

Renal Artery Disease

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Financial Disclosure Information

Renal Artery Disease

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None

Learning objectives: Renal Artery Disease

To appreciate:

1. Which patients with hypertension require screening for renal artery stenosis
2. Which patients with renal artery stenosis require an intervention
3. Proper evaluation and management of renal fibromuscular disease.

Renal Artery Disease

SCREENING

54 y/o male

He has a 10 year history of hypertension. He is a non-smoker. He takes chlorthalidone 25 mg/day (like his father). Renal function is normal.

Exam: BP 160/90 Pulse 80 regular
Cor: normal JVP, PMI. No M/R/C/G
Abdomen: No HSM or bruits

What would you recommend for this patient?

1. Renal Duplex ultrasound
2. CTA renal arteries
3. MRA renal arteries
4. Plasma renin activity
5. Augment chlorthalidone



> 65,000,000

<http://www.cdc.gov/bloodpressure/facts.htm>

Societal Cost of Hypertension



~\$50 Billion each year

<http://www.cdc.gov/bloodpressure/facts.htm>

“Primary” Hypertension

90-95% of all hypertension

- Family history
- African American
- Excess Na⁺ intake
- Excess alcohol intake
- Obesity
- Inactivity

Who should be evaluated for secondary causes?

- **Severe** or **resistant** hypertension
- **Acute onset**
- Onset before **puberty**
- Onset \leq 30 yrs old, **no family history** or obesity
- Search for **clinical clues**

Renovascular Hypertension

Clues:

- Diffuse atherosclerosis
- 50% rise in creatinine with ACE-I or ARB
- Renal atrophy (>1.5 cm)
- Flash pulmonary edema
- Severe htn onset $>$ 55 yrs
- Abdominal bruit



Renovascular Hypertension:

Prevalence

- By hypertension severity
 - Mild – mod: $<1\%$
 - Severe: 30 – 45%
- Coexisting cardiovascular disease
 - CAD 20%
 - PAD 50%
 - CHF 50%
 - ESRD 50%

Am J Hypertens 2010;23:1159
J Vasc Surg 2002;36:443
J Hypertens 2009;27:1333

Limit testing to those **likely to benefit** from **an intervention**

- Short duration of hypertension
- Failure of optimal treatment
- Medication intolerant
- Progressive CKD
- FMD (particularly young female)
- Recurrent flash pulmonary edema

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Duplex Ultrasound

Advantages

- Widely available
- No contrast or radiation
- Trials: > 90% sens/spec

Limitations

- Obesity
- Technically difficult
- Time intensive (~ 2 hours)
- Real world: 60% sens/spec
20% technically inadequate



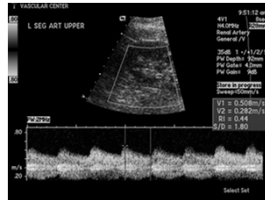
Renal US: Resistive Index

- Measure of parenchymal fibrosis
- Segmental arteries

$$\text{RI} = (\text{PSV} - \text{EDV}) / \text{PSV}$$

Values > 80

- Intrinsic kidney disease
- Poor outcomes from interventions



CT Angiography

Advantages

- Widely available
- Beautiful pictures
- Trials: > 90% sens/spec

Limitations

- No intervention possible
- Radiation exposure
- Contrast nephropathy



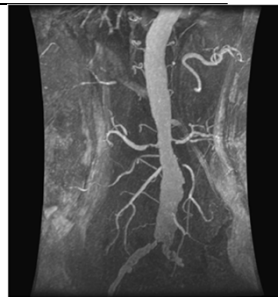
MR Angiography

Advantages

- Widely available
- Beautiful pictures
- No radiation
- Trials: > 90% sens/spec

Limitations

- No intervention possible
- Nephrogenic systemic fibrosis



Renal artery disease: Screening

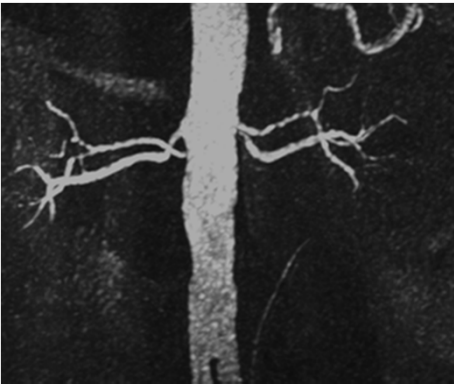
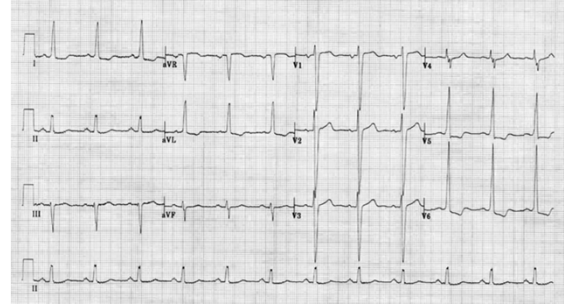
- Only if a corrective procedure will be pursued if disease detected

54 y/o male

He has a 5 year history of hypertension. He uses moderate daily alcohol. Sedentary. He takes chlorthalidone 50 mg, amlodipine 2.5 mg, metoprolol 50 mg/BID (like his father).

Exam: Wt 120 kg Ht 170 cm
BP 160/90 Pulse 50 regular
Cor: normal JVP. S4 at apex
Abdomen: bruit on left

Creatinine is 1.5.



When counselling this patient, which of the following statements is true regarding PTRA/stenting of his left renal artery?

1. Renal artery stenosis is the most likely cause of his hypertension
2. PTRA/stenting is likely to improve his BP
3. PTRA/stenting is likely to preserve renal function
4. Renal artery stenosis is an independent predictor of MI and CV mortality
5. PTRA/stenting is likely to improve CV outcomes

When counselling this patient, which of the following statements is true regarding PTRA/stenting of his left renal artery?

1. Renal artery stenosis is the most likely cause of his hypertension
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3. PTRA/stenting is likely to preserve renal function
4. **Renal artery stenosis is an independent predictor of MI and CV mortality**
5. PTRA/stenting is likely to improve CV outcomes

Resistant Hypertension

- Definition
 - Not controlled by ≥ 3 BP meds
- Associations
 - Obesity
 - Increasing age
 - **Poor compliance (meds or diet)**
 - **“Secondary” hypertension**
 - “White coat” hypertension

Resistant Hypertension Causes

- Excess salt
- Medication
 - Inadequate doses
 - Inadequate diuretic
 - Drugs (e.g., NSAIDs, illicit drugs, sympathomimetics, OCPs)
- Excess alcohol intake

Obstructive Sleep Apnea

Clues:

- Nocturnal choking/gasping
- Daytime somnolence
- Inappropriate sleep

Screen:

- Overnight oximetry
- Polysomnography



54 y/o male

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Creatinine is 1.5.

Renovascular Hypertension

- **Most common** potentially correctable cause
 - <1% of mild hypertension
 - **10-40%** of patients with **severe** hypertension
- Strong **mortality** predictor
 - 16%/year
- 2-4x elevated risk of **MI**



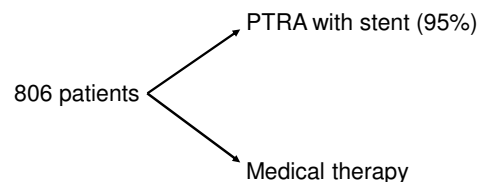
Renovascular Hypertension

Progression to ESRD, "Ischemic nephropathy"

- Rare with FMD
- Rare with unilateral disease
- More likely if bilateral or solitary kidney
- Difficult to predict which patients will progress

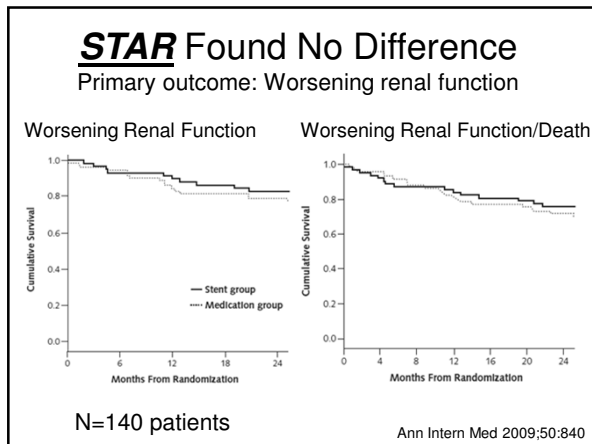
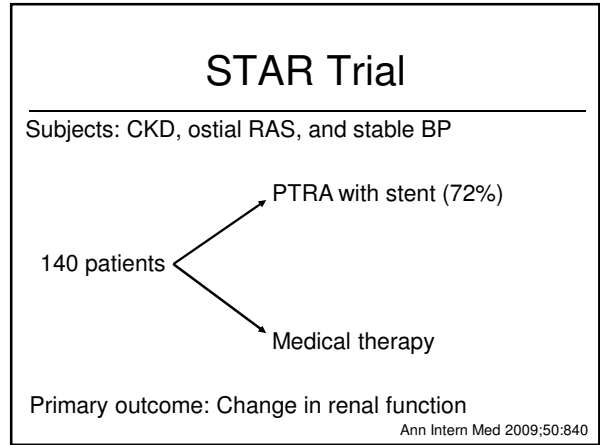
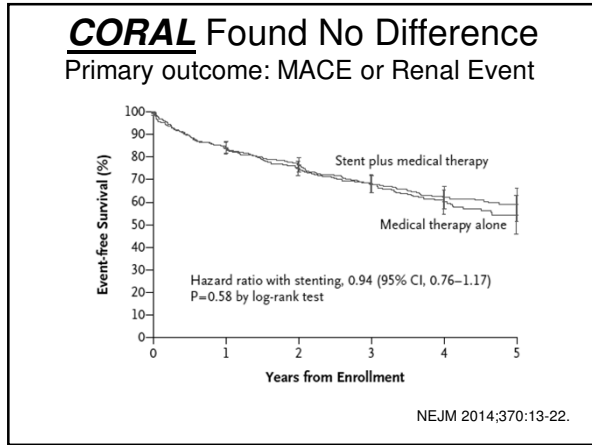
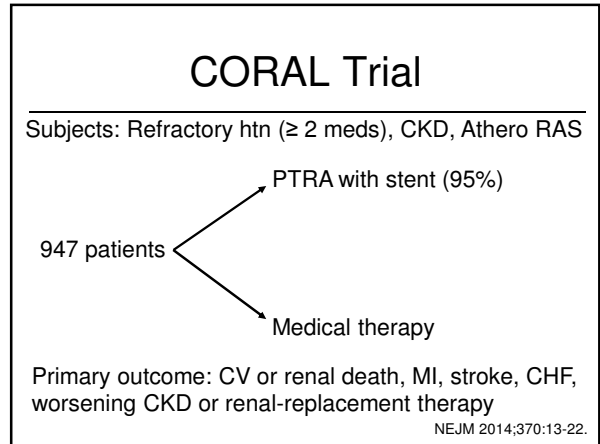
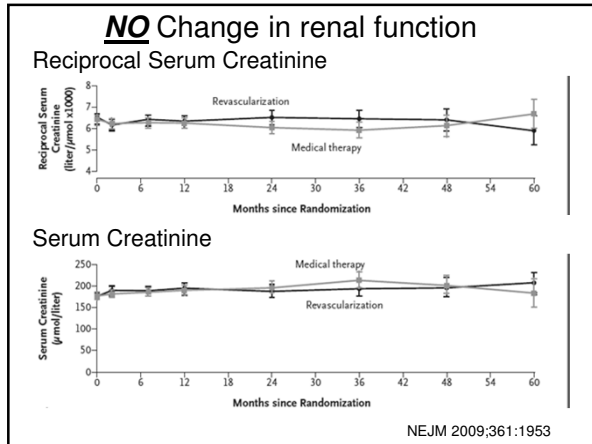
ASTRAL Trial

Subjects: Refractory htn, renal dysfx, Athero RAS



Primary outcome: Change in renal function

NEJM 2009;361:1953



Trial	N	No Difference
ASTRAL	806	Renal preservation Blood pressure Renal events CV events Overall survival
CORAL	947	MACE or Renal events Medication requirements Overall survival
STAR	140	Renal preservation Blood pressure Overall survival

Renal artery stenosis

- Know the **clinical clues** to its presence
- Recognize the association with **ischemic cardiovascular disease**
- Recognize that patients may have **incidental RAS** (< 70% stenosis) which may not be the cause of hypertension
- **Only if the clinical scenario is compelling** (severe stenosis, severe resistant HTN, recurrent flash pulmonary edema, declining GFR/atrophy), then stenting may be indicated.

When considering Treatment Renovascular Hypertension

- Antihypertensive drugs are effective
- Correcting the stenosis may not improve outcomes
- No tools to predict who will benefit
- Don't forget to treat other risk factors
 - Tobacco
 - Lipids
 - DM

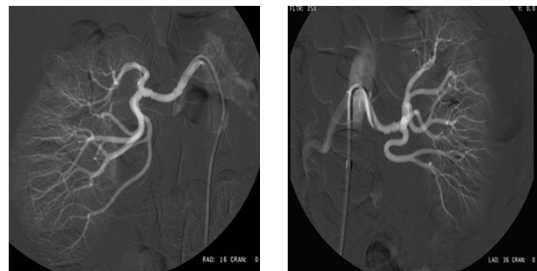
30 y/o female

Notes intermittent forceful palpitations for 2 months. She is an RN. Recent serial BPs: 168/96 & 186/102. Five months ago, her GYN evaluation included a normal BP assessment. She is very active. No tobacco, minimal alcohol. Otherwise healthy.

Exam: Wt 52 kg Ht 162 cm
BP 138/102 Pulse 70 regular
Cor: normal JVP. Subtle S4 at apex
Abdomen: bruit subxyphoid

Creatinine is 1.1. GFR 56

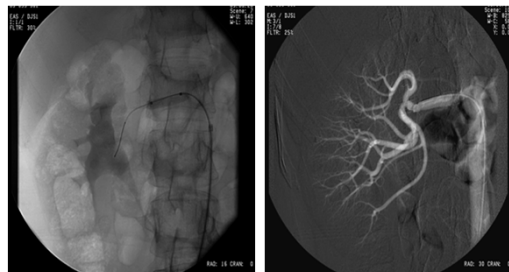
Renal Angiogram: FMD



When counselling this patient, which of the following would you recommend?

1. Balloon angioplasty
2. Balloon angioplasty with bare metal stent
3. Balloon angioplasty with drug eluting stent
4. Renal artery Bypass
5. Treat medically: ARB or ACE I.

PTA right renal artery



PTA left renal artery



Hypertension: “Cured”

- Bilateral perimedial fibroplasia
- Pre PTA 180/110
- Post PTA 122/78

Drugs to **Avoid** During Pregnancy

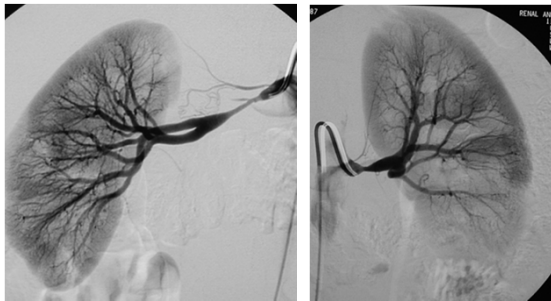
- **ACE I, ARB**
 - Renal (late trimester)
 - Cardiac (early trimester)
- Diuretics
- Nitroprusside
 - Fetal cyanide poisoning



When counselling this patient, which of the following would you recommend?

1. **Balloon angioplasty**
2. Balloon angioplasty with bare metal stent
3. Balloon angioplasty with drug eluting stent
4. Renal artery Bypass
5. Treat medically: ARB or ACE I.

But, what if this was the angiogram?



What is your Diagnosis?

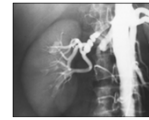
1. Atherosclerosis
2. Variant FMD
3. Vasculitis
4. Neurofibromatosis
5. Vasospasm :
Ergotamine/Cocaine

What is your Diagnosis?

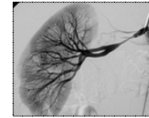
1. Atherosclerosis
2. **Variant FMD**
3. Vasculitis
4. Neurofibromatosis
5. Vasospasm :
Ergotamine/Cocaine

McCormick Classification

Medial Fibroplasia: 90 %
Distal 2/3rds of artery
"String of beads"



Intimal Fibroplasia: 5%
Long smooth tubular stenosis



Perimedial Fibroplasia
Beads "smaller than normal artery"

Medial Hyperplasia
Adventitial Fibroplasia

Mayo Clin Proc 1971;46:161



Atherosclerosis



FMD

US FMD Registry

- 9 Centers
- 447 patients

Age @ first symptom	47 ± 15 years
Age @ diagnosis	52 ± 13 years
Females	91%
Race	Caucasian 95%
	Black 2%
	Hispanic 2%

Circulation 2012;125:3182

Distribution of Vascular Involvement

- | | |
|-------------------------|-----|
| • Renal artery | 80% |
| • Extracranial Carotid | 74% |
| – Intracranial carotid | 17% |
| – Intracranial aneurysm | 8% |
| • Vertebral | 37% |
| • Mesenteric | 26% |
| • Lower extremity | 60% |
| • Upper extremity | 16% |

*Multivessel involvement 35%

**Medial fibroplasia 91%

Circulation 2012;125:3182

Dissections

- | | |
|----------------|-------------------|
| Overall | 88 (19.7%) |
| • Carotid | 68 |
| • Renal | 19 |
| • Vertebral | 15 |
| • Mesenteric | 4 |
| • Coronary | 3 |
| • Celiac | 2 |
| • Iliac | 2 |

Dissection of > 1 vessel 19%

Circulation 2012;125:3182

Aneurysms

Overall	76 (17%)
• Renal	25
• Carotid	16
• Aorta	15
• Celiac	12
• Intracerebral	9
• Mesenteric	5
• Vertebrobasilar	7
• SCA	2
• Popliteal	2

> 1 vessel 17%

Circulation 2012;125:3182

28 y/o female

Fatigue, anemia, left arm and leg weakness. She works as an X-ray technician. Her anemia was attributed to "chronic disease". Her physical therapist could not detect a pulse in her left arm.

Exam: BP (right) 162/70 (left) not obtainable

Chest: multiple bruits

Cor: S4

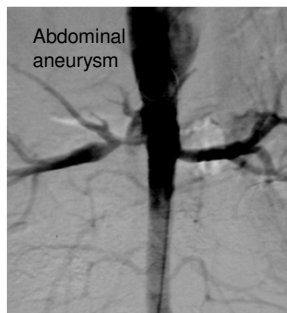
Abdomen: bruit centrally

Hgb 10.8 ESR 61



Left subclavian artery occluded

Aneurysmal and stenotic arterial disease



Abdominal aneurysm

Right renal artery stenosis

Takayasu Arteritis

- Women of reproductive years 15 - 50 yrs

Stenoses

- Subclavian
- Common carotid
- Aorta
- Renal

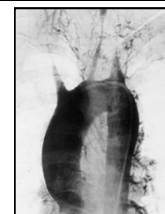
Aneurysms

- Aorta
- Innominate
- Subclavian

Takayasu Arteritis

Hypertension

- High renin
- Often unrecognized
- Common cause of death



Renal Artery Occlusive Disease: Potential Causes

- Atherosclerosis
- FMD
- Aneurysm
- AV fistula
- Trauma
- Coarctation
- Vasculitis
- Embolism

Renal Artery Stenosis: Summary

- Hypertension is common
- Antihypertensive drugs are effective
- Secondary causes require searching for clinical clues
- Assessment includes a careful pre-test probability of disease evaluation
- Selecting patients for renal artery interventions should be done carefully