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Renal Artery Stenosis: Diagnosis and Clinical Management

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GOALS

- Understand Renal Artery Stenosis (RAS) as an important sequela of atherosclerosis
- List three reasons to clinically suspect RAS
- Be familiar with the most up-to-date imaging and diagnostic modalities in RAS
- Consider the debate regarding medical vs. interventional management of RAS

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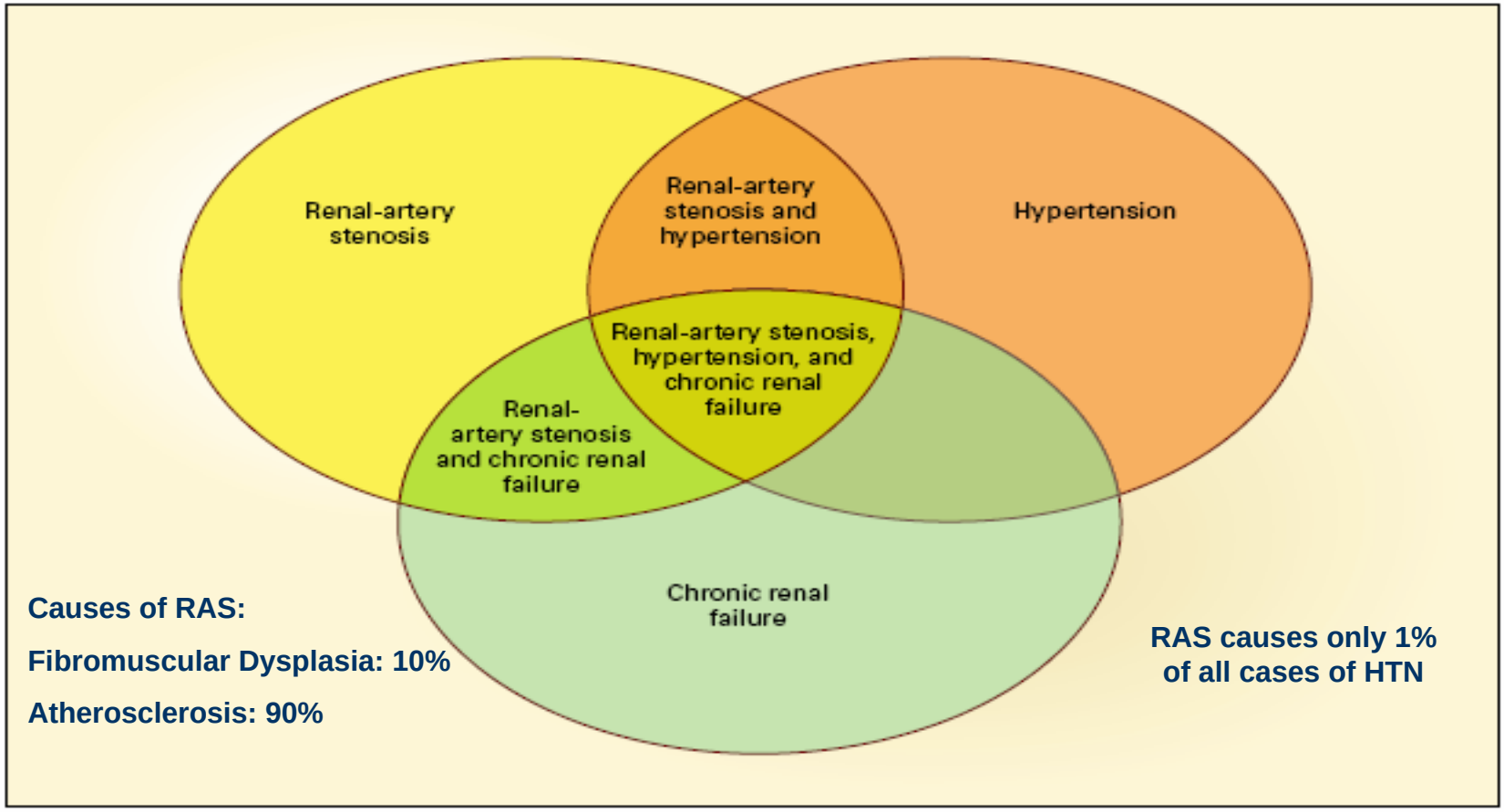
RAS Introduction: Part 1 of 3
RAS can stand alone or it can exacerbate other disease processess, particularly HTN and renal failure



Causes of RAS:

Fibromuscular Dysplasia: 10%

Atherosclerosis: 90%

RAS causes only 1% of all cases of HTN

Safian et al. "Renal-Artery Stenosis." New England Journal of Medicine *2001; 344: 431-442.*

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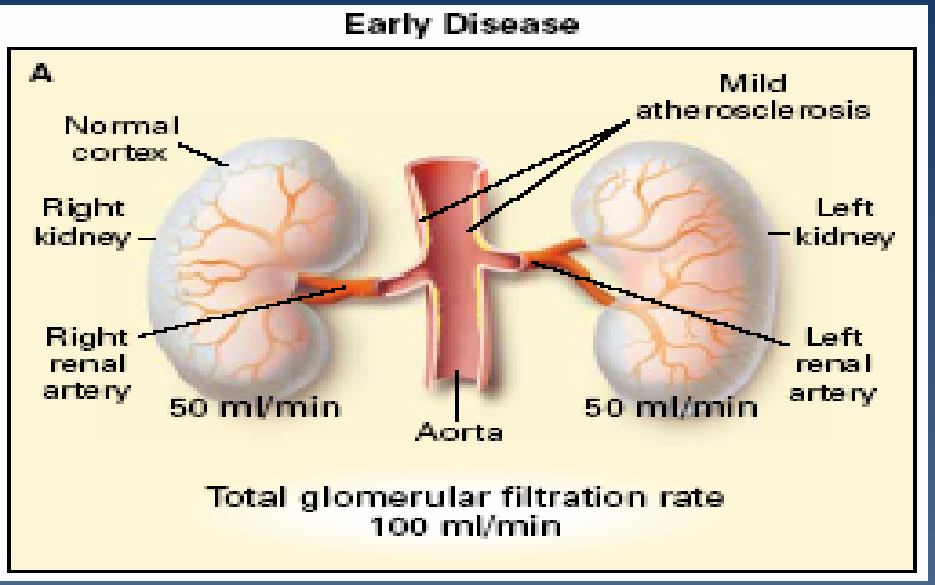
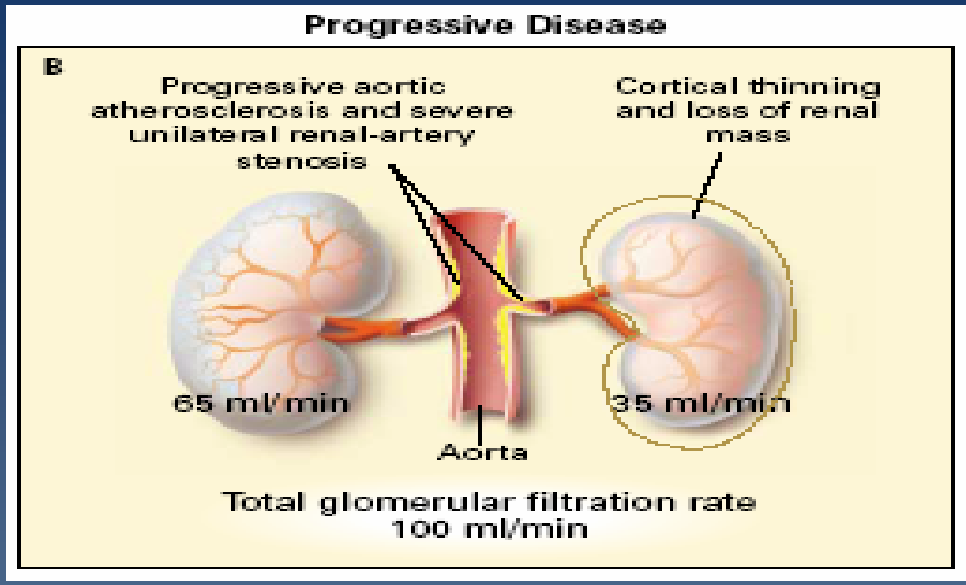
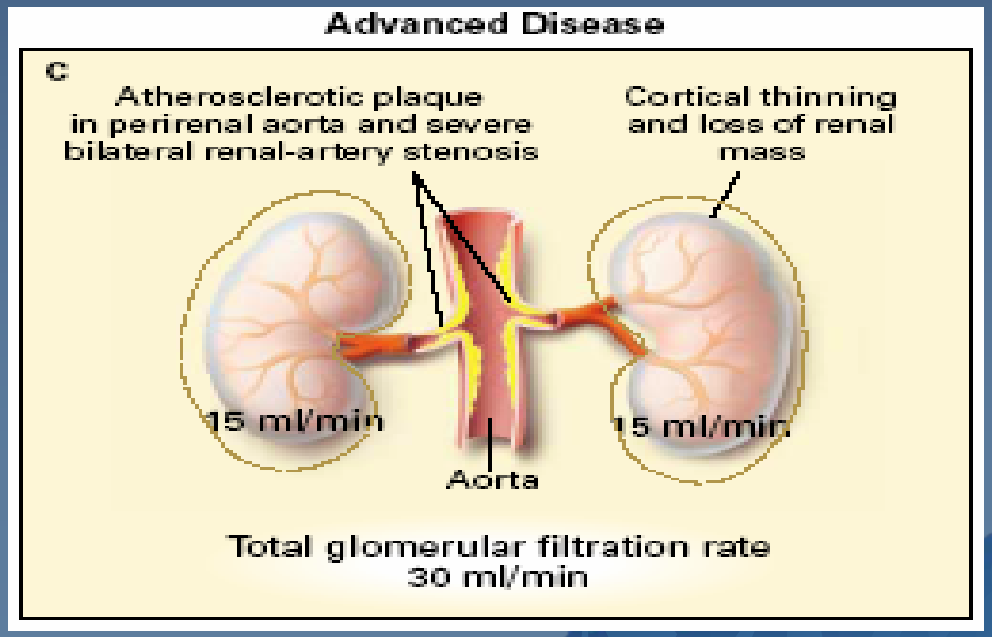
RAS Introduction: Part 2 of 3

RAS can lead to renal failure







Safian et al NEJM 344: 6
See previous slide

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RAS Introduction: Part 3 of 3

RAS can complicate pre-existing HTN

Atherosclerotic Disease
of Renal Artery (represents 90% of RAS)

↓

Renin-Angiotensin System Activated
Increased Vascular Oxidative Stress

↓

Renovascular Hypertension

Acute/Severe HTN

Poorly-Controlled HTN

In this presentation, we're concerned with patients for whom RAS is complicating the management of their HTN

Well-Controlled HTN
(NB: Most patients with HTN have ESSENTIAL HTN. And most of the time, it responds to medical management)

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RAS: A Key Player in Refractory HTN

- Mild Hypertension: RAS causes 1% of cases
- Acute, Severe, Refractory HTN: RAS causes 10-40% of cases
- In a study of 300 patients with well-controlled HTN:
  - 53% had normal renal arteries
  - 28% had <50% stenosis of one renal artery
  - 19% had >50% stenosis of one renal artery
  - 7% had >70% stenosis of one renal artery
  - 3% had bilateral disease

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Meet Our Patient

- Mr. W.R.
  - 54 year-old male
  - PMH: HTN
  - Meds: ASA, Plavix, Norvasc (10 mg qd), Diovan (160 mg qd), Toprol XL (50 mg qd)
  - Former smoker
  - FH: DM
  - BP: 160-170 systolic
  - BUN/Cr: 1.1-1.2 mg/dl
  - Physical Exam: an abdominal bruit is appreciated
- Should we suspect RAS?

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Clinical Findings of RAS

- Hypertension
  - refractory to therapy with 3 or more drugs
  - abrupt onset before age 50– likely fibromuscular dysplasia
  - abrupt onset after age 50– likely atherosclerotic RAS
  - malignant HTN
- Renal Abnormalities
  - unexplained rise in BUN (azotemia)
  - unilateral small kidney
  - unexplained hypokalemia
- Other Findings
  - unexplained CHF or acute pulmonary edema
  - abdominal bruit, flank bruit, or both
  - severe retinopathy
  - peripheral or coronary vascular disease

If you suspect it clinically, how should you evaluate RAS?

- In choosing assessment and imaging modalities, consider the questions you hope to answer with the study

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Physiologic/Perfusion Studies

- Guiding questions:
  - What is overall kidney function?
  - Is the lesion hemodynamically significant?

- Tests
  - Activity of renin-angiotensin system (renin levels, etc.)
  - Serum creatinine
  - Urinalysis
  - Nuclear Medicine: Captopril Renography and Technetium-labeled DPTA
    - What is the differential flow velocity across each artery? What is the GFR in each kidney?

- Drawbacks:
  - lack of specificity (e.g. many disease processes cause increased creatinine)
  - low predictive accuracy (i.e. studies do not indicate if re-vascularization would change clinical picture)

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Vascular Studies

Guiding Question: What is the anatomic status of the lesion?

- Gold Standard:
  Contrast-Enhanced Angiography

- Non-Invasive Studies:
  - Duplex Ultrasonography
  - MR Angiography
  - CT Angiography (not discussed here, but increasingly popular)

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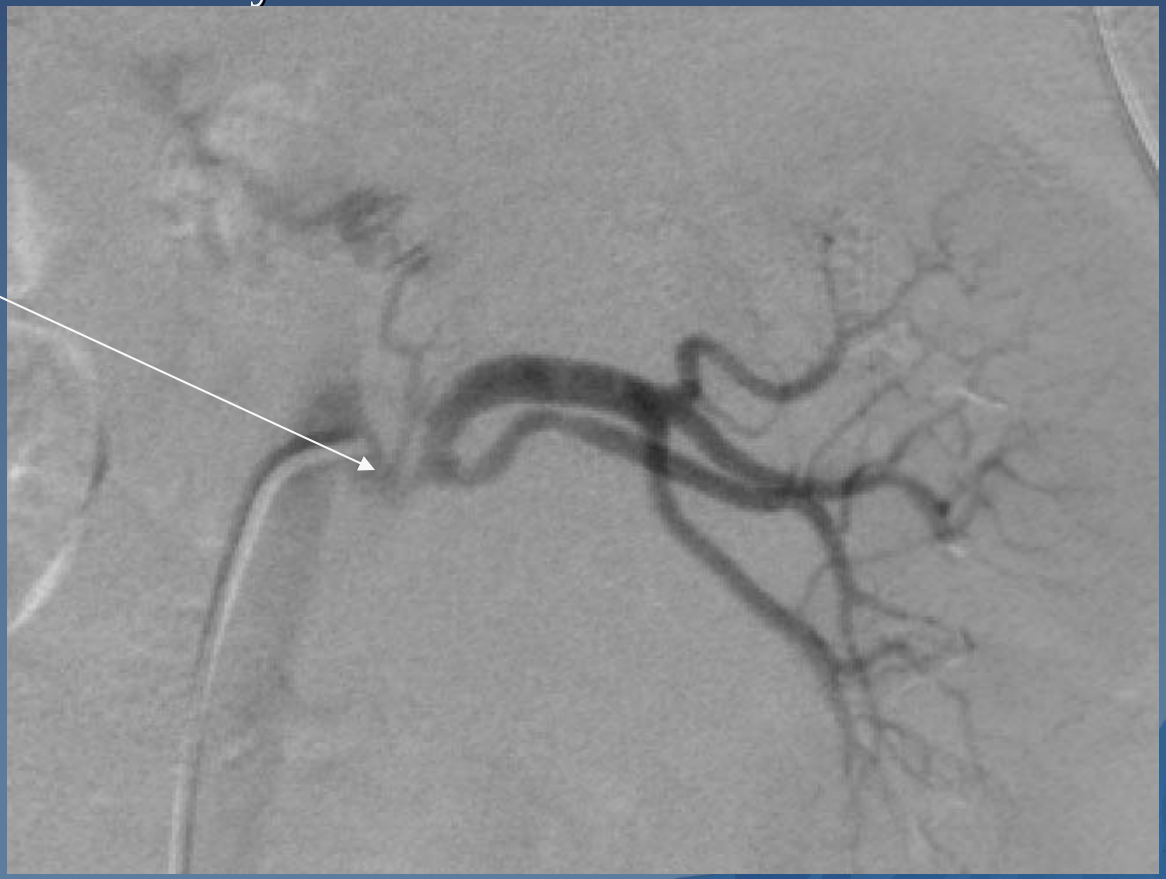
Contrast-Enhanced Angiography

- Gold Standard, but no longer a diagnostic study– used for intervention
- Concerns: complications from procedure and contrast
  - consider use of gadolinium and visipaque as contrast agents in cases of renal insufficiency

plaque causing stenosis in left main renal artery– note catheter in the abdominal aorta



Duplex Sonography

- Inexpensive but significant drawbacks
  - Operator-dependent
  - Time-consuming
  - Sensitivity: 81%
  - Specificity: 87%
- Yields important functional information
  - Hemodynamic information (what is the flow to each kidney?)
  - Predictive value with respect to revascularization (is lesion impeding flow?)

MR Angiography

- Sensitivity = 97%
- Specificity = 86%
- Fast, Operator-independent, 3-D Imaging
- Some limitations
  - Pacemaker incompatible
  - Inferior spatial resolution to interventional angiography (may over-estimate stenosis)

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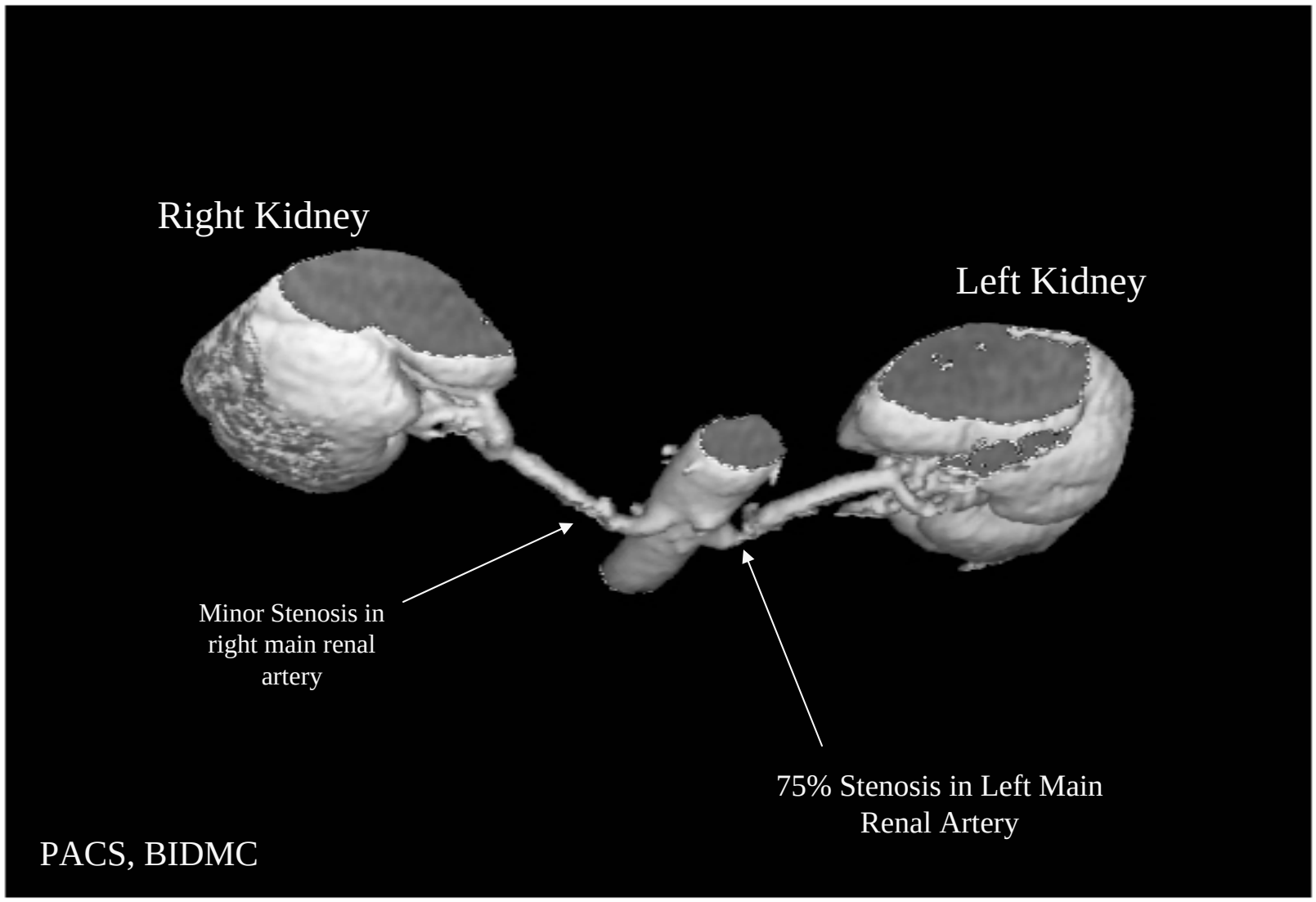
Our Patient's MRA



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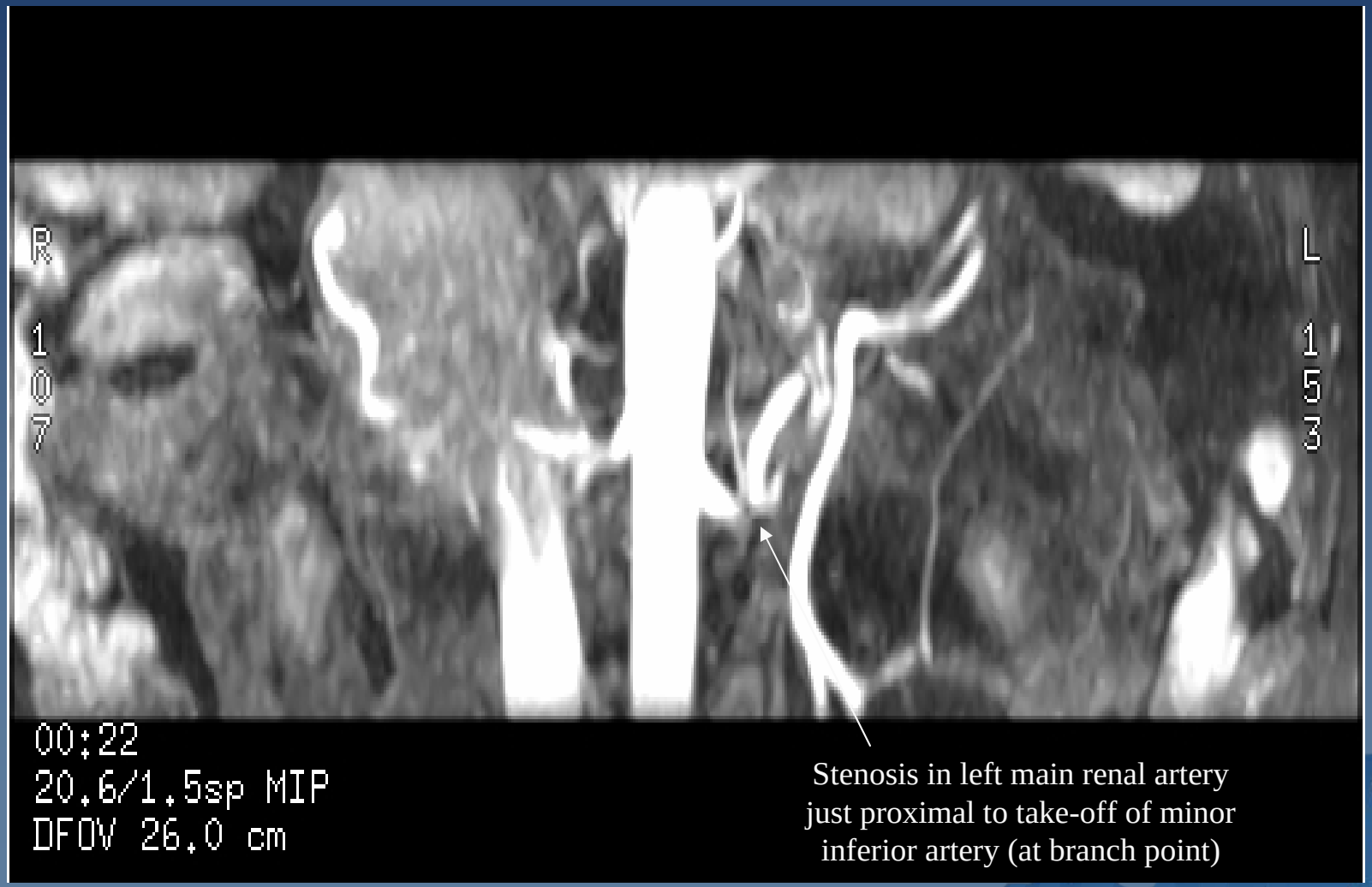
Patient MRA: A Different View



Management Dilemmas in RAS

Although our patient presents with significant stenosis and clinical symptoms,

- Incidental findings increasingly common
  - What if RAS is found on abdominal MRA for a different indication in an asymptomatic patient?
- Difficult to correlate progression of stenosis with clinical manifestations
  - What if lesion was 50% this year and 60% the next? Does 10% progression justify intervention?
- No good data comparing optimal medical management with revascularization interventions
- What to do?

When faced with management dilemmas, consider the risks of disease progression and the goals of intervention

Progression of Atherosclerosis is Significant:

-Certain populations are at greater risk for worsening stenosis

-Although they rarely occlude, stenotic arteries narrow over time

-Ischemic nephropathy associated with significant mortality

  -Dialysis patients have 50% mortality over 3 years

Clinical consequences of intervention may not be significant:

-Will intervention improve renal function?

-Will intervention change the medical management of the patient?

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RAS: An Approach to Intervention

- After assessing via MRA/CTA and before intervention, consider:
  - Clinical characteristics
  - Baseline renal function
  - Degree of asymmetry of flow

IF:

1) >50% Unilateral Stenosis
or 10 mmHg gradient across lesion,
2) Bilateral Stenosis,
or 3) Refractory HTN, Rising Cr,
Recurrent Pulmonary Edema

→ Intervention

- No intervention with advanced renal disease or chronic HTN

Intervention Strategies Part 1 of 2

- Surgical
  - specific indications
    - Fibromuscular Dysplasia (FD)
    - Patient requires extensive reconstruction of aortic structures
  - recent data
    - 2004 data available with long-term follow-up (11 years)
    - 93% of those with FD had stable or improved renal function
    - 71% of those with atherosclerotic disease had stable or improved renal function

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Intervention Strategies Part 2 of 2

- Percutaneous Interventions
  - Balloon Angioplasty
    - technically successful, but procedural risks
      - e.g. distal embolization, artery dissection
    - consider recurrence rates and effects on HTN
      - 15-42 percent re-stenose (inferior to stenting)
      - Unlikely to have long-term correction of HTN
  - Stenting
    - technically successful, avoids some risks of angioplasty
      - Stenting often repairs damage secondary to angioplasty
    - consider impact on renal function
      - Creatinine decline: 1.7 to 1.3 over four-year follow-up (N=1058)
      - Most lesions: 5-13% re-stenose (superior to angioplasty)
    - consider nature of stenotic lesion
      - No stenting in branch-vessel disease because stenting one vessel risks occlusion of the other

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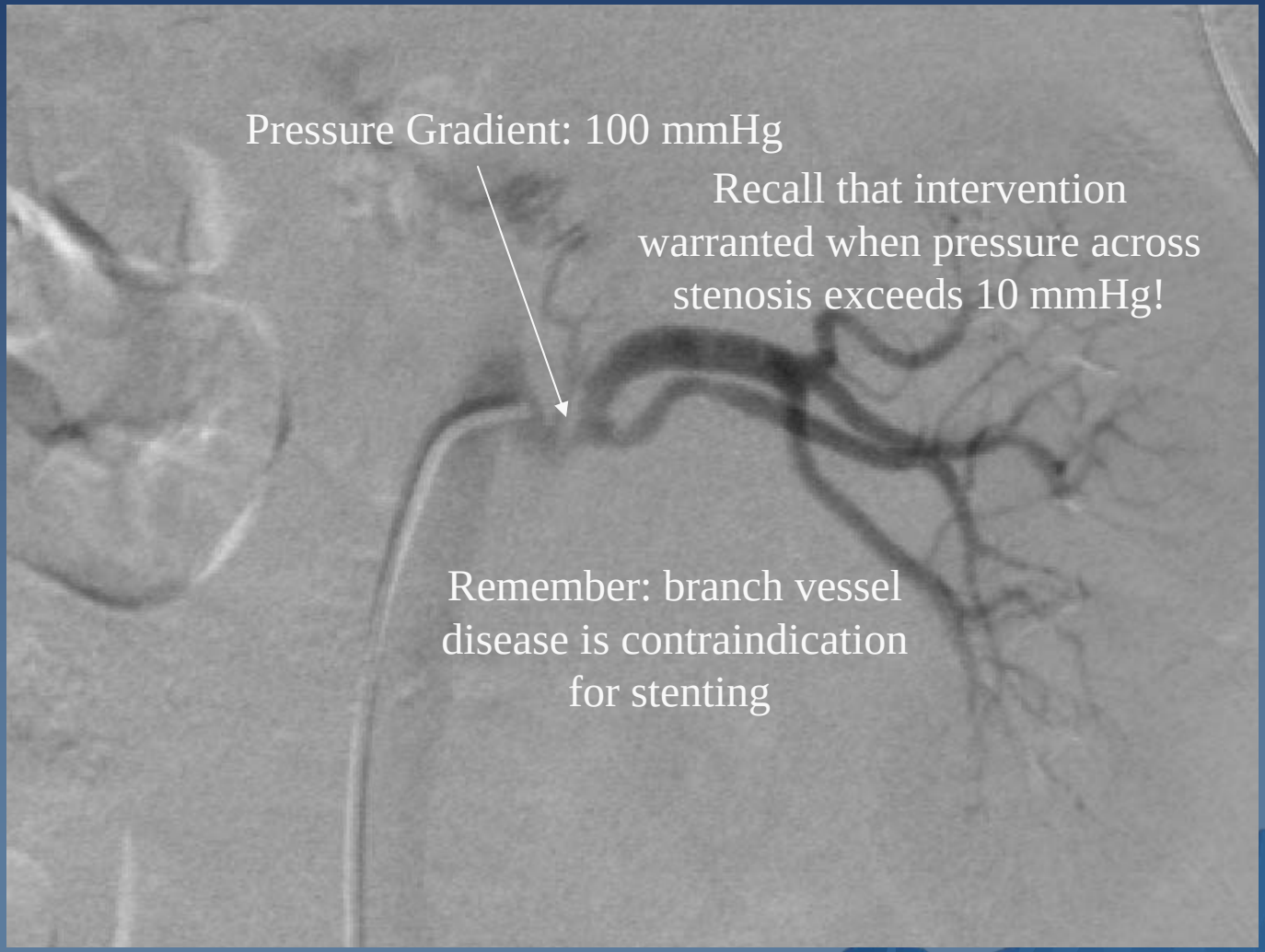
Which intervention did our patient undergo?
Angioplasty



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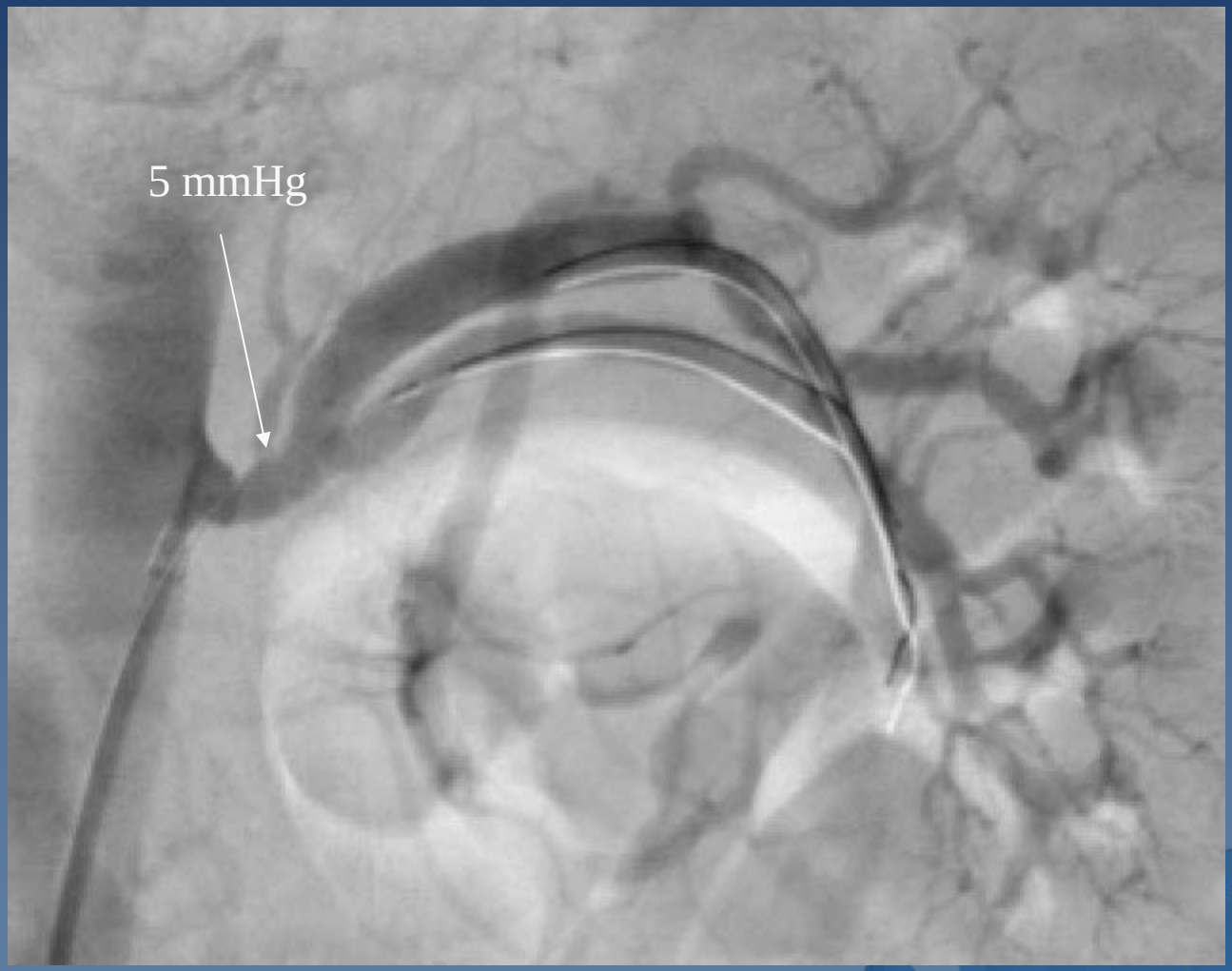
Our Patient's Angiography

After Angioplasty

Post-Procedure:

- BP: 140 systolic
- Cr: 1.1-1.2 mg/dl



Recall our GOALS

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- List three reasons to clinically suspect RAS
- Be familiar with the most up-to-date imaging and diagnostic modalities in RAS
- Consider the debate regarding medical vs. interventional management of RAS

References (1 of 3)

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