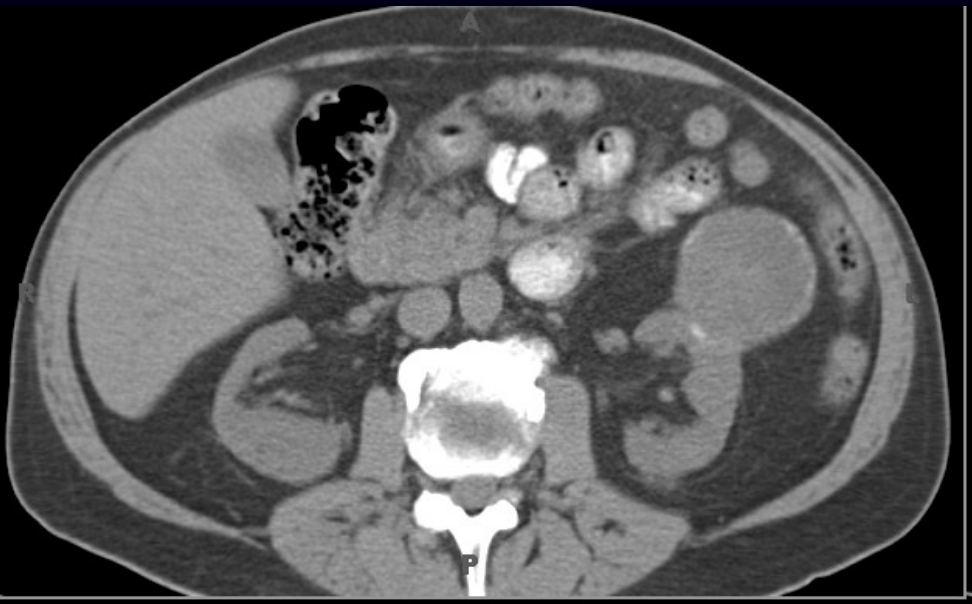
Steady State Free Precession (SSFP): TrueFISP, NATIVE

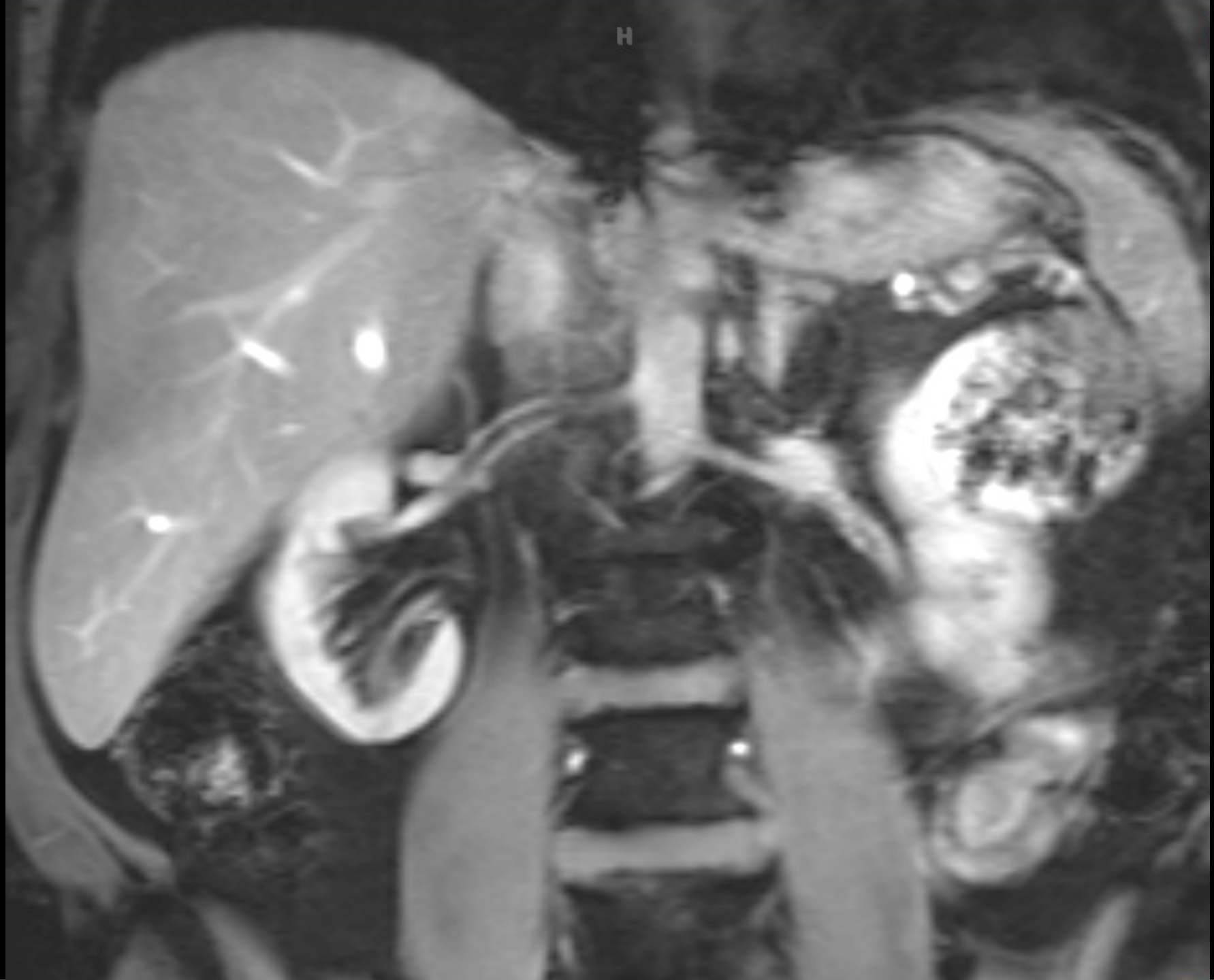


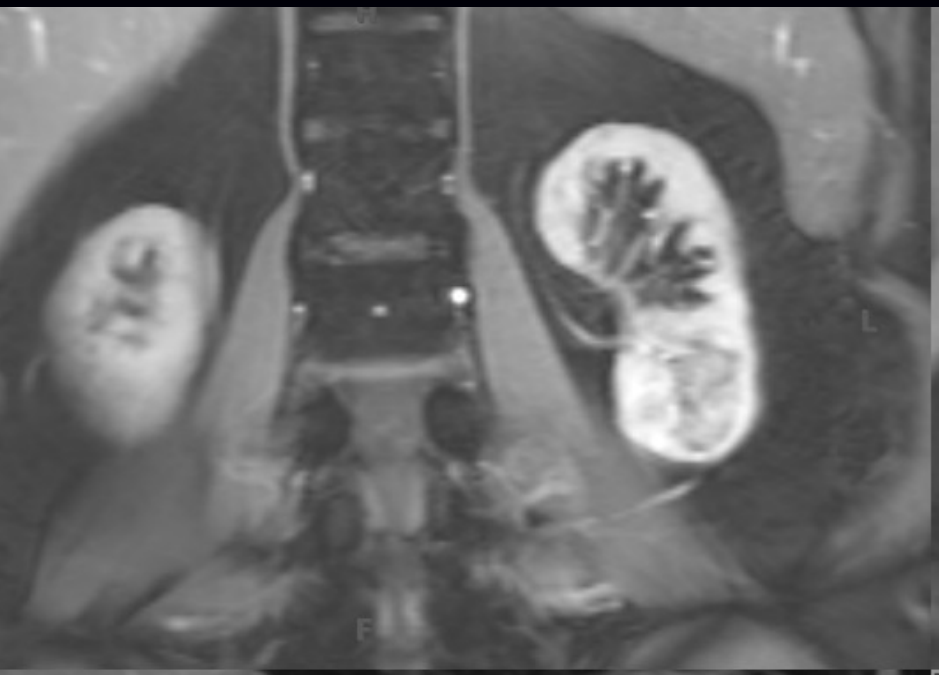
Multihance, 3T



0.08 mmol/kg





H


H
L
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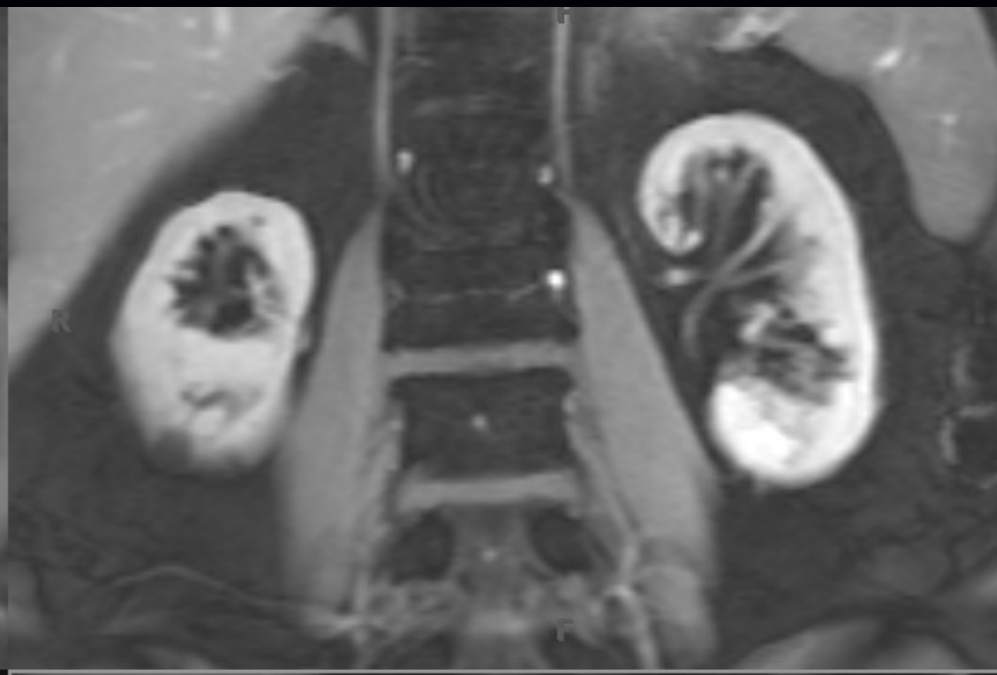
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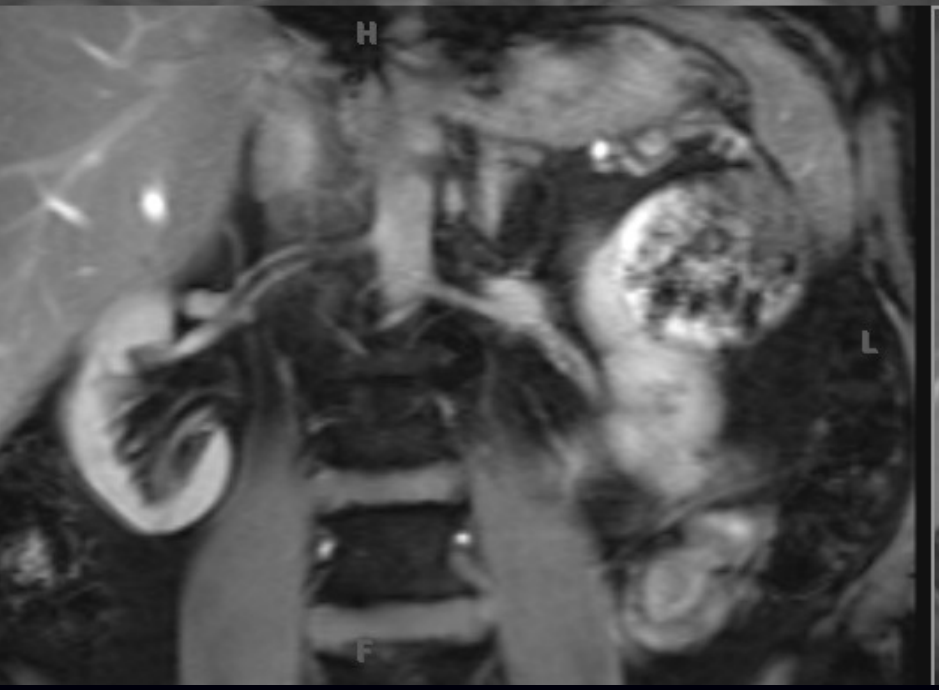
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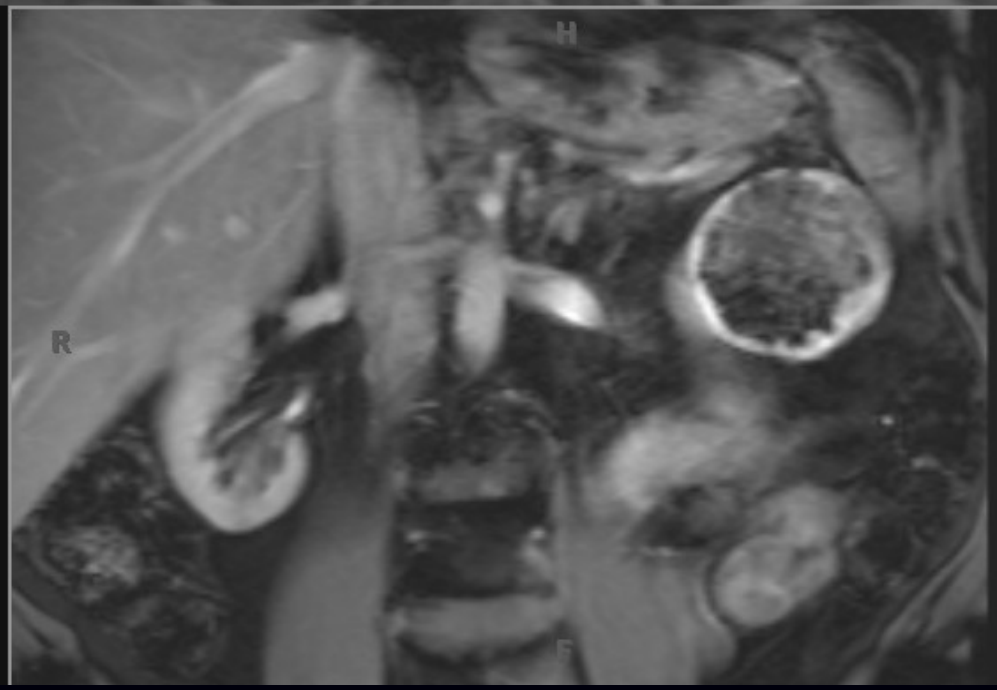
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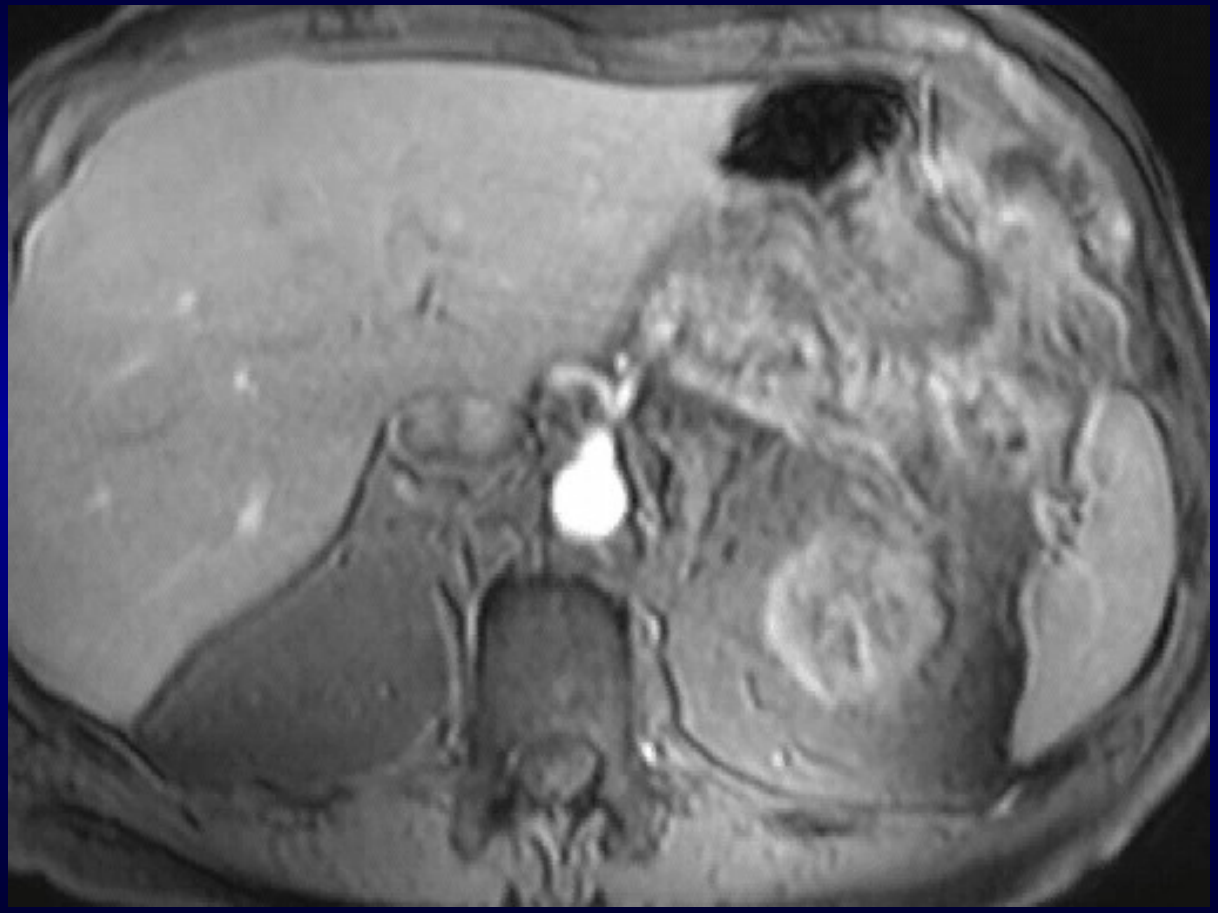
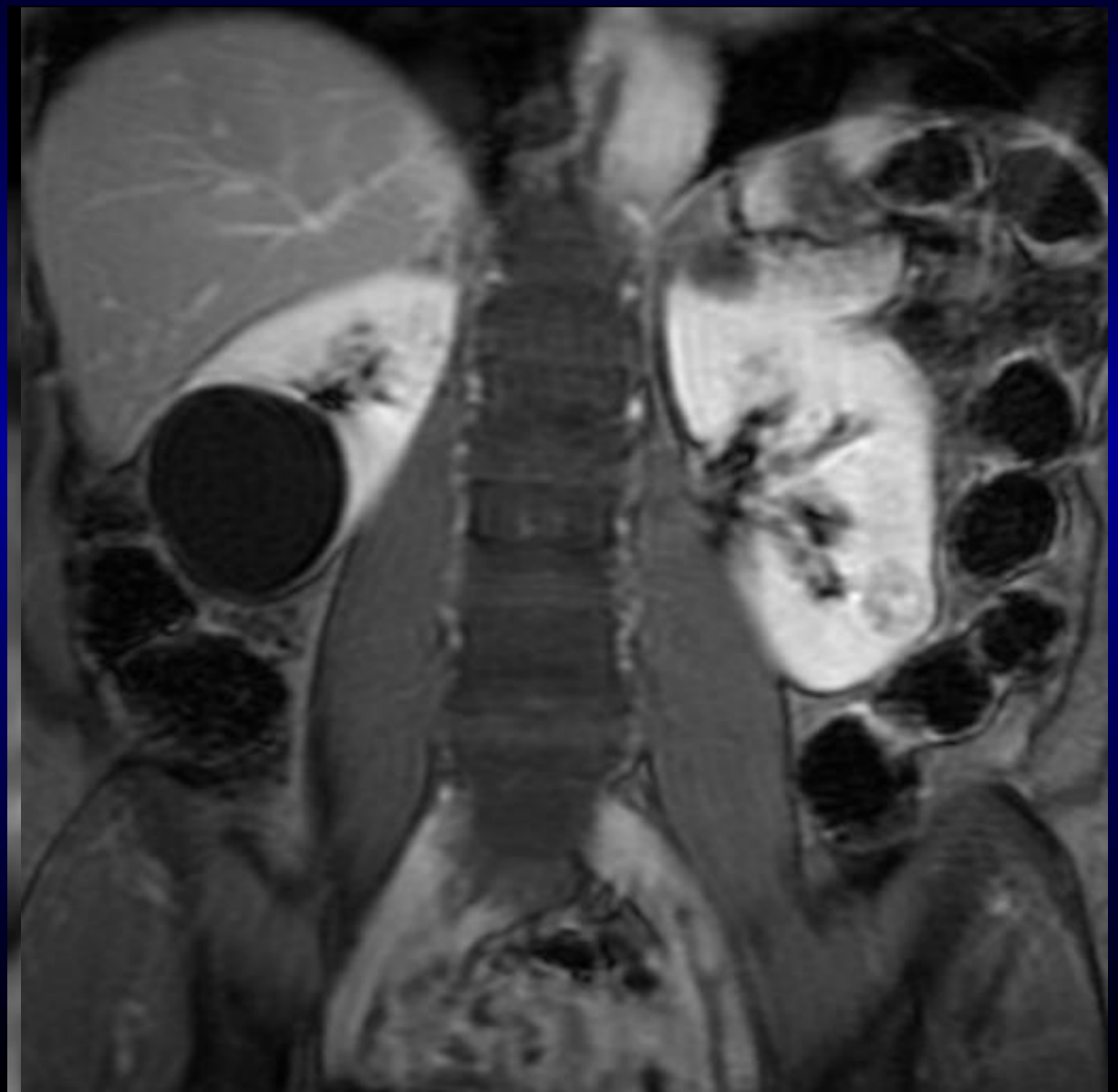
Multihance, 3T



5 cc

Renal MRA (3T): with 3d T1



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- Gerhard Laub, PhD, Siemens

Thank you