Radiology Update: How to Effectively Employ Current Imaging Technologies

October 2015

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Objective

All slides and answers can be found at:

http://cebi.partners.org (presentations tab)

I. Discuss factors that may contribute to the inappropriate use of radiological studies

II. Discuss the imaging workup of some commonly encountered clinical problems

III. Recommend methods to reduce inappropriate use of imaging studies

Background

- Excessive number of tests with ? Impact on patients' outcome
  - Increasing concern of radiation risk
  - Increasing concern of costs
- Steady growth of imaging costs
  - Pre-authorization programs by payers
- Proper selection of imaging tests
  - Clinical problem, test characteristics, local expertise
  - Increasing complexity of imaging technology
  - Use of contrast-e.g. gadolinium induced NSF
- Impossible to present "all" guidelines

I. Main causes of inappropriate use of imaging studies

- Test results are unlikely to affect patient management
- “short” interval follow-up studies
- Repeating studies which have already been performed (including elsewhere)
- Patient demand
- Not requesting the best test
  - Access to technology
- Inadequate clinical information provided on the requisition

II. Imaging Guidelines

- American College of Radiology (ACR)
  - "Appropriateness criteria"; 1995, 1999, 2002, updates through 2008, 2010, 2013
- The British royal College of Radiologists (BRCR):
  - "Making the best use of a department of clinical radiology: guidelines for doctors"; 1995

II. Imaging Guidelines

- 80-90% of recommendations based on consensus opinion
- Take a long time to develop
- These are not algorithms:
  - do not account of local expertise
  - do not account for patient to patient variations
- Role of a Radiology Consultation Service?

Radiology Consultation Service- Peer to peer consultation

- Designed like other consultation services in medicine
- Allows for on-the-ward, outpatient clinic consultation
- Comprehensive imaging consultation
- Many advantages and disadvantages

Imaging Modalities

- Ultrasound:
  - adv: ionizing radiation, relatively cheap and accessible. Exam of choice in OB, excellent in the female pelvis
  - disadv: operator dependent, interference from bone, air, fat, difficult in the very obese

Imaging Modalities

- Computed Tomography (CT):
  - adv: no interference from bone, air or fat, easy in the obese, non-operator dependent, rapid exam, easily accessible at most sites
  - disadv: more expensive than US, ionizing radiation, intravenous contrasts with associated costs and risks

Imaging Modalities

- Magnetic Resonance Imaging (MRI):
  - adv. No ionizing radiation, exquisite soft tissue contrast (similar spatial resolution to CT), multiplanar imaging
  - disadv: more expensive than CT, less accessible than US/CT, rapidly changing technology, length of exam longer than CT, patient contraindications

Clinical Problem: Imaging Strategy

- Neuroradiology:
  - acute and chronic headache, low back pain
- Thoracic Radiology:
  - pulmonary embolism
- Abdominal Radiology:
  - bowel obstruction, appendicitis, renal colic, hematuria, common incidental lesions
- Musculoskeletal radiology
  - hip fracture

Case 1

- 40 year old female with acute onset of severe headache and loss of consciousness
- Best study to do first:
- If the first study is normal, the next test:

Best study to do first: CT

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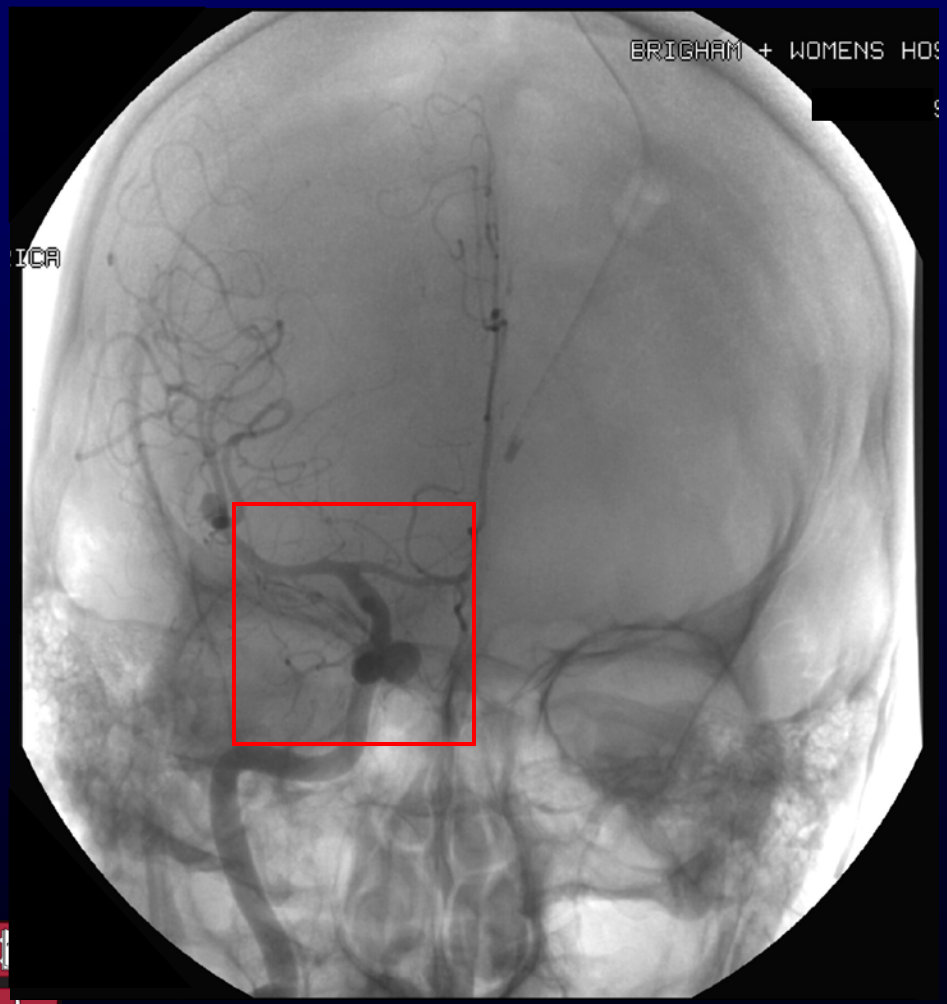
Next imaging study: cerebral arteriogram



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Order #:1 Modified from #:0 Requested Date:
Order: HEAD -VGH ED- CT Side:
Special View(s):

Pertinent History/Reason for Exam:
wrong place, wrong time

Contraindications:
Comments:
Physician Name/Pager: ed

Diabetic: Not Diabetic
Latex Allergy: None Known- No Latex Allergy
CREAT: 64 UMOL/L 2013-07-31
EGFR: >120 ML/MIN 2013-07-31
INR:
PTT:
PLT: 326 GIGA/L 2013-07-31

Transport: **Stretcher** [ ]No Sling
[ ]O2 [ ]HiFlow O2 [ ]Vent
[ ]Pump [ ]Multi Pump [ ]Monitor

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Clinical Decision Support for *iterative* Data Collection- e.g. Head CT Minor Head Trauma

Decis

Decision Support

Pleas

Does any of the following apply to your patient:

1. Dic

2

Decision Support

Please select ALL of the following that apply to your patient.

- ☐ Persistent anterograde amnesia (short-term memory deficit)
- ☐ Posttraumatic amnesia of 2 to < 4 hours
- ☐ Contusion of the skull
- ☐ Neurologic deficit
- ☐ Glascow coma scale deterioration of 1 point (1 hour after presentation)
- ☐ None of the above

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Submit Cancel

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BWH

Clinical Decision Support Output for Imaging Study Requests Deviating from Evidence

Decision Support

In patients with minor head injury and based on the information you have provided, the chance of positive findings on Head CT is extremely small according to three published large prospective controlled trials.

Stiell IG, Wells GA. et al. The Canadian CT Head Rule for Patients with Minor Head Injury. Lancet 2001; 357: 1391-96.

Haydel MJ., Preston CA. et al. Indications For Computer Tomography in Patients with Minor Head Injury. The New England Journal of Medicine 2000; 343: 100-5.

Smits M, Dippel DWJ. et all. Predicting Intracranial Traumatic Findings on Computed Tomography in Patients with Minor Head Injury: The CHIP Prediction Rule. Annals of Internal Medicine 2007; 146: 397-405.

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Continue | Cancel

Head and Neck
Clinical Problem: headache

- Acute, severe:
  - CT excellent for intracranial hemorrhage,
- Chronic
  - imaging not routinely indicated in the absence of focal signs or symptoms, unless evidence of raised intracranial pressure, posterior fossa signs
- MRI is superior to CT in the posterior fossa, sellar and juxta-sellar regions

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Case 6

- 24 year old male with 6 wk history of low back pain not improving despite conservative treatment, right S-I radiculopathy
- Best study to do first:
- If first study is normal, the next test:

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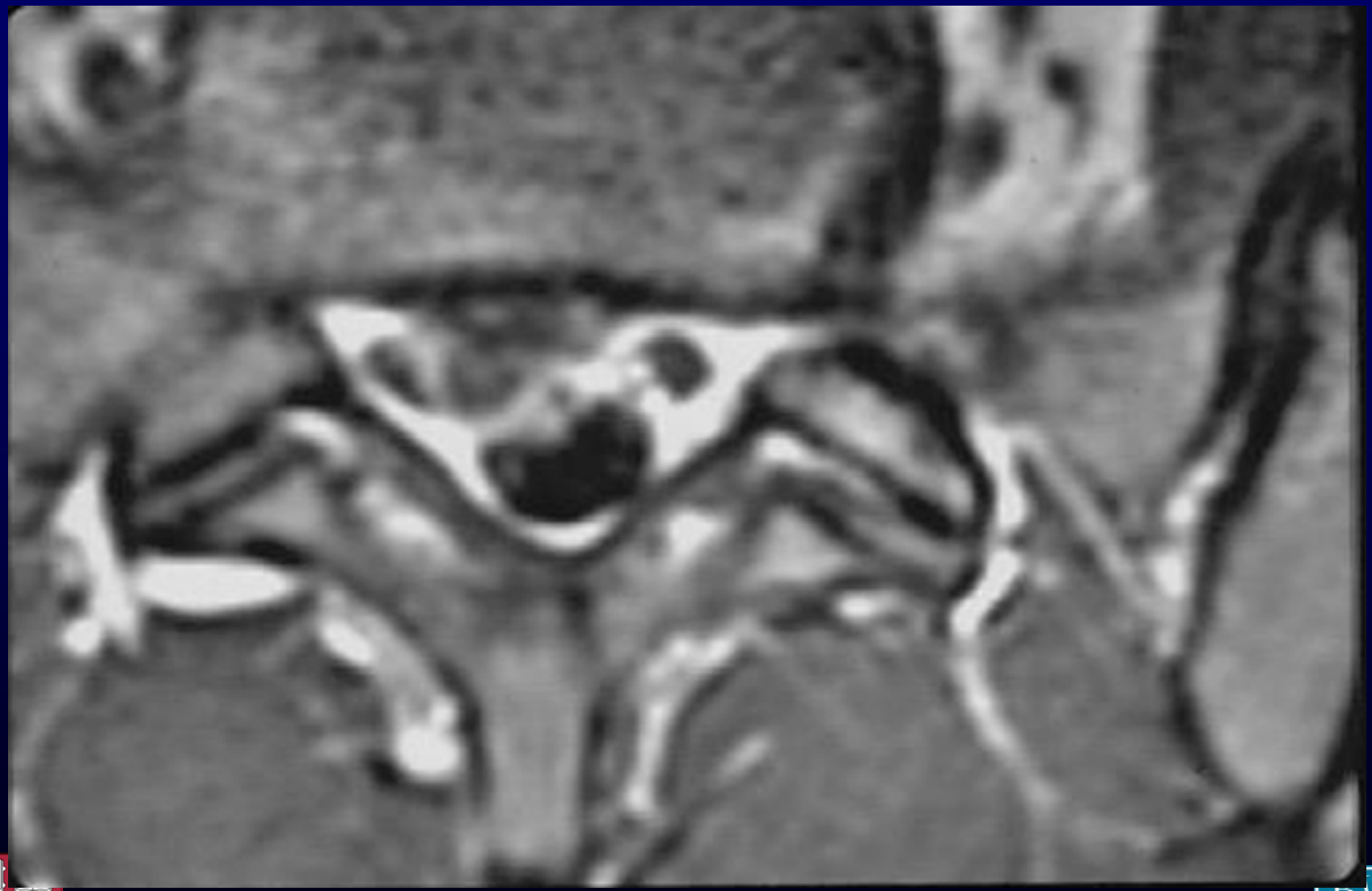

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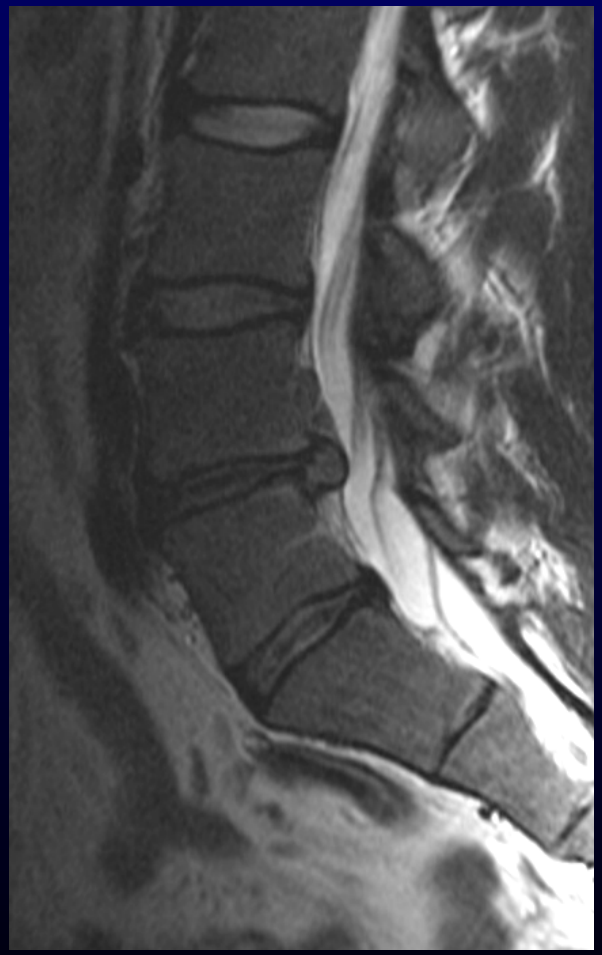
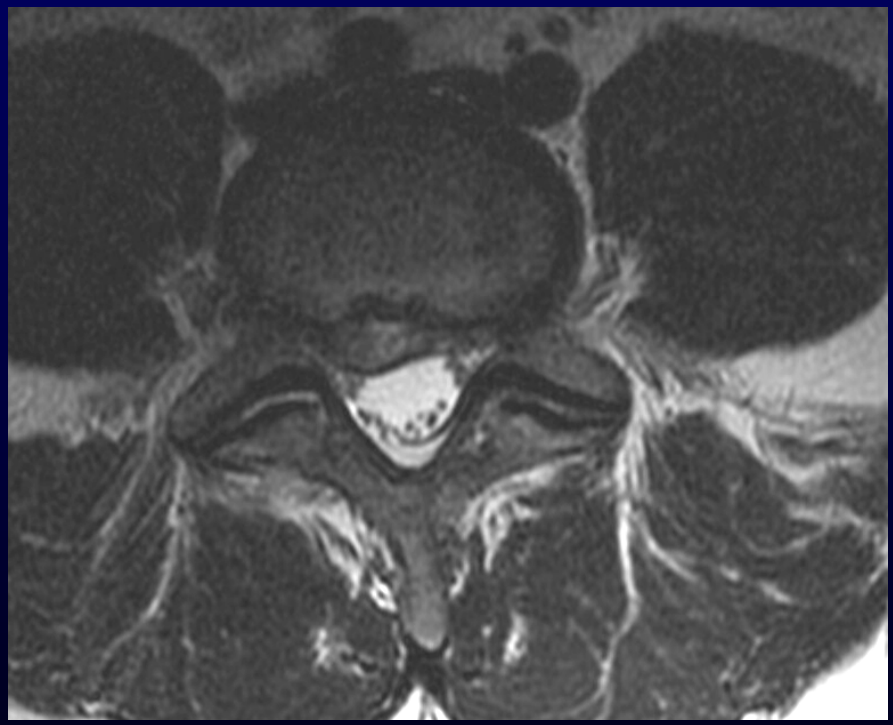
Best study to do first: MRI





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Spine- Clinical Problem: low back pain

- 4-6 weeks of conservative treatment if no ‘red flag’
  - E.g. Malignancy, infection, bladder/bowel symptoms
- Remember that normal patients can have abnormal MRIs
- Need to continue to develop better decision rules and guidelines-
  - ACP October 2007, ACR
  - Embed as decision support in order entry systems

* Pain severity (Specify) ▶ Specify: mild / moderate / severe	Leg weakness left (Specify) ▶
* Pain duration (Specify) ▶ Specify: Acute (<4 weeks) / Subacute (>4 weeks - <3 months) / Chronic (>3 months)	Leg weakness right (Specify) ▶
Radicular pain left (Specify) ▶	Leg weakness bilateral (Specify) ▶
Radicular pain right (Specify) ▶	☐ Progressive focal motor weakness
Radicular pain bilateral (Specify) ▶	Bladder/Bowel dysfunction (Specify) ▶
Radicular numbness/tingling left (Specify) ▶	☐ Fever
Radicular numbness/tingling right (Specify) ▶	☐ Neuralgia
Radicular numbness/tingling bilateral (Specify) ▶	Reflex change (Specify) ▶
☐ Back Pain	☐ Myelopathy
☐ Asymptomatic	☐ Saddle anesthesia
Other:	

Relevant History: (Select one or more)	*Differential Diagnosis: (Select one or more)*
* Course of conservative treatment during this episode (Specify) ▶ Specify: None / Pharmacological therapy / Physical Therapy	☐ Disc herniation
Trauma severity (Specify) ▶	☐ Spinal stenosis
Trauma: chronicity (Specify) ▶	☐ Fracture
☐ IV conscious sedation/anesthesia required	☐ Demyelinating disease

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BWH **Ordering Physician:** Khorasani, Ramin, M.D.,M.P.H. **Site:** Primary Care Assoc of Norwood Logoff

Welcome to Percipio - bwfapp4-ORM1

Decision Support **Order Placement**

Patient Name: Oetest, Carol		PERCIPIO MRN M8652089	
Birth Date: February 2, 1974	Age: 34 years	Gender: Unknown	Phone Number:
Ordering Provider: **Khorasani, Ramin, M.D.**		Payor: Fallon	
Exam: **MRI L-Spine**		Order ID: 12408448	
Signs and Symptoms: **Pain severity(Specify:mild), Pain duration(Specify:Acute (<4 weeks))**			
Relevant History: **Course of conservative treatment during this episode(Specify:None)**			
Created By: N/A		Ordering Site: Primary Care Assoc of Norwood	

Decision Support

Based on published evidence MRI is not recommended in the absence of clinical "red flags". If symptoms are disabling, consider consultation with the comprehensive spine center at 617 732-6600.

Clinical guidelines from the American College of Physicians and American Pain Society: Clinicians should perform diagnostic imaging and testing for patients with low back pain when severe or progressive neurologic deficits are present or when serious underlying conditions are suspected on the basis of history and physical examination (strong recommendation, moderate-quality evidence).

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About Advice

Comments: Advise,

Source 1: Diagnosis and Treatment of Low Back Pain: A Joint Clinical Practice Guideline from the American College of Physicians and the American Pain Society

- **Recommendation 3:** Clinicians should perform diagnostic imaging and testing for patients with low back pain when severe or progressive neurologic deficits are present or when serious underlying conditions are suspected on the basis of history and physical examination (strong recommendation, moderate-quality evidence).

- **Recommendation 5:** Clinicians should provide patients with evidence-based information on low back pain with regard to their expected course, advise patients to remain active, and provide information about effective self-care options (strong recommendation, moderate-quality evidence).

- **Recommendation 6:** For patients with low back pain, clinicians should consider the use of medications with proven benefits in conjunction with back care information and self-care. Clinicians should assess severity of baseline pain and functional deficits, potential benefits, risks, and relative lack of long-term efficacy and safety data before initiating therapy (strong recommendation, moderate-quality evidence). For most patients, first-line medication options are acetaminophen or nonsteroidal anti-inflammatory drugs.

Ann Intern Med. 2007;147:478-491. www.annals.org

Source 2: American College of Radiology

ACR Appropriateness Criteria American College of Radiology Appropriateness Criteria.pdf

Indications of a more complicated status, often termed

"red flags," include the following:

- Recent significant trauma, or milder trauma, age > 50

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Relevant History: **Course of conservative treatment during this episode(Specify:None)**			
Created By: N/A		Ordering Site: Primary Care Assoc of Norwood	

Decision Support

A peer-to-peer consultation is required in order to submit an order.

Peer-to-peer consultation is available Monday - Friday 8 am - 6 pm. Please page Percipio Support at pager #38499 during off-hours.
For a faster response, please be sure to enter a direct call back number in the space provided below.

Click the "**SEND PAGE**" button for peer-to-peer consultation.

Name:	Lumbar Spine, Mri
Telephone:	None
Pager:	17032
Call Back #:	(e.g. 1112223333) SEND PAGE

Enter the peer-to-peer consultation number **here**:

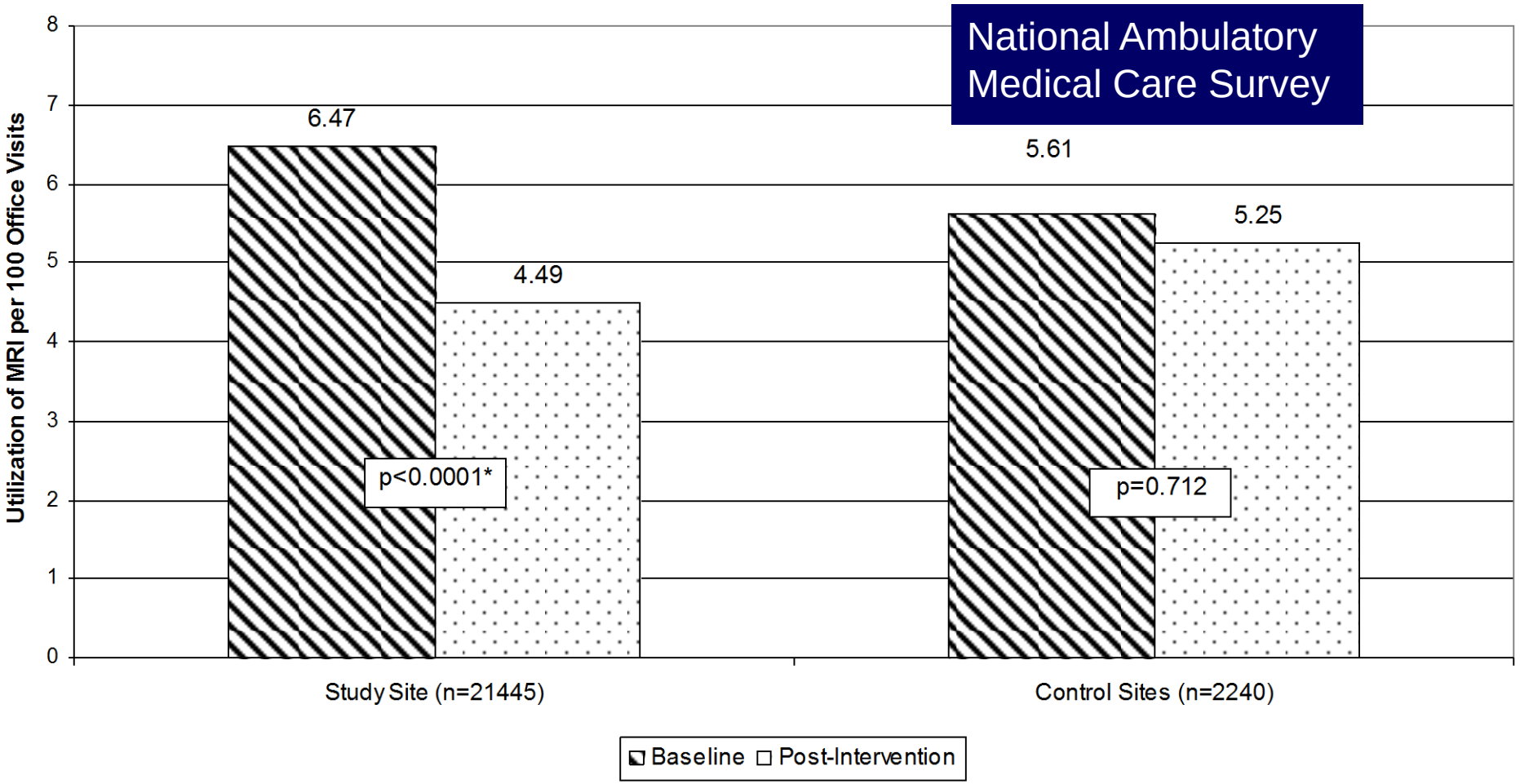
Please note: If you have not received a callback within 15 minutes of clicking the "**SEND PAGE**" button, please page Percipio Support at pager #38499

Submit Reset Order

More Info
Feedback

Internet

Utilization of Magnetic Resonance Imaging in Back-Pain Related Primary Care Office Visits



Reference:

Ip IK, Schneider LI, Gershanik EF, Raja AS, Mar W, Seltzer S, Khorasani R. Promoting primary care physician guideline adherence for MRI use among patients with low back pain: Impact of clinical decision support and accountability tools. Am. J. Med. 2014.

Outcome Measure	*Pre-Intervention*	*Post-Intervention*	*p-value*
Lumbar Spine MRI ordered by PCP on Day of Office Visit	443 (5.3%)	477 (3.7%)	<0.001*
Lumbar Spine MRI ordered by any outpatient providers within 30 days of index primary care visit	753 (8.9%)	1009 (7.8%)	0.0023*
Lumbar Spine MRI ordered by Specialty Clinics within 30 days	188 (2.2%)	352 (2.7%)	0.0292*
Lumbar Spine MRI ordered by primary care outpatient providers within 30 days	565 (6.7%)	657 (5.1%)	<0.001*
Follow-up PCP Visit within 30 days	855 (10.1%)	1224 (9.4%)	0.080
Guideline adherence rate in the use of lumbar spine MRI based on manual chart review	78/100 (78%)	96/100 (96%)	0.0002*

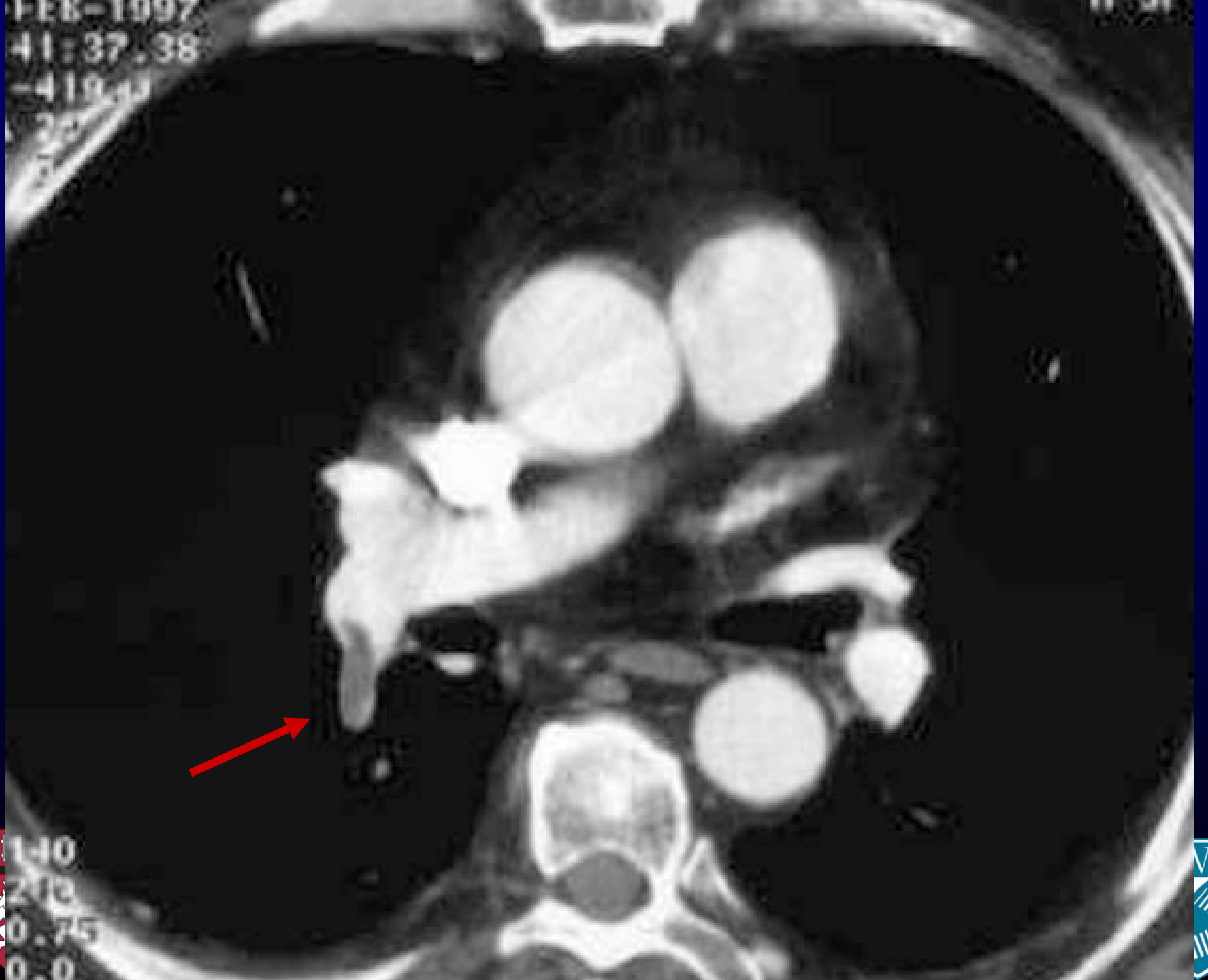
Ip IK, Schneider LI, Gershanik EF, Raja AS, Mar W, Seltzer S, Khorasani R. Promoting primary care physician guideline adherence for MRI use among patients with low back pain: Impact of clinical decision support and accountability tools. AM. J. Med. 2014.

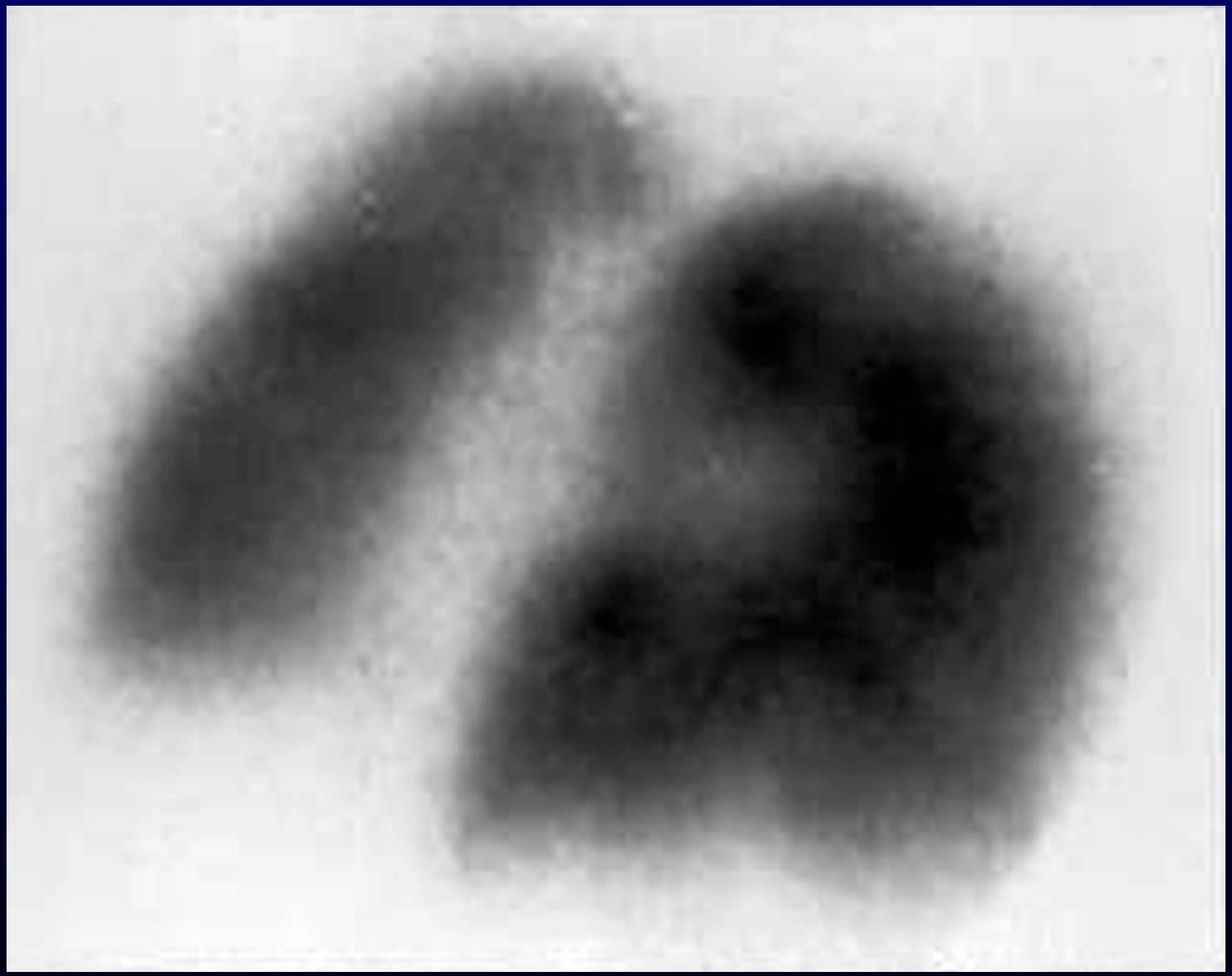
Protecting Access to Medicare Act (HR 4302; 2014)- Section 218b *Promoting Evidence-Based Care*

- Beginning January 1, 2017
- Targeted ambulatory and ED imaging studies will have to be exposed to clinical decision support as requirement for payment for imaging services
- CDS developed or endorsed by national professional societies or other provider-led entities

Case 8

- 73 F, with acute SOB, pleuritic chest pain, moderate clinical suspicion for acute PE
- Best study to do first:
- If the study is normal, the next test:





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BWH **Ordering Physician:** Khorasani, Ramin, M.D.,M.P.H. **Site:** Foxborough Primary Care Logoff

Welcome to Percipio - BWFAPP3-ORM1

Decision Support **Order Placement**

Patient Name: OETEST, BRIDGET M.		BWH MRN 11489986	
Birth Date: February 13, 1934	Age: 76 years	Gender: Female	Phone Number: 6175551212
Ordering Provider: **Khorasani, Ramin, MD MPH**		Payor: BWH - BCBS of MA /HMO Blue/Blue Choice	
Exam: **CT Chest Pulmonary Embolism**		Order ID: 15311850	Room: N/A
Created By: N/A		Ordering Site: Foxborough Primary Care	

Decision Support

To accurately assess the probability of pulmonary embolism in this patient based on Well's Criteria you MUST check all that apply below.

- ☐ Clinical Signs and Symptoms of DVT
- ☐ PE is #1 Diagnosis, or Equally Likely
- ☐ Heart Rate >100
- ☐ Immobilization at least 3 days, or Surgery in the Previous 4 weeks
- ☐ Previous, objectively diagnosed PE or DVT
- ☐ Hemoptysis
- ☐ Malignancy with Treatment within 6 months, or palliative
- ☐ None of the Above

More Info

Feedback

Please see "More Info" for references.

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Submit

Reference: Wells PS, et al. Thromb Haem 2000;83(3):416-420

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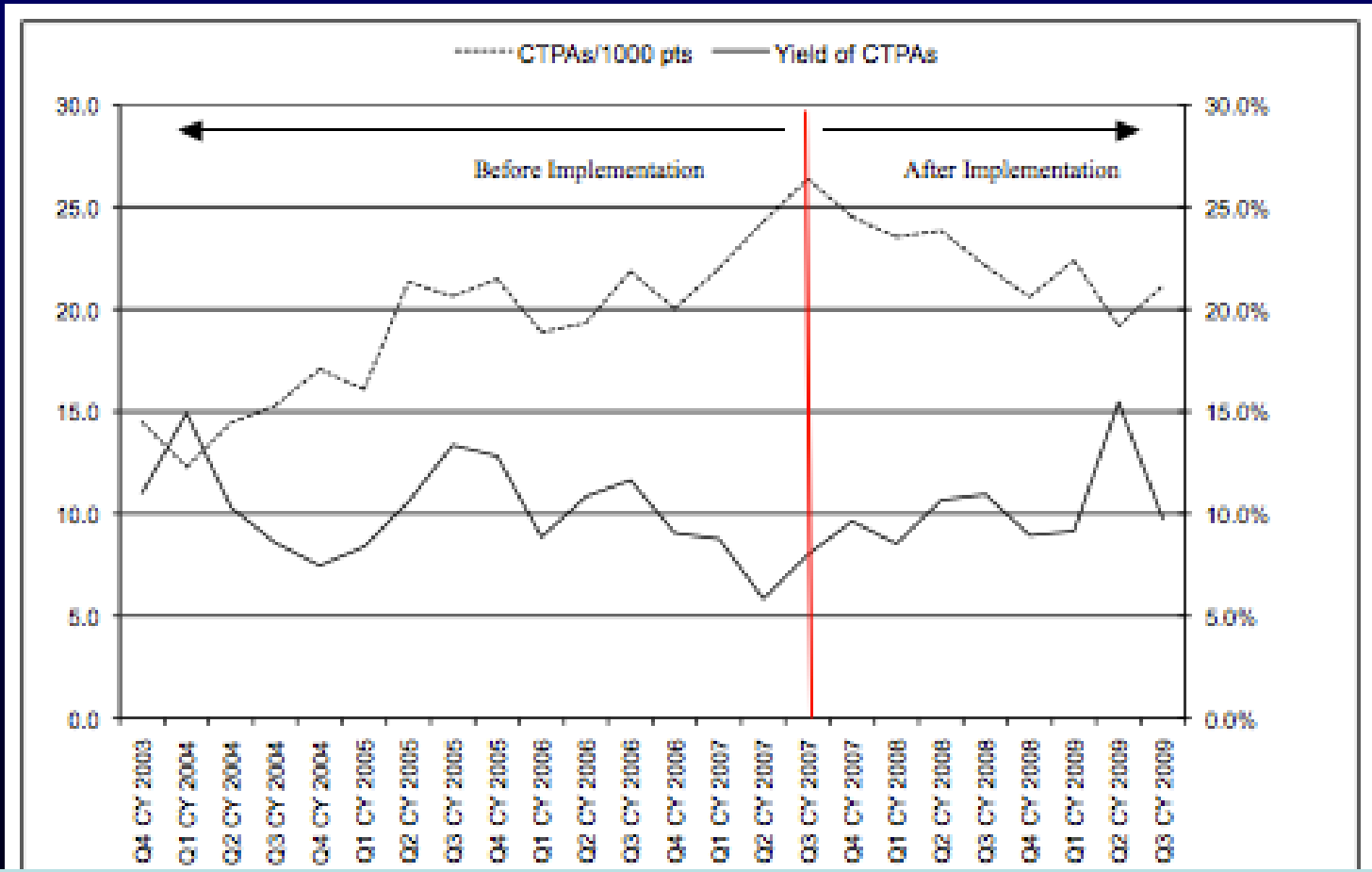
Use and Yield of CT pulmonary angiography Before and After Decision Support (DS) in ED

20.1% lower use (p<0.04); 69% higher yield (p<0.04)

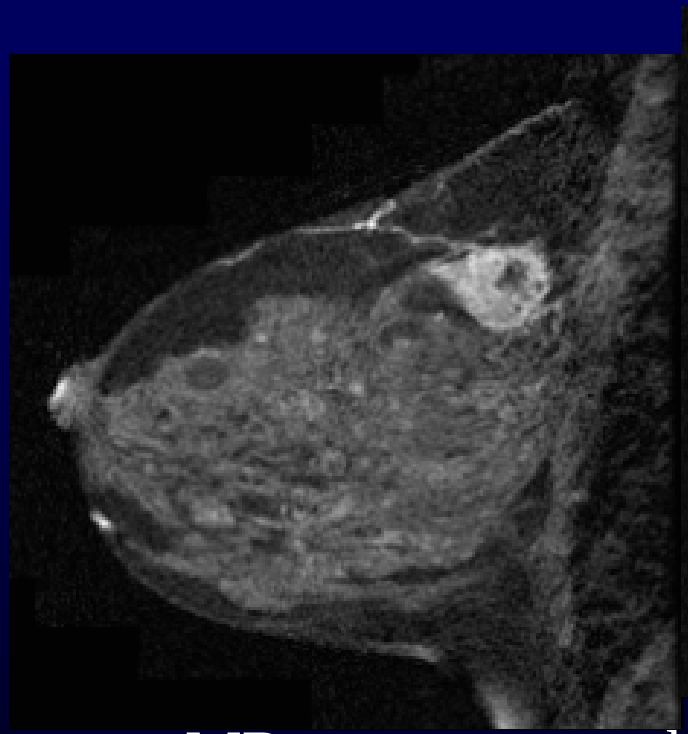


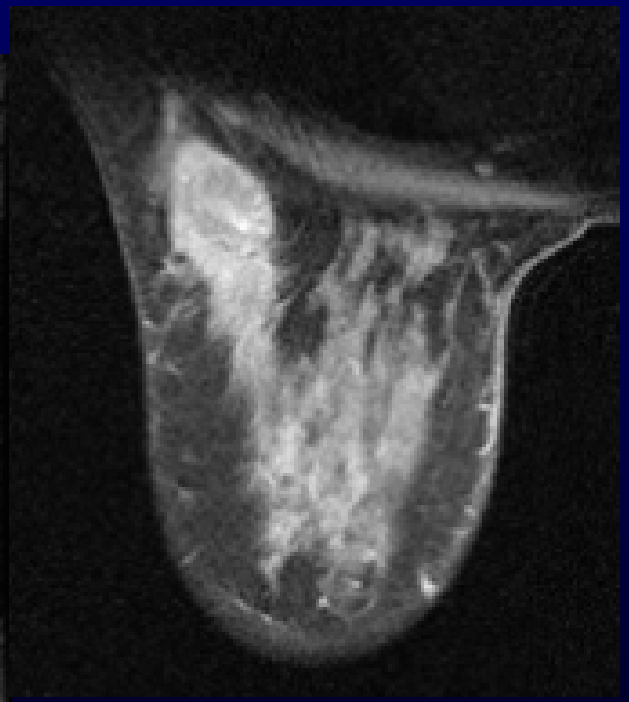
Raja AS, Ip IK, Prevedello LM, Sodickson AD, Farkas C, Zane RD, Hanson R, Goldhaber SZ, Gill RR, Khorasani R. Effect of Computerized Clinical Decision Support on the Use and Yield of CT Pulmonary Angiography in the Emergency Department. Radiology 2012;262(2):468–474.

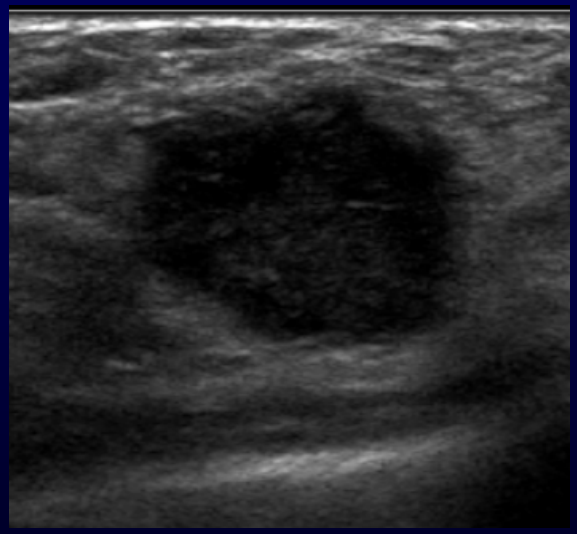
Case 9

- 32 Y.O. Female with Braca1 gene mutation. Need to screen for breast cancer.
- Best study to do first:
- If the first study is normal, the next test:

42 y/o BRCA 1
ER/PR Her2/Neu Negative
High Grade Invasive Ductal Carcinoma (IDC)
No Ductal Carcinoma In situ (DCIS)







MR post contrast shows round rim enhancing mass
Axial delayed MR shows washout delayed kinetics
Ultrasound shows an oval mass with irregular margins

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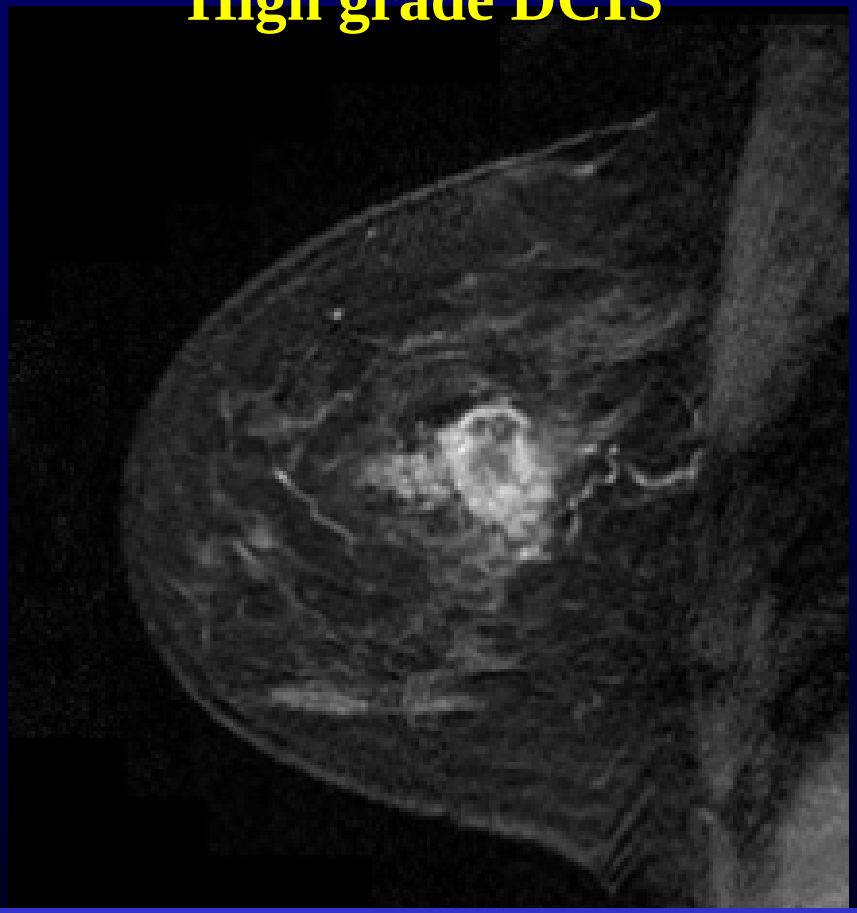
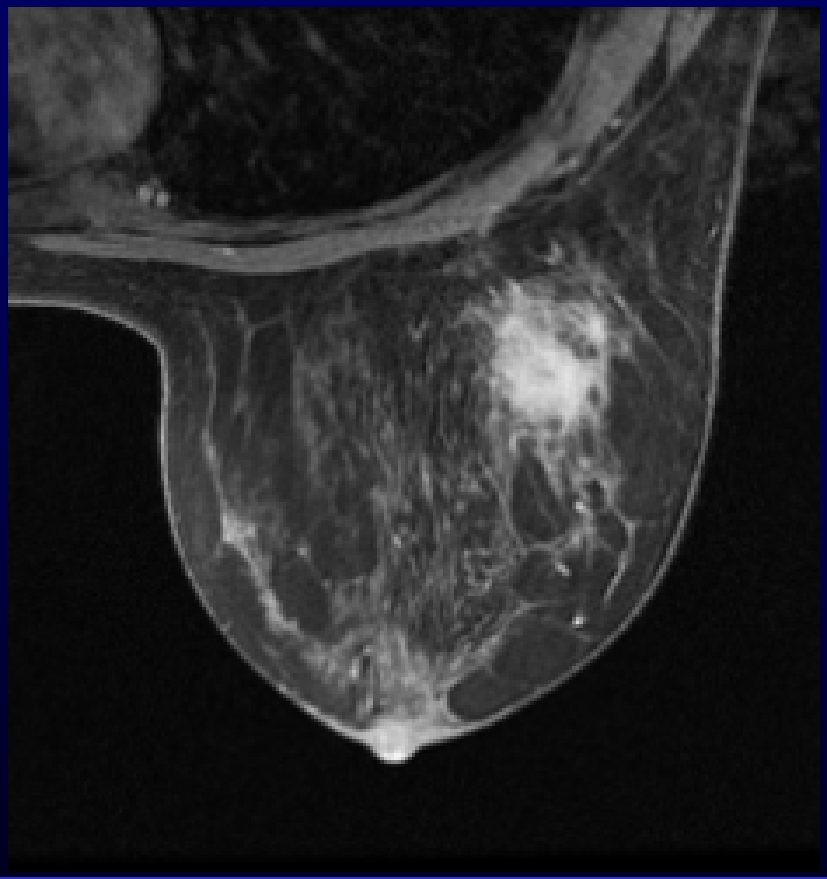
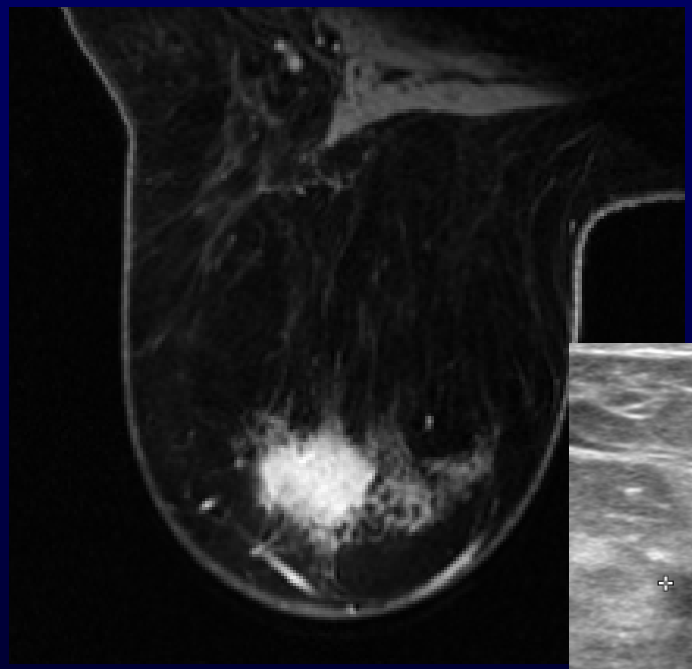
56 y/o , Strong Family History; BRCA Negative
ER/PR Her2/neu Negative
High Grade IDC
High grade DCIS

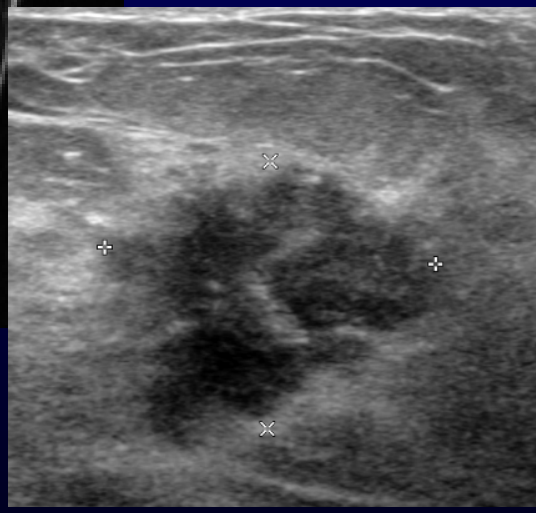




Contrast enhanced MRI shows an oval mass with irregular margins and rim enhancement. Around the mass is non-masslike enhancement worrisome for DCIS

57 y/o BRCA 2
ER/PR Her2/Neu Negative
Intermediate Grade IDC
No DCIS





Oval mass with irregular margins
Heterogeneous internal enhancement

US shows irregular mass
Angular margins

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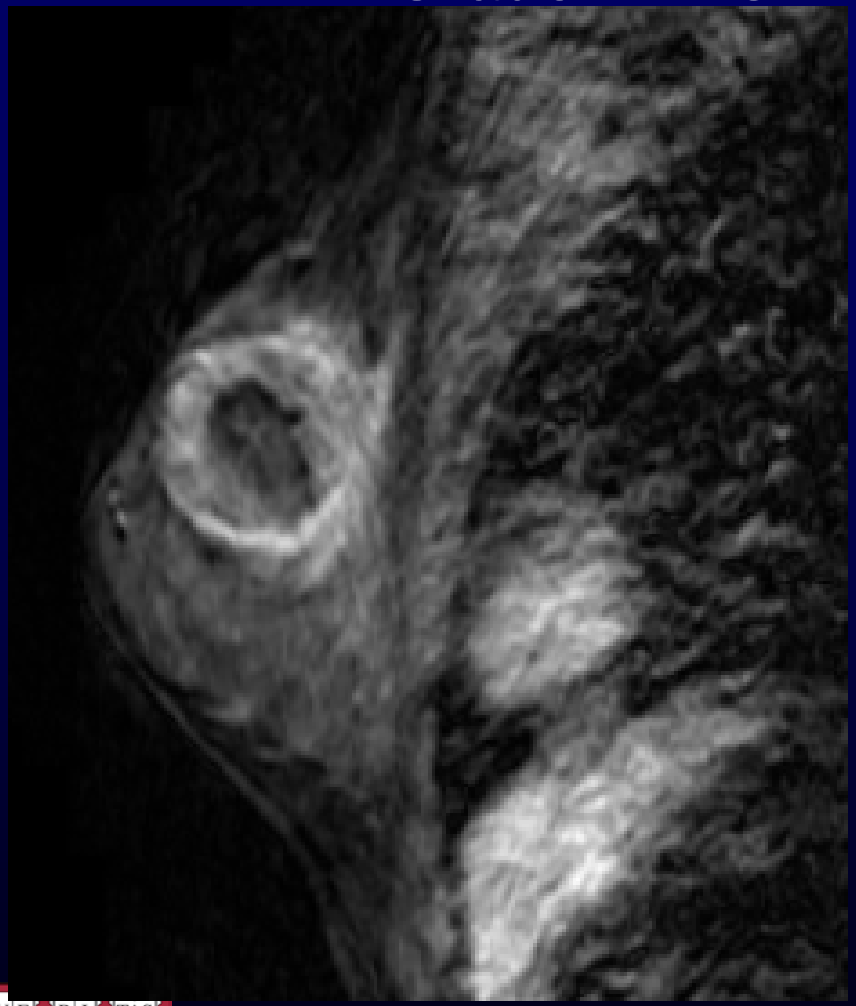
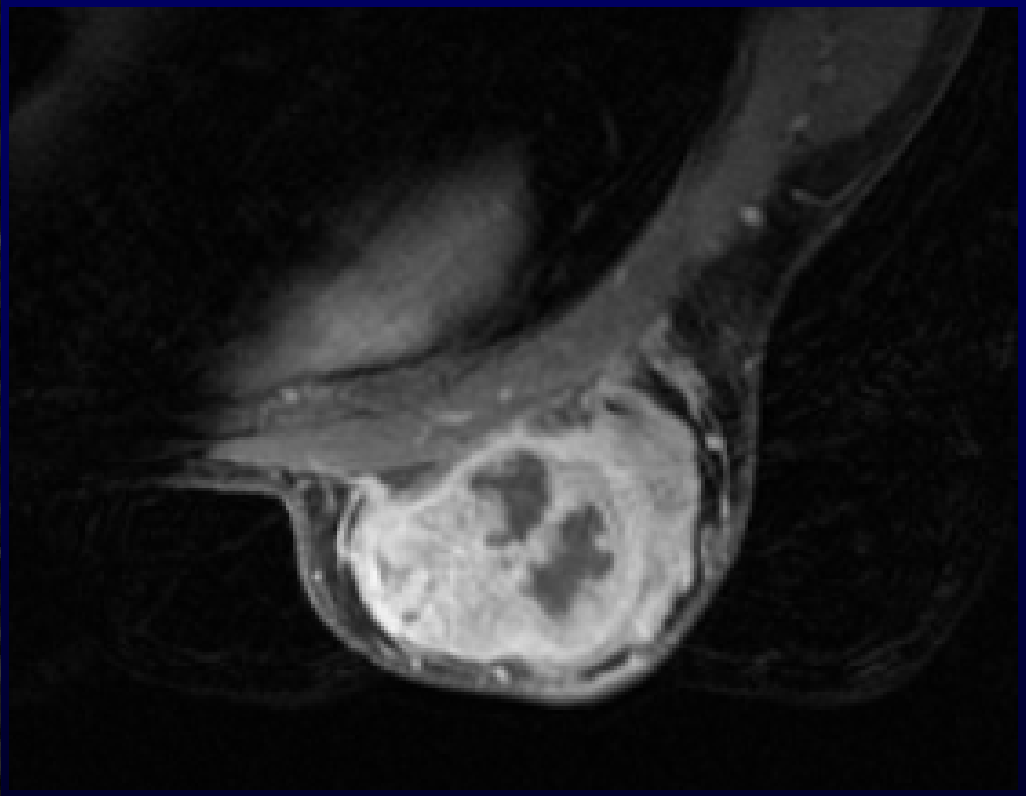
33 year old BRCA 1
ER/PR Her2/Neu Negative
Grade III IDC





Large round mass with rim enhancement

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Breast MRI and breast cancer

- Established yearly screening tool adjunct to mammography in high risk population- e.g. Braca1 gene mutation
- It is being used [with large variation in practice] in staging of newly diagnosed breast cancer primarily to look for multi-centric disease
  - Need to develop evidence on use of MRI in this context to improve patient outcomes
- Other screening use not supported by current evidence

Case 10

- 42 F with acute onset lower abdominal pain, N/V, no fever, normal WBC, no prior surgical history, you are worried about an acute small bowel obstruction

- Best study to do first:

If the first study is normal, the next test:

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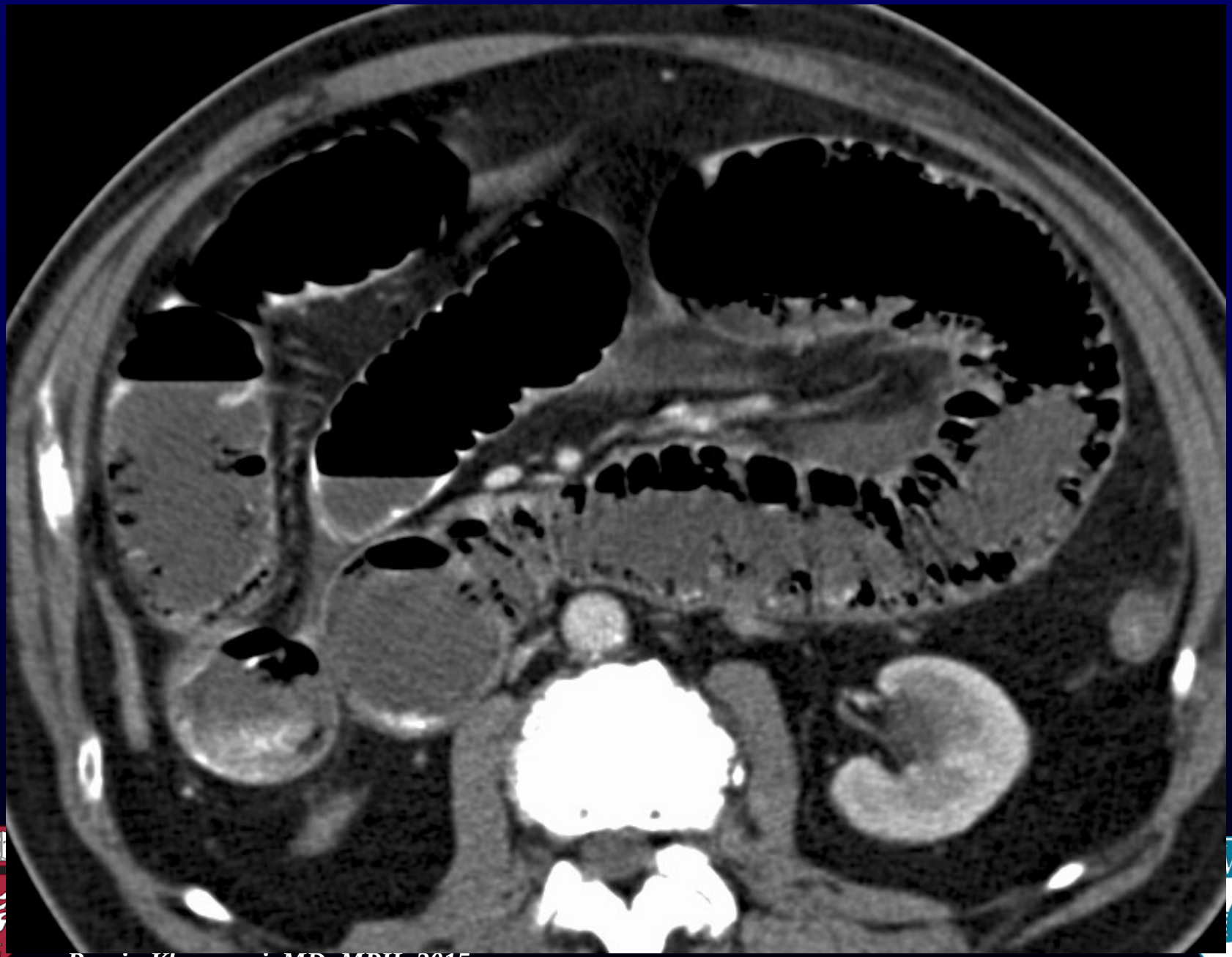

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Abdomen
utility of “KUB”

- Excellent for suspected perforation (supine abdomen, erect CXR),
- If suspected bowel obstruction with history of prior obstruction (supine and upright)
- In most other instances not very helpful as negative or positive result usually leads to another imaging test such as CT or US

Abdomen-Clinical Problem: ? Small bowel obstruction

- "KUB" good first test if:
  - prior surgery, obstruction;
  - may be normal rarely in acute obstruction
- Acute SBO:
  - if further imaging, CT better than small bowel follow through (barium study) to diagnose obstruction and its etiology
- Chronic or recurrent SBO:
  - CT enterography
- CT to look for other etiologies for pain

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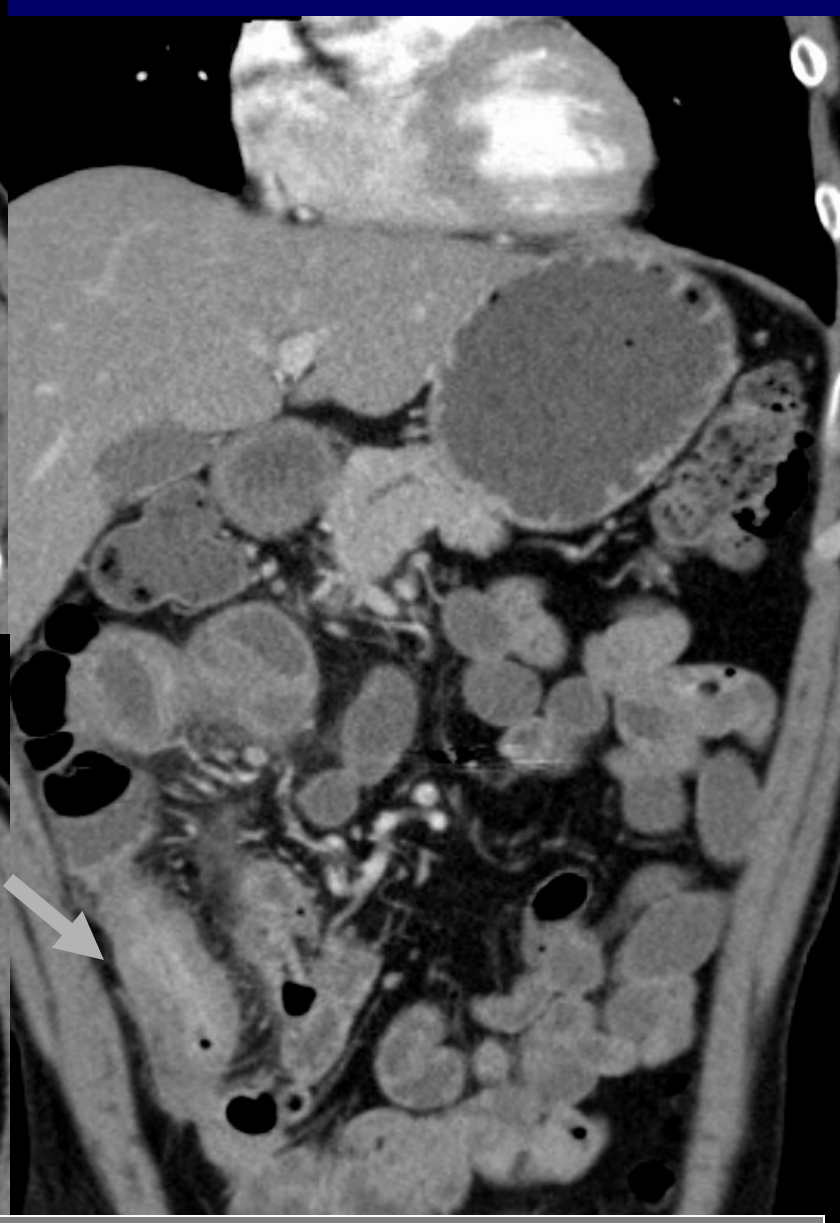
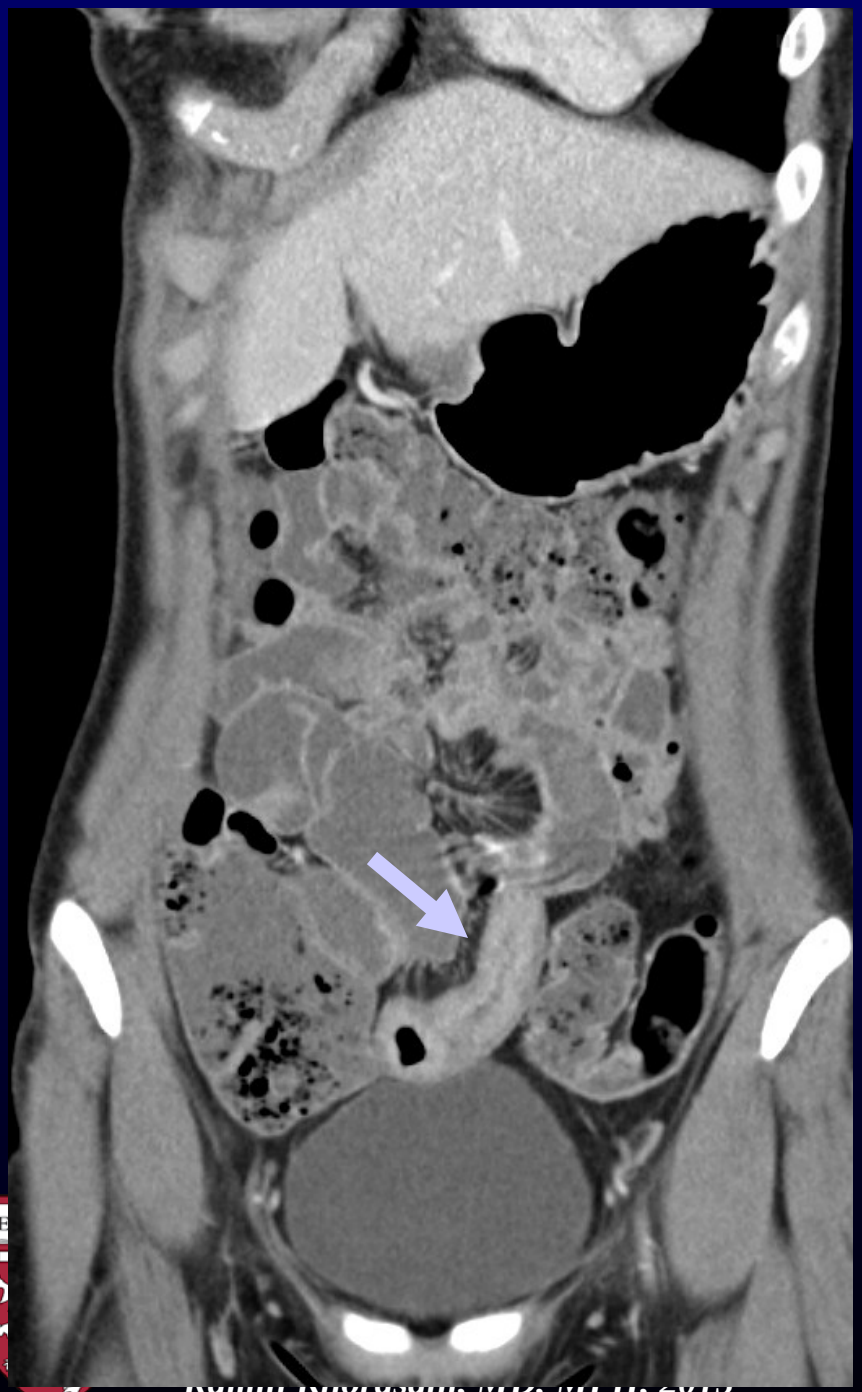


mucosal hyperenhancement: segmental attenuation greater than adjacent jejunum or ileum (+/- wall thickening [> 3mm])



Case 11

- 24 F, with 2 day history of RLQ pain, anorexia, fever, no prior surgical history, peritoneal signs in the RLQ, WBC = 12k, negative BHCG

- Best study to do first

If first study is normal, the next test:

Case 12

- 24 M diabetic with 2 day history of RLQ pain, fever, WBC = 6k, elevated blood sugars, could be acute appendicitis

- Best study to do first:

- If first study is normal, the next test:

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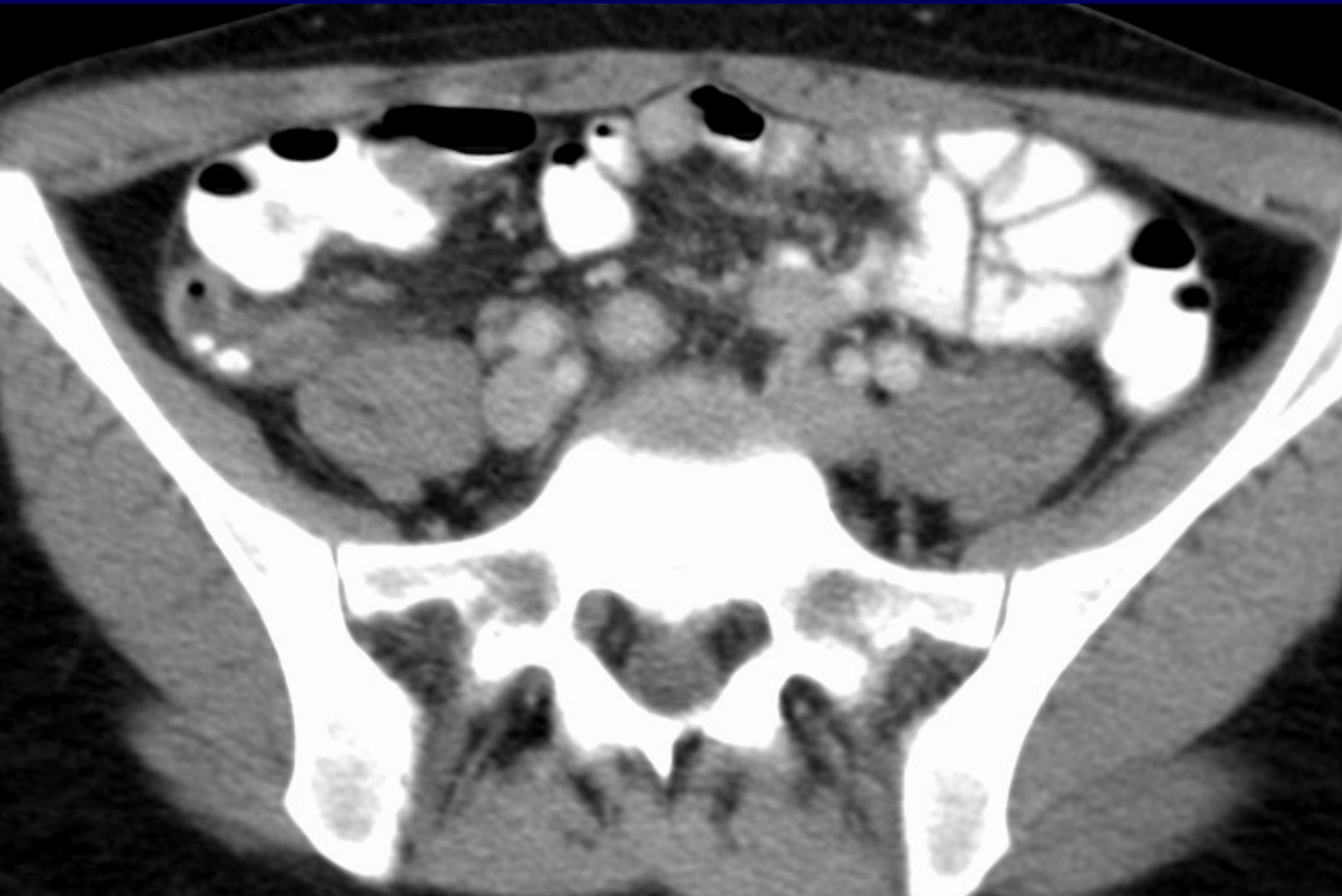
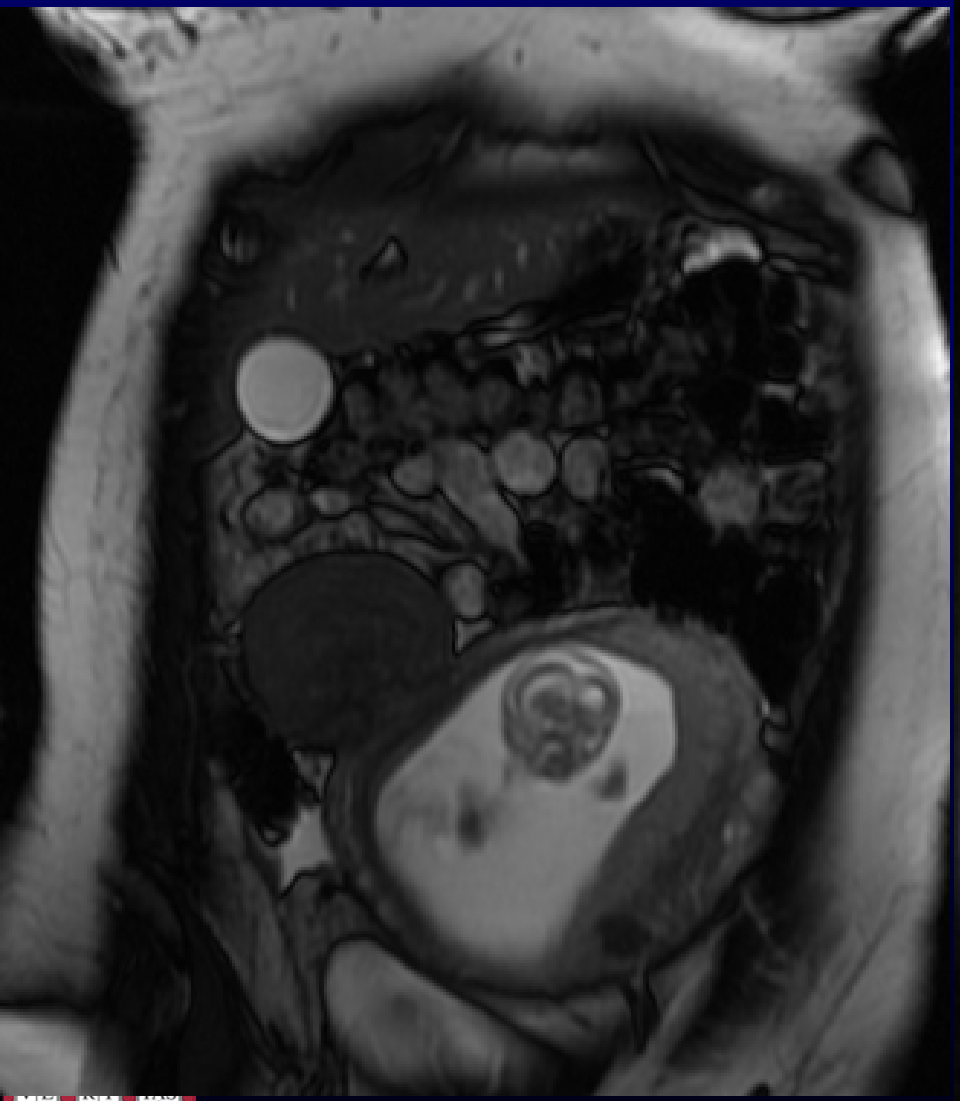


Case 12 variant

- RLQ pain x2days, 16 wks pregnant
- Best study to do first:
- If first study is normal, the next test:



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Abdomen-Clinical Problem: appendicitis

- Clinical diagnosis, imaging not routinely indicated
- If equivocal clinical diagnosis: CT is test of choice in this scenario with sensitivity and specificity > 95%
- In pregnancy, ultrasound in expert hands, MRI best test
- NEJM
  - 1/98: CT on all patients with RLQ pain-not standard of care
  - 2008- CT decreased negative appendectomy rate to <2%
- BWH
  - NAR 30% in females, 12% in males in 1990
  - NAR 1.5% females, 1.8% males in 2007
  - >95% of appendectomies had preoperative CT
  - 14.6% of CT for appendicitis went to OR
  - Estimate 20 CT per 1 less appendectomy-need further studies

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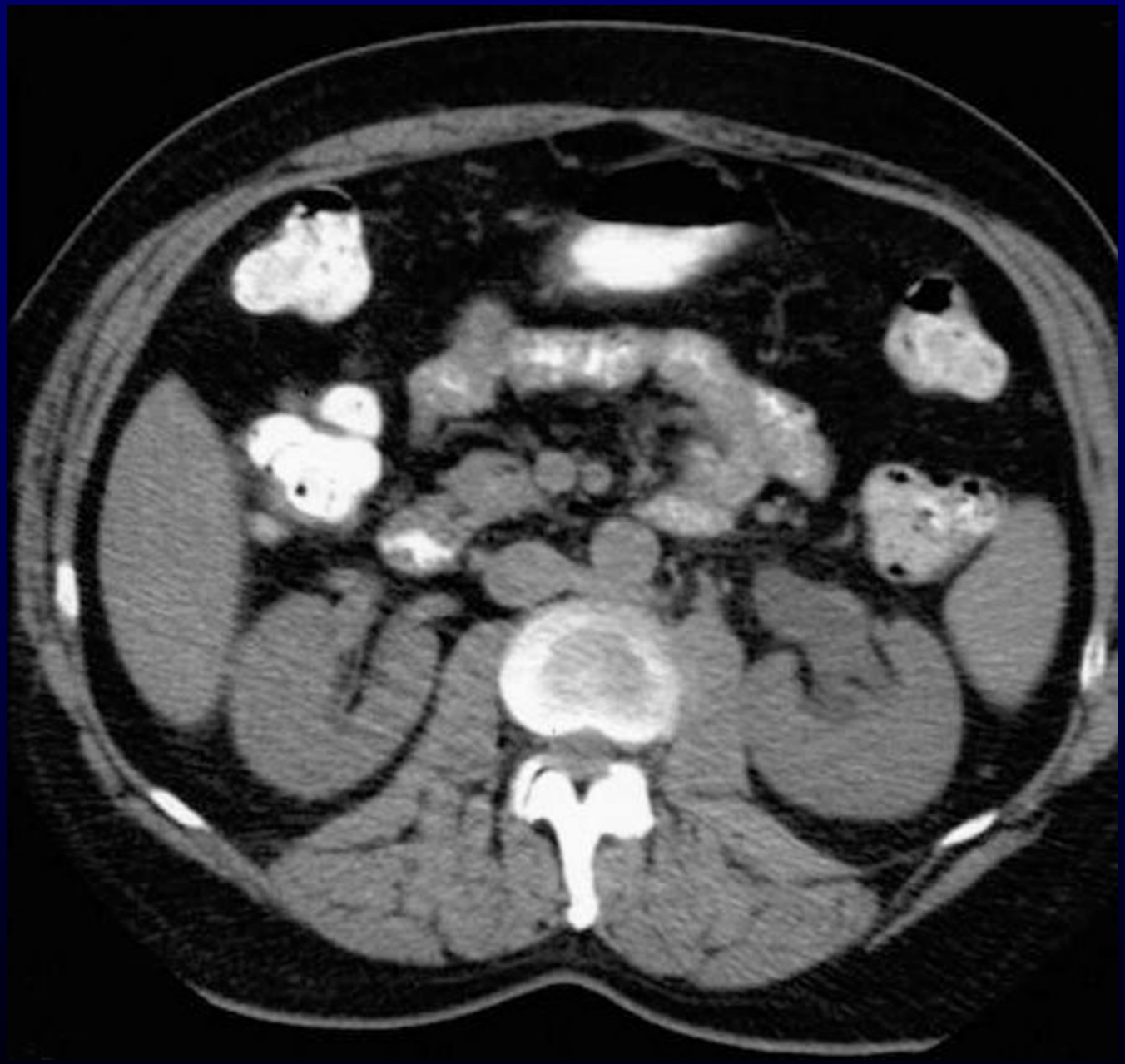
Case 13

- 25 M, acute onset of right renal colic, hematuria
- Best study to do first:
- If the first study is normal, the next test:



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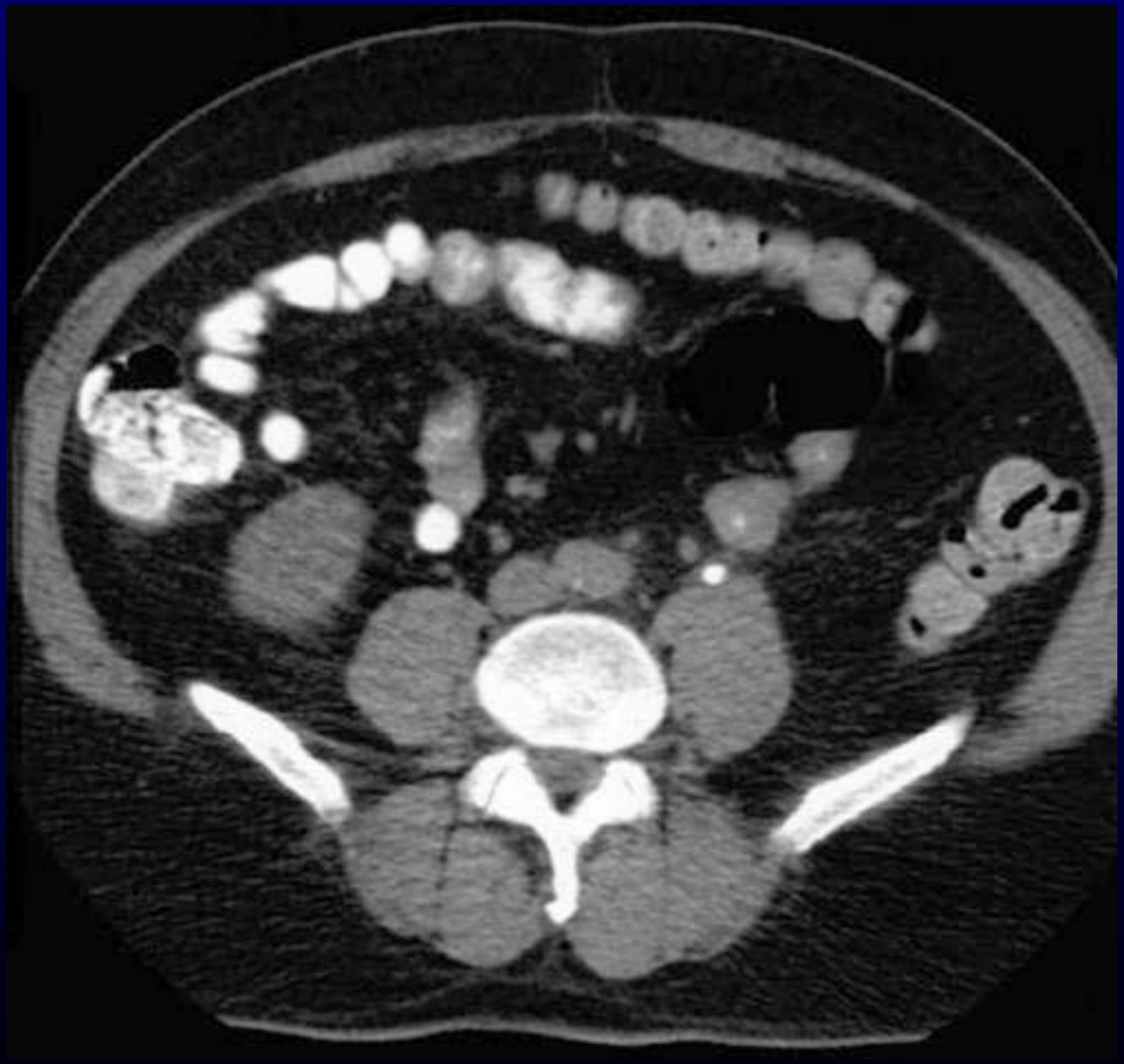

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Abdomen
Clinical Problem: renal colic

- Most common imaging strategy used to be “KUB” followed by IVP or US if necessary. IVP had been considered the gold standard
- Spiral CT without oral or IV contrast is now the examination of choice replacing “KUB” and IVP
  - similar radiation dose
  - 5 – 10 minute study, no IV contrast
  - Can see all stones

How about harm from radiation exposure?

- 'Substantial' concern for harm from radiation exposure from Medical Imaging, esp CT-
  - Real but overblown in the media
- 1-2% potential (many assumptions) incrementally increased risk of malignancy over baseline of approximately 40% lifetime cancer risk in US

How about harm from CT radiation exposure?

- If CT is clinically appropriate and superior to other imaging modalities, its benefits substantially exceed the potential harm
- We do need better science to more accurately assess risk

Case 14

- 45 F with an incidental 2.5 cm right adrenal mass found on CT, performed to elevate an incidental liver lesion on RUQ US looking for gallstones!

- Best study to do first:

- If the first study is normal, the next test:

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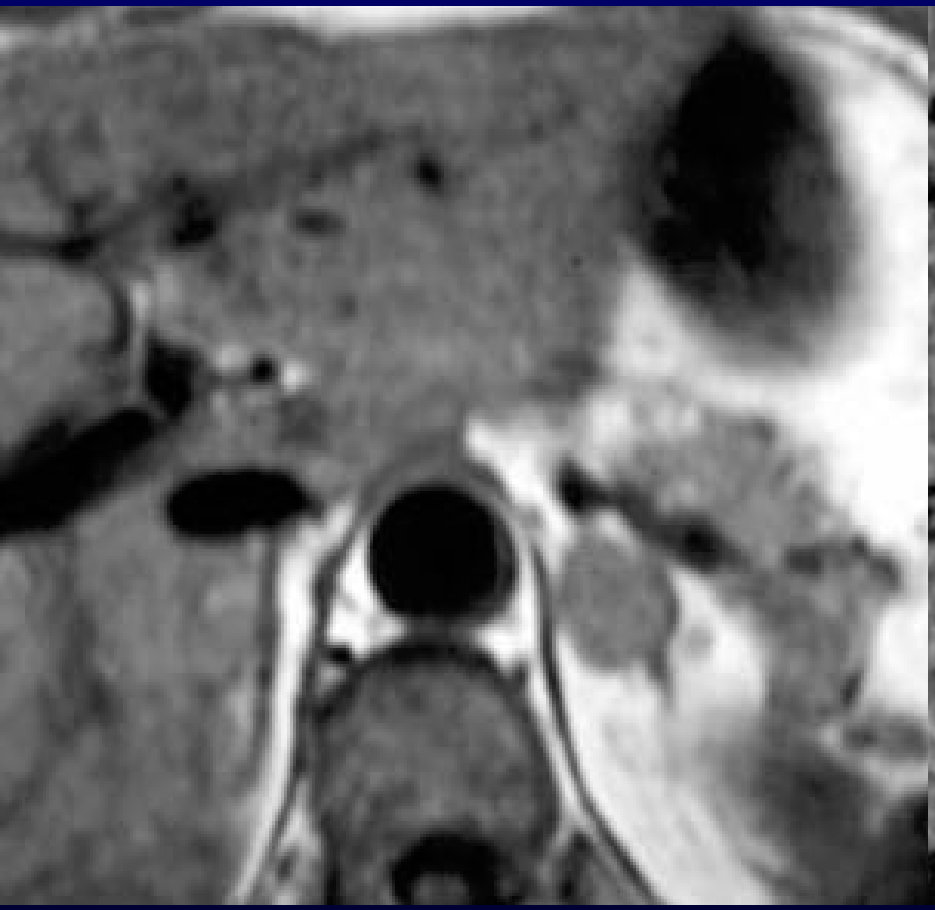
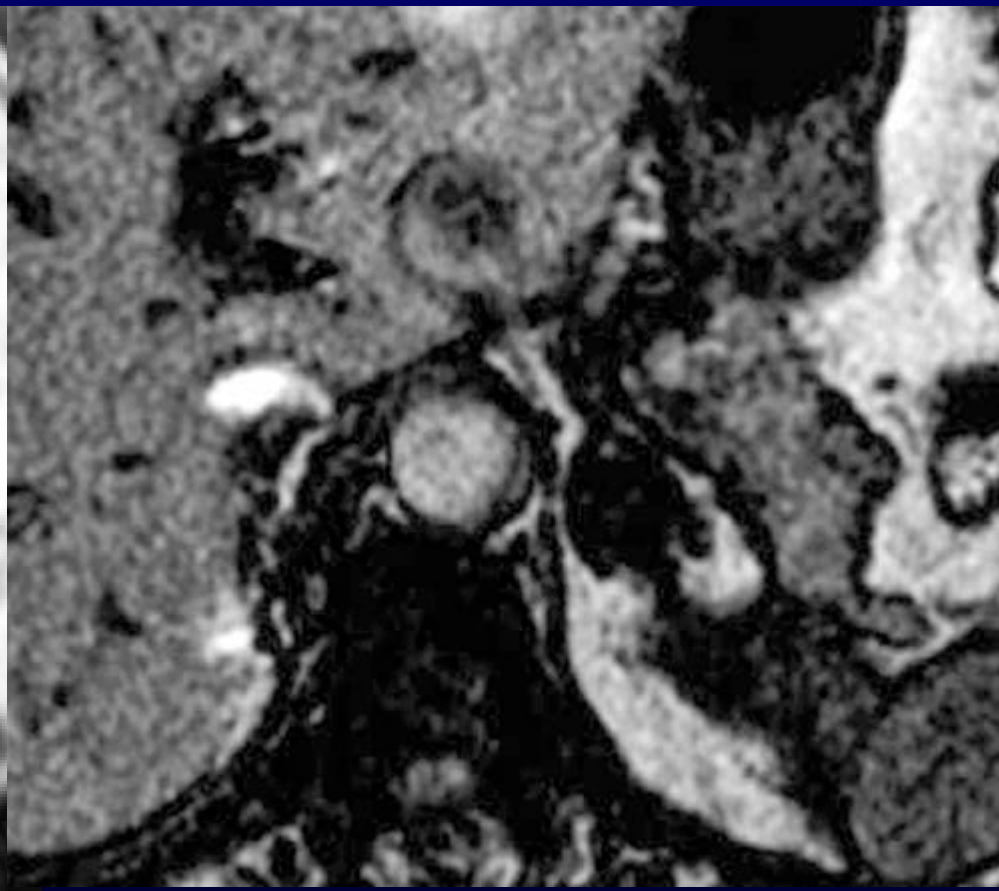
1





In-Phase

Out of Phase

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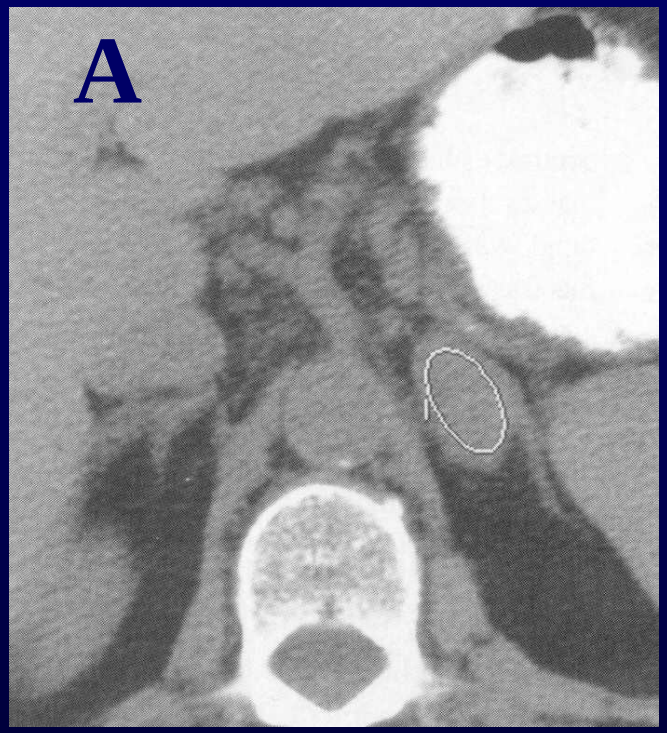
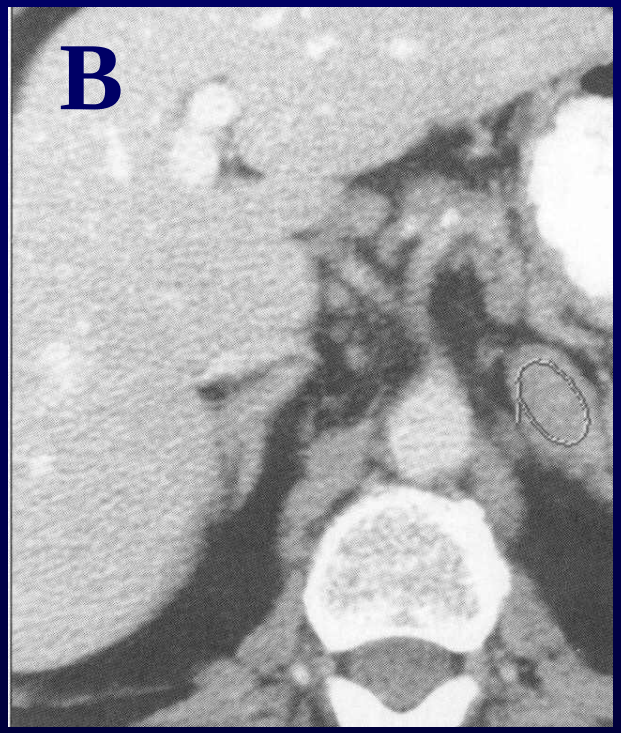
“Lipid-poor” Delayed Washout





A: Unenhanced CT HU= 29
B: Enhanced HU= 73
C: 15 min. HU= 44

Absolute enhancement washout=
(73-44/73-29)x100= 66%

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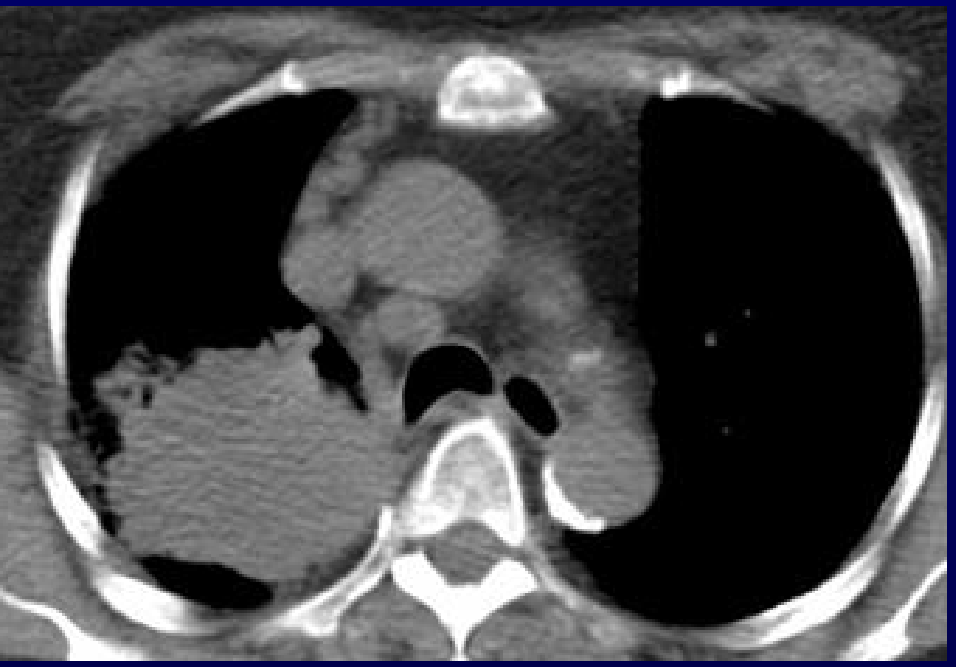
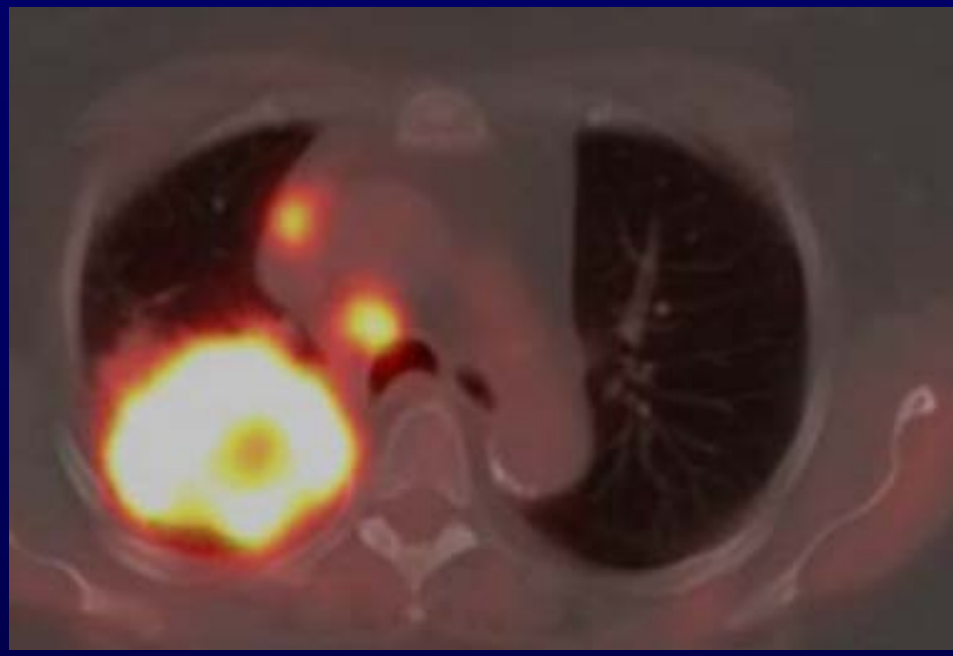
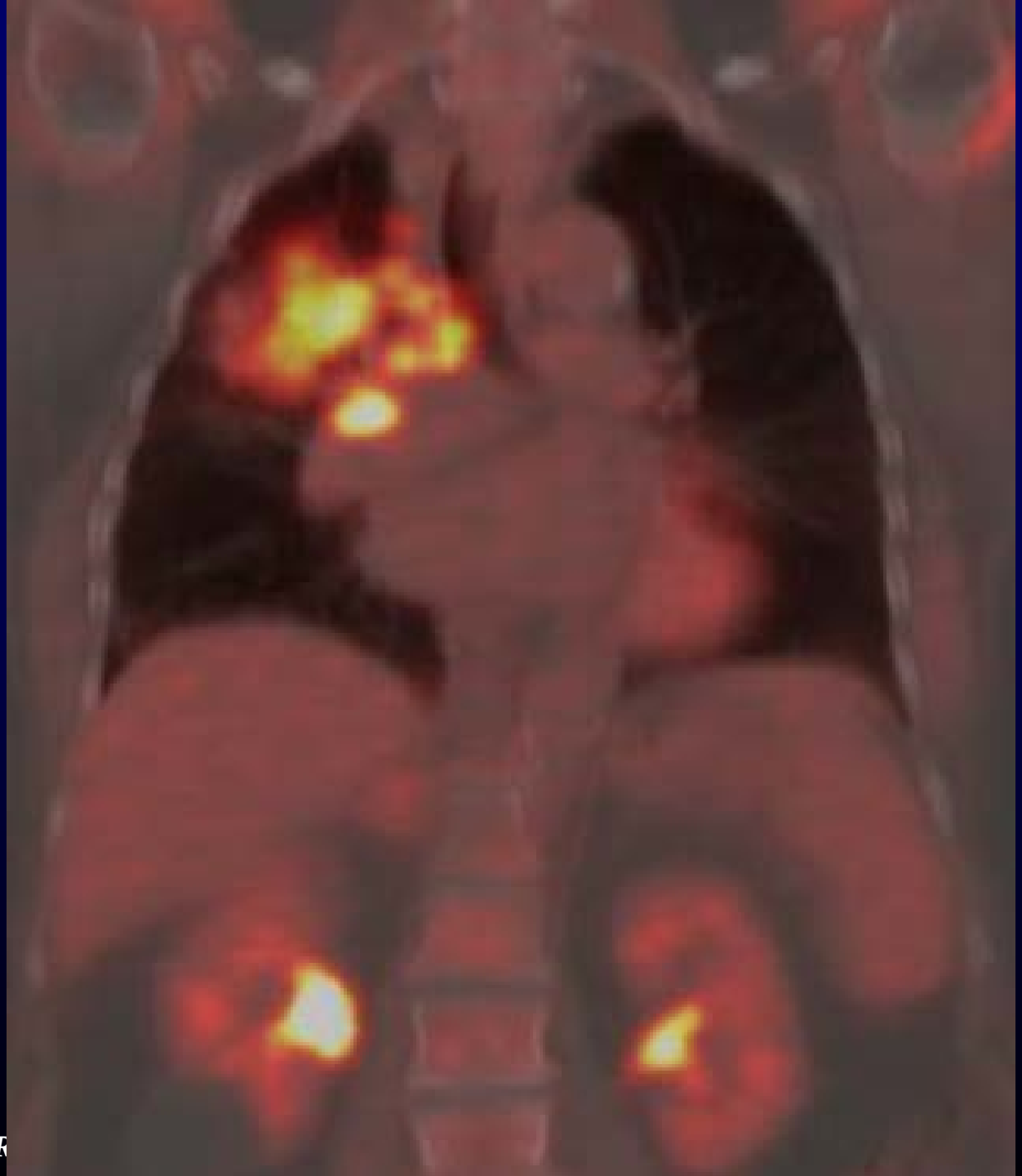
Case 14a

- 56 F with a right lung mass, ipsilateral mediastinal nodes on CT with 2 cm right adrenal mass, Adrenal metastasis?
- Best study to do first:
- If the first study is normal, the next test:







Abdomen-Clinical Problem: adrenal lesion

- Adrenal imaging predominantly anatomic, diagnosis of functional adrenal tumors requires biochemistry
- In patients with an incidental adrenal lesion or those with a primary malignancy, a non-contrast CT, limited adrenal MR, washout CT, or occasionally PET CT may obviate the need for follow up or biopsy

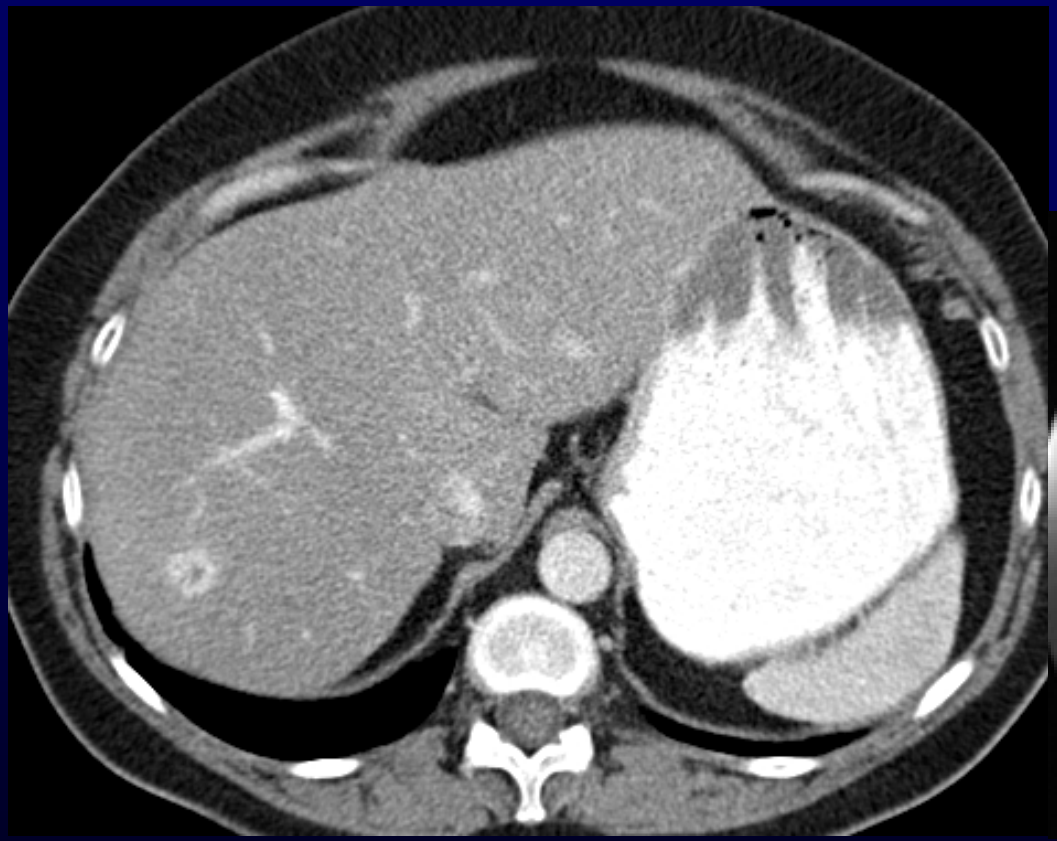
Case 15

- 45 M, medical malpractice lawyer, found to have an incidental 6 cm simple right renal cyst on abdominal ultrasound
- Best study to do first:
- If first study is normal, the next test:

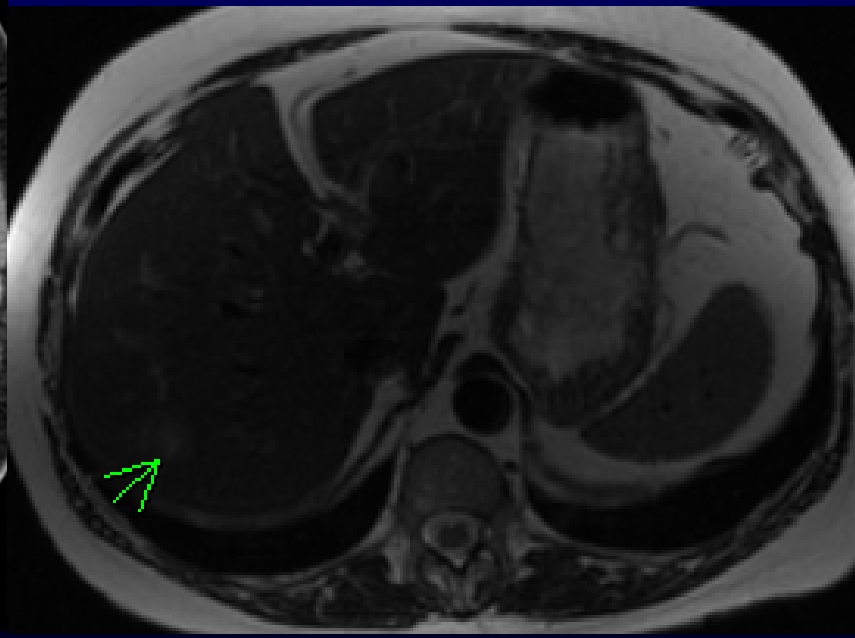
Case 16

- 73 F, who has a 2 cm echogenic mass in the liver found incidentally on ultrasound, no prior medical history
- Best study to do first:
- If first study is normal, the next test:

CT with Contrast



T2 Weighted MRI



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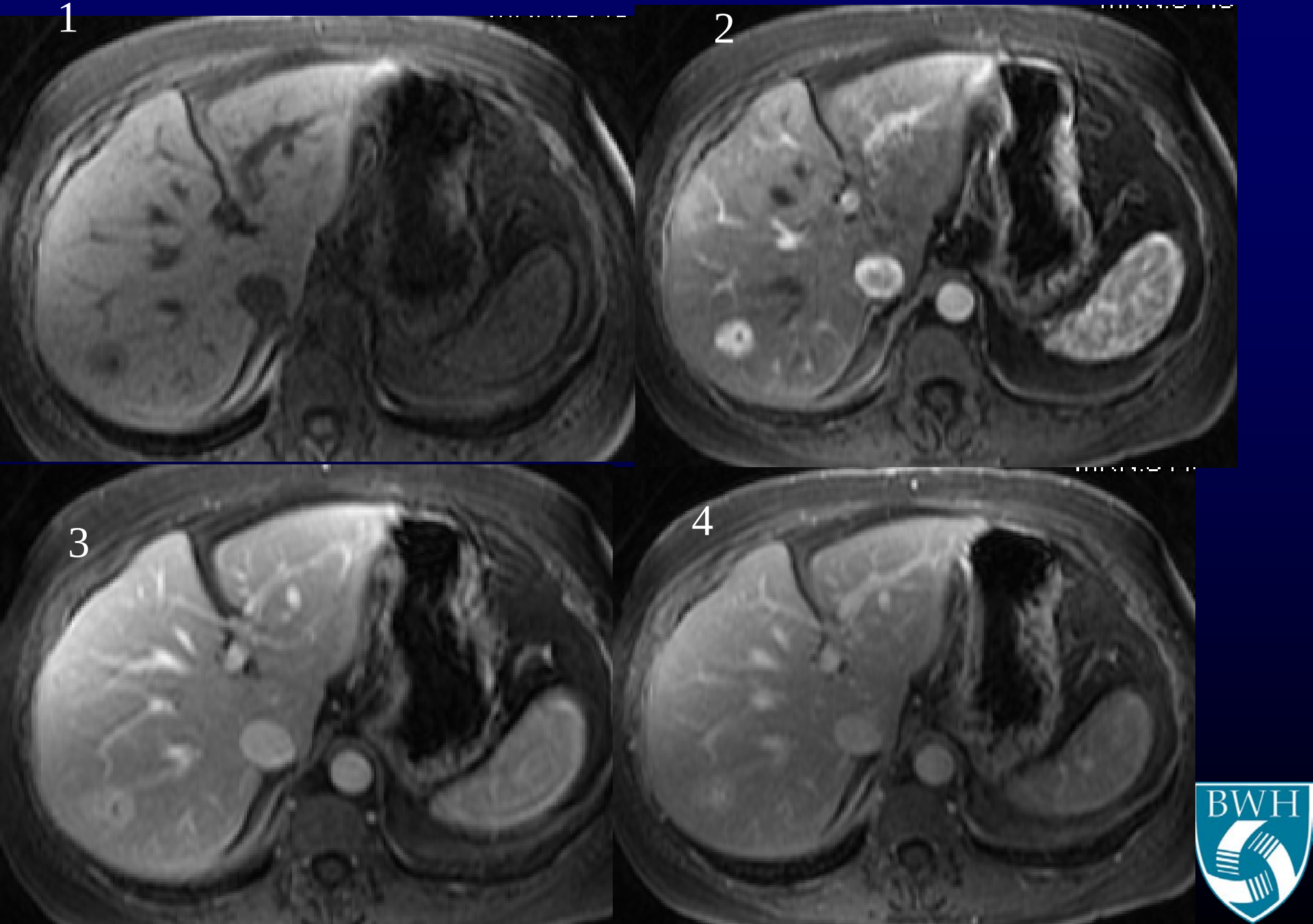
Dynamic MRI sequence with Gadolinium: FNH



Incidental Liver lesions

- Great majority are benign cysts, hemangiomas- diagnosis can be made on ultrasound, CT, MRI
- If no prior malignancy, indeterminate solitary <15 mm hepatic lesion is highly likely to be benign (>98%), options:
  - Do nothing
  - Re-image in 6-12 months-show stability-then stop
  - Make benign diagnosis with MRI then stop

Incidental Liver lesions

- Modality of choice for characterization is MRI

Case 18

- 52 M, with Rheumatoid arthritis, diabetes and chronic renal insufficiency, with new 3 cm brain lesion on CT done for headache
- Best study to do first:
- If the first study is normal, the next test:

ternet Explorer

/template.jsp

Signs and Symptoms: **Chronic headache**

Relevant History: **Abnormal Prior Imaging(Specify:CT)**

Additional Comments: **CT shows 3 cm mass lesion. Chronnic renal failure**

Created By: N/A | Ordering Site: Foxborough Primary Care

Decision Support

Nephrogenic Systemic Fibrosis (NSF) is a rare disease that has been described in patients with **renal insufficiency** receiving intravenous MRI contrast material (gadolinium). In rare cases NSF has resulted in lung or heart failure and patient death.

Patients with the following conditions may be at increased risk for severe renal insufficiency (eGFR <30) and therefore at increased risk for NSF.

- Personal or family history of kidney failure
- Diabetes Mellitus treated with oral hypoglycemic and/or insulin
- Multiple Myeloma or other paraproteinemia syndromes or diseases
- Lupus or other collagen vascular diseases

Other conditions that have been associated with NSF include:

- Current dialysis treatment
- Acute renal failure
- Hepatorenal syndrome
- Awaiting or 6 weeks status post liver transplantation
- End stage liver disease

More Info

Feedback

1) Do any of the above conditions apply?

◯ Yes ◯ No

2) Is the patient currently taking Cox-1 or Cox-2 inhibitors nonsteroidal anti-inflammatory drugs (e.g. naproxen, celecoxib, ibuprofen)?

◯ Yes ◯ No

This information is presented to assist you in providing care to your patients. It is your responsibility to exercise your independent medical knowledge and judgment in providing what you consider to be in the best interest of the patient.

Submit

Internet 100%

-- Webpage Dialog

artners.org/rule/ruleabout_view.jsp?rule=MRI_NSF_Screen&screen=1

Policy:

1.Guidelines for patients who are not on dialysis

When contrast-enhanced MR imaging is requested for a patient with renal insufficiency who is not on dialysis, the decision to administer gadolinium will depend on the severity of the renal insufficiency as follows:

- **eGFR > 60 (normal renal function):** The regular dose of gadolinium will be calculated using a weight-based FDA approved formula: 0.1 mmol/kg body weight [0.2ml/kg] with a maximum dose of 20 ml/patient. In some clinical situations, high dose injection will be used. Regardless of the dose used, no informed consent is necessary in these patients with eGFR above 60.

- **eGFR between 30-60 (mild to moderate renal failure):** Gadolinium will be administered using a weight-based FDA approved formula: 0.1 mmol/kg body weight [0.2ml/kg] with a maximum dose of 20 ml/patient. High dose injection should only be used when absolutely necessary (e.g. cardiovascular MRI exams, brain perfusion studies). Regardless of the dose used, no informed consent is necessary in these patients with eGFR between 30 and 60.

- When contrast-enhanced MR imaging is requested for a patient with **severe renal insufficiency, (eGFR <30)** alternative imaging, if possible, should be considered, to avoid use of gadolinium-based contrast agents. The decision to administer gadolinium should be made after consultation by a radiologist with the referring service. If the use of a gadolinium-based contrast agent is considered to be a medical necessity in these patients, the referring physician and the patient will be informed of the potential risks of developing NSF. An informed consent must be obtained from the patient prior to the administration of gadolinium using a consent form specifically developed for the administration of gadolinium in patients with severe renal impairment. The radiologist covering the MRI section protocolling the MRI study is responsible for obtaining the consent.

ers.org/rule/ruleabout_view.jsp?rule=MRI_NSF_Screen&screen=1

Internet

Case 23

- 25 y.o F with presentation suggestive of appendicitis. There is a 30% chance in your estimation that she has appendicitis. We have a test with 95% sensitivity, 95% specificity. The test is positive. What is the chance that she has appendicitis?

  <30% 30-75% 75-90% >90%

Case 24

- 25 y.o F with presentation unlikely of appendicitis. There is a 2% chance in your estimation that she has appendicitis. We have a test with 95% sensitivity, 95% specificity. The test is positive. What is the chance that she has appendicitis?

  <30% 30-75% 75-90% >90%

Prevalence 30%

	Appy	Normal appendix	P
Positive test	2850	350	0.89
Negative test	150	6650	0.98
Total	3000	7000	10000

Prevalence 2%

	Appy	Normal appendix	P
Positive test	190	490	0.28
Negative test	10	9310	0.999
Total	200	9800	10000

III. Recommendations

- Think of how the result of an imaging test may change the management of your patient BEFORE you request an examination
- Give as much clinical information as reasonable on the requisition
  - history more helpful than “rule out”s!!
  - blank requisition may result in a radiologist missing a subtle but important finding

III. Recommendations

- Use your radiologist as a consultant, this is her/his Job!!
- **Slides at http://cebi.partners.org**