INTRODUCTION TO ABDOMINAL IMAGING: RIGHT IMAGE FOR THE RIGHT PATIENT

Kristen Olinger, MD
Department of Radiology, UNC-CH
Abdominal Imaging
QUESTION:
T/F: Background radiation in the US is typically ~3 mSev/yr

QUESTION:
Which is the correct order for least expensive to most expensive imaging?
I: CT
II: MRI
III: US
IV: Radiographs

A: I, II, III, IV
B: IV, III, II, I
C: IV, III, I, II
D: IV, II, III, I

QUESTION:
Which of the following modalities is first line imaging for the reproductive system (ovaries, uterus, testicles)?

A: CT
B: MRI
C: US
D: Radiographs

QUESTION:
For which indication would a noncontrast CT be appropriate?
A: Diverticulitis
B: Renal calculus
C: Aortic dissection
D: Concern for metastatic disease

QUESTION:
T/F: NSF (nephrogenic systemic fibrosis) is associated with iodinated CT contrast.
OVERVIEW

- Overutilization
- Review of general scan limitations
- Review of each modality, pros and cons, common indications
GROWTH OF IMAGING

• In the past decade, imaging services and their cost have grown at twice the rate of other technologies in the health care industry
  • Radiation dose!
  • $$$

GROWTH OF IMAGING: DOSE CONCERNS

• Dose to the public
  • 1980: Medical radiation made up <25% of average total radiation dose to US residents
  • 2010: Medical radiation made up >50% of average total radiation dose to US residents
  • “...we must ensure that patients undergoing CT receive the minimum radiation dose possible to produce a medical benefit”
  • *LOWEST* dose for any given patient

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  • “…we must ensure that patients undergoing CT receive the minimum radiation dose possible to produce a medical benefit”
  • *LOWEST* dose for any given patient
  • *APPROPRIATE* dose for any given patient

**GROWTH OF IMAGING: DOSE CONCERNS**

- Radiology is measured in effective dose (millisieverts: mSv)
  - Refers to radiation risk averaged over the entire body
- Background radiation (cosmic radiation, radon): 3 mSv/year
- Effective dose may be used to estimated risk of cancer/cancer related death
- Risk levels: Additional risk of fatal cancer from an examination
  - **Negligible:** less than 1 in 1,000,000
  - **Minimal:** 1 in 1,000,000 to 1 in 100,000
  - **Very low:** 1 in 100,000 to 1 in 10,000
  - **Low:** 1 in 10,000 to 1 in 1,000
  - **Moderate:** 1 in 1,000 to 1 in 500
  - These risk levels represent a very small addition to the 1 in 5 chance we all have of dying from cancer
GROWTH OF IMAGING: DOSE CONCERNS

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Effective dose</th>
<th>Comparable for natural background radiation for:</th>
<th>Additional life risk of fatal cancer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intra-oral XR</td>
<td>0.005 mSv</td>
<td>1 day</td>
<td>Negligible</td>
</tr>
<tr>
<td>Extremity XR</td>
<td>0.001 mSv</td>
<td>3 hours</td>
<td>Negligible</td>
</tr>
<tr>
<td>Chest XR</td>
<td>0.1 mSv</td>
<td>10 days</td>
<td>Minimal</td>
</tr>
<tr>
<td>Spine XR</td>
<td>1.5 mSv</td>
<td>6 months</td>
<td>Very low</td>
</tr>
<tr>
<td>Head CT</td>
<td>2-4 mSv</td>
<td>8-16 months</td>
<td>Low</td>
</tr>
<tr>
<td>Chest CT</td>
<td>1.5-7 mSv</td>
<td>6 months-2 years</td>
<td>Very low to low</td>
</tr>
<tr>
<td>Abdominopelvic CT</td>
<td>10-20 mSv</td>
<td>3-7 years</td>
<td>Low to moderate</td>
</tr>
<tr>
<td>PET-CT</td>
<td>25 mSv</td>
<td>8 years</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

- New software and dose reduction protocols are continually evolving
- Doses vary with scan technique and patient size
GROWTH OF IMAGING: COST OF EXAMS

- Conventional Radiography (X-ray): $149-$388
  - Two view chest x ray: $207
  - 4 views of the knee: $266
- Ultrasound: $386-1360
  - Breast ultrasound: $386
  - Abdominal ultrasound: $783
  - Carotid Doppler: $1360
- CT: $1072- $1832 per body part!
  - CT CAP w/wo contrast: $5322!
- MR: $1555 - $4547
  - Brain MR: $2189
  - Abdominal MRI w/wo contrast: $4547

"You see, Ms. Jenkins, by doubling up on patients in the MRI, we're able to cut costs in half, thereby passing the savings on to you."
GROWTH OF IMAGING: OVERUTILIZATION

• **Overutilization**: applications of imaging procedures where circumstances indicate that they are unlikely to improve patient outcome

• **Why does it happen?**
  - Self referral
  - Defensive medicine
  - Lack of comprehensive/accessible practice guidelines
  - Referring physicians
  - Radiologists
  - Patients

YOUR OPTIONS...

X-ray  Ultrasound  CT  MR
YOUR OPTIONS…

X-ray  Ultrasound  CT  MR

What views?
YOUR OPTIONS…

- X-ray
- Ultrasound
- CT
- MR

Limitations?
YOUR OPTIONS...

- X-ray
- Ultrasound
- CT
- MR

- IV Contrast?
- PO Contrast?
- What type of CT?
YOUR OPTIONS…

X ray
Ultrasound
CT
MR

IV Contrast?
YOUR OPTIONS…

- X-ray
- Ultrasound
- CT
- MR

IV Contrast?

- NSF
- Gadolinium deposition
- Renal function
YOUR OPTIONS…

X-ray
- Views?

Ultrasound
- Limitations?

CT
- IV?
- PO?
- Protocol?

MR
- IV Contrast?
- NSF
- Gadolinium deposition
- Renal function
RESOURCES AT YOUR DISPOSAL

• ACR Appropriate Criteria
  • https://www.acr.org/Quality-Safety/Appropriateness-Criteria
RESOURCES AT YOUR DISPOSAL

- Your radiologist!!!!
CONVENTIONAL RADIOGRAPH (X-RAY)

Pros:
- Cheap
- Relatively low radiation dose
- Readily accessible
- Clinician friendly

Cons:
- Limited sensitivity
- Possibly over utilized
- False positives
- Unsatisfying reports!
CONVENTIONAL RADIOGRAPHS

• Unsatisfying reports
  • “Thin lucency in the proximal tibia, possibly non-displaced fracture. Correlate for point tenderness”
  • “Left lower lobe consolidation may represent atelectasis, pneumonia or edema; cannot exclude underlying mass lesion”
  • “Further evaluation with CT of the ______ is recommended”
  • “Non specific finding. Clinical correlation recommended…”
CONVENTIONAL RADIOGRAPH

Non specific lobulated left lower lobe mass, possibly loculated fluid, pleural based mass, neoplasm, infection. .... Recommend correlation with CT of the chest.
CONVENTIONAL RADIOGRAPH

Multiloculated collection in the pleural space consistent with empyema
CONVENTIONAL RADIOGRAPH

- Specific views and patient positioning may be helpful
  - Upright chest x ray: Pneumoperitoneum
  - Expiratory upright film: Pneumothorax
  - Decubitus films: Layering effusion, pneumoperitoneum
  - Upright abdominal x ray: Small bowel obstruction
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Expiration

Inspiration

Image courtesy of Saint Vincent's University Hospital
CONVENTIONAL RADIOGRAPH

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  - Expiratory upright film: Pneumothorax
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CONVENTIONAL RADIOGRAPH

- Easily accessible
- Not always sensitive or specific
- Specific views may answer specific clinical questions
- You get what you pay for!
ULTRASOUND

Pros

- No radiation
- "Real time" imaging: blood flow, peristalsis, etc
- Cheap (relatively speaking)

Cons

- Operator dependent
- Patient dependent
  - Body habitus
  - Positioning
  - Breath hold
ULTRASOUND LIMITATIONS: BODY HABITUS

BMI 24

BMI 49
ULTRASOUND LIMITATIONS: BOWEL GAS
ULTRASOUND: LIMITATIONS

<table>
<thead>
<tr>
<th>High Frequency ultrasound</th>
<th>Low Frequency ultrasound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good spatial resolution</td>
<td>Worse spatial resolution</td>
</tr>
<tr>
<td>Superficial penetration</td>
<td>Deep penetration</td>
</tr>
</tbody>
</table>

**Superficial structures**
- Thyroid
- Subcutaneous
- Breast
- Lymph nodes
- Superficial vessels

**Deeper structures**
- Abdominal organs
ULTRASOUND: SUPERFICIAL STRUCTURES

THYROID NODULE

Cervical lymph nodes
ULTRASOUND: SUPERFICIAL STRUCTURES

LONG THYROID RT LOBE MEDIAL

Cervical lymph nodes

THYROID NODULE
ULTRASOUND: DYNAMIC IMAGING

Left inguinal hernia with Valsalva
ULTRASOUND: DYNAMIC IMAGING

Left inguinal hernia with Valsalva
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ULTRASOUND: DYNAMIC IMAGING

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ULTRASOUND: DYNAMIC IMAGING

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ULTRASOUND: DYNAMIC IMAGING

Left inguinal hernia with Valsalva
ULTRASOUND: VASCULAR EVALUATION

- Cirrhotic patient: TIPS evaluation

Elevated velocities through TIPS indicative of stent malfunction
ULTRASOUND: BILIARY TREE

Intrahepatic biliary ductal dilatation

Normal caliber common bile duct
ULTRASOUND: BILIARY TREE

Intrahepatic biliary ductal dilatation

Normal caliber common bile duct
ULTRASOUND: GALLBLADDER/BILIARY TREE

- Incidental gallstone
ULTRASOUND: GU IMAGING

- First line modality:
  - Uterus
  - Ovaries
  - Testicles
  - Superficial structures

- Why?
  - Good soft tissue contrast
  - No radiation
ULTRASOUND: GU EVALUATION: UTERUS

- Post menopausal bleeding

III defined uterine mass, possibly leiomyoma although neoplasm cannot be excluded. Recommend ultrasound for further evaluation...
ULTRASOUND: GU EVALUATION: UTERUS

- Post menopausal bleeding

Indefinite uterine mass, possibly leiomyoma although neoplasm cannot be excluded:
Recommend ultrasound for further evaluation...
ULTRASOUND: GU EVALUATION: UTERUS

FIGO grade II endometrial adenocarcinoma involving 81% of the myometrium
FIGO grade II endometrial adenocarcinoma involving 81% of the myometrium
ULTRASOUND: GU EVALUATION: TESTICLES

- 13 year old male with testicular pain
ULTRASOUND: GU EVALUATION: TESTICLES

- 13 year old male with testicular pain

Right sided testicular torsion
ULTRASOUND: GU EVALUATION: KIDNEYS

• Useful:
  • Stones (sometimes)
  • Hydronephrosis
  • Cysts (sometimes)

• Not useful:
  • Characterizing solid renal masses (except CEUS)
  • Ureteral stones (sometimes)
ULTRASOUND: HYDRONEPHROSIS
ULTRASOUND: NEPHROLITHIASIS
ULTRASOUND: SOLID VERSUS CYSTIC

Characteristics of a cyst

1. Anechoic = “black”
2. Posterior acoustic enhancement = “bright shadow”
3. No blood flow
4. Nothing in it

Multiple simple renal cysts

Simple cyst
ULTRASOUND: SOLID VERSUS CYSTIC

Characteristics of a cyst

1. Anechoic = “black”
2. Posterior acoustic enhancement = “bright shadow”
3. No blood flow
4. Nothing in it

Simple cyst  Mildly complex cysts
ULTRASOUND: GU: KIDNEYS

- 79 year old female with acute kidney injury

Characteristics of a cyst
1. Anechoic = “black”
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Simple cyst  Mildly complex cysts
79 year old female with acute kidney injury

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Simple cyst  |  Mildly complex cysts
ULTRASOUND: GU: KIDNEYS

- 79 year old female with AKI

Renal cell carcinoma
ULTRASOUND: GU: EVALUATION OF KIDNEY

- 71 year old male with right upper quadrant pain
ULTRASOUND: GU: EVALUATION OF KIDNEY

- 71 year old male with right upper quadrant pain
ULTRASOUND: GU: EVALUATION OF KIDNEY

- 71 year old male with right upper quadrant pain

Clear cell renal cell carcinoma: 5 cm
ULTRASOUND: GU EVALUATION: KIDNEYS

- **Uses**
  - Hydronephrosis: Very good
  - Calculi: Good (renal caluli, not necessarily ureteral calculi)
  - Cysts: Okay (simple cysts, non-obese patient)
  - Masses (detection and characterization): Poor
ULTRASOUND

• First line imaging modality
  • Vascular pathology
  • Dynamic "real time" imaging
  • Biliary pathology
  • Uterus, ovaries, testicle
  • Kidneys (sometimes)

• NOT useful for
  • Characterizing solid lesions
  • Detection of occult pathology outside of the probe’s range
  • Penetrating extensive fat/gas
COMPUTED TOMOGRAPHY

Pros
Quick
Easily accessible
“Screening test”

Cons
Radiation: doses are 100-500x those of conventional radiograph
IV contrast
CT CONTRAST AGENTS

- At risk patients: BUN/Creatinine recommended within 30 days of the exam IF...
  - >60 year old
  - History of renal disease
    - Dialysis
    - Renal transplant
    - Single kidney
    - Renal cancer
    - Renal surgery
  - Hypertension requiring medical therapy
  - History of diabetes
  - Metformin use
- No universal cutoff- will vary with institution
  - Range of serum creatinine 1.5-2.0, we go by GFR

We use GFR cutoff of 30 at UNC

CT CONTRAST AGENTS: WHEN TO AVOID IT

- Risk factors for contrast induced nephropathy…
  - Repeated doses (20 hours to clear contrast from system)
  - Acute renal injury
  - Dehydration
  - Radiologist is consulted to determine if contrast is needed or if situation can be optimized

- DIALYSIS
  - If the patient is on hemodialysis AND anuric, IV contrast can be given
  - If the patient is still making urine, proceed cautiously

- PREVENTION
  - Hydration: oral or IV, no ideal rate
  - Sodium bicarbonate and Nacetylcysteine (mucormyst) not validated
  - **Acute renal failure is a contraindication to IV contrast**
CT CONTRAST AGENTS: PREMEDICATION

- Reactions to contrast agents
  - **Mild** (no treatment): 5-8% of patients (flushing, nausea, vomiting)
  - **Moderate** (require treatment): 1% of patients (severe nausea/vomiting, hives, swelling)
  - **Severe** (require treatment): 0.1% of patients (anaphylaxis)
    - Expected death rate of 1 in 75,000¹
  - “Pseudo-allergy”: No allergic antibody- IV contrast causes histamine release from mast cells

CT CONTRAST AGENTS: PREMEDICATION

- Contrast reaction: At risk patients
  - Prior reaction
  - Shellfish allergy does not necessitate premedication

- Premedication:
  - 13 hours prior: Prednisone 50 mg (IV or po)
  - 7 hours prior: Prednisone 50 mg (IV or po)
  - 1 hour prior: Prednisone 50 mg (IV or po) and Diphenhydramine (Benadryl) 50 mg po

- “Emergency” premedication
  - Q4 hours until injection: 40 mg Methylprednisolone succinate (Solu-medrol) or 200 mg hydrocortison sodium succinate (Solu-Cortef)
  - 1 hour prior: 50 mg diphenhydramine (Benadryl)

- Steroid less effective when given less than 4-6 hours prior to exam

CT CONTRAST: METFORMIN, BREASTFEEDING

- **Metformin**
  - Acute renal failure caused by IV contrast can lead to an accumulation of metformin, resulting in lactate accumulation/lactic acidosis
  - Hold metformin for 48 hours post injection

- **Breastfeeding**
  - >1% of the dose is excreted in breast milk
  - >1% of the contrast in breast milk is absorbed from the GI tract
  - 0.01% of dose ingested by infant
  - If the mother is concerned, she may abstain from breast feeding for 24 hours
CT: WHEN AND WHY OF CONTRAST AGENTS

- **Principle**: Increased attenuation (brightness) from the iodine atom in contrast = “enhancement”
  - Magnitude of enhancement is related to amount of contrast deposited in a target organ or in the intravascular blood pool

- **Variables in enhancement**
  - Rate of injection
  - Cardiac output of the patient
  - Organ perfusion (i.e. single versus dual blood supply)
  - Timing of imaging

- **When do we use it?**
  - Vascular imaging
  - Infectious/inflammatory processes
  - Neoplasm

Herman, S. Computed Tomorgraphy Contrast Enhancement Principles and the Use of High Concentration Contrast Media. J Comput Assist Tomogr 2004; 28: S7-S11
CT: WHEN AND WHY OF CONTRAST AGENTS

- Getting a diagnostic scan...
  - Appropriate *use* of IV contrast
  - Appropriate *timing* of IV contrast
- Based on clinical history, a scan protocol is chosen to optimize the diagnostic yield
  - Precontrast imaging?
  - Multiple phases of imaging?

**ADULT BODY CT PROTOCOLS**

<table>
<thead>
<tr>
<th>CONTENTS:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Page</td>
<td>3</td>
</tr>
<tr>
<td>Abdomen-Single Phase (Survey)</td>
<td>4</td>
</tr>
<tr>
<td>Abdomen-Dual Phase</td>
<td>5</td>
</tr>
<tr>
<td>Abdomen-Triple Phase</td>
<td>6</td>
</tr>
<tr>
<td>Abdomen-Four Phase</td>
<td>7</td>
</tr>
<tr>
<td>Abdomen/Pelvis-Single Phase</td>
<td>8</td>
</tr>
<tr>
<td>Abdomen/Pelvis-Single Phase with Pelvic Focus</td>
<td>9</td>
</tr>
<tr>
<td>Abdomen/Pelvis-Dual Phase</td>
<td>10</td>
</tr>
<tr>
<td>Chest/Abdomen/Pelvis-Single Phase</td>
<td>11</td>
</tr>
<tr>
<td>Adrenal Mass: Non-Pheochromocytoma</td>
<td>12, 13</td>
</tr>
<tr>
<td>Adrenal Mass: Suspected Pheochromocytoma Only</td>
<td>14</td>
</tr>
<tr>
<td>Kidneys: Renal Stone</td>
<td>15</td>
</tr>
<tr>
<td>Kidneys: Renal Mass</td>
<td>16</td>
</tr>
<tr>
<td>Kidneys: Infection (Pyelonephritis)</td>
<td>17</td>
</tr>
<tr>
<td>GU Tract: CT IVP (Urogram)</td>
<td>18</td>
</tr>
<tr>
<td>GU Tract: Cystography</td>
<td>19</td>
</tr>
<tr>
<td>Pancreas Mass</td>
<td>20</td>
</tr>
<tr>
<td>Pelvis-Single Phase (Survey)</td>
<td>21</td>
</tr>
<tr>
<td>Pelvis-Rectal Contrast</td>
<td>22</td>
</tr>
<tr>
<td>Trauma</td>
<td>23</td>
</tr>
<tr>
<td>Abdomen/Pelvis (Retropertoneal Hemorrhage)</td>
<td>24</td>
</tr>
<tr>
<td>Unenhanced Abdomen/Pelvis (Not the same as renal stone protocol)</td>
<td>25</td>
</tr>
<tr>
<td>CT Enterography</td>
<td>26, 27</td>
</tr>
<tr>
<td>Aortic Aneurysm-Pre EVR</td>
<td>28</td>
</tr>
<tr>
<td>Aortic Aneurysm-Post EVR</td>
<td>29, 30</td>
</tr>
<tr>
<td>CTA Chest (Thoracic Aortic Dissection – ECG Gated)</td>
<td>31</td>
</tr>
<tr>
<td>CTA Abdomen/Pelvis (Abdominal Aortic Dissection – ECG Gated)</td>
<td>32</td>
</tr>
<tr>
<td>CTA Chest/Abdomen/Pelvis (Aortic Dissection – ECG Gated)</td>
<td>33</td>
</tr>
<tr>
<td>Renal Artery Stenosis</td>
<td>34</td>
</tr>
<tr>
<td>Renal Artery – Pre-renal Transplant Evaluation (CP)</td>
<td>35</td>
</tr>
<tr>
<td>CTA Abdomen</td>
<td>36</td>
</tr>
<tr>
<td>CTA Runoff</td>
<td>37</td>
</tr>
<tr>
<td>CTA Upper Extremity</td>
<td>38</td>
</tr>
<tr>
<td>Thoracic Aorta CTA</td>
<td>39</td>
</tr>
<tr>
<td>Pulmonary CT Angiogram</td>
<td>40</td>
</tr>
<tr>
<td>Post-transplant CT Angiography</td>
<td>41</td>
</tr>
</tbody>
</table>
CT CONTRAST AGENTS: TIMING IS EVERYTHING

Same patient: Two lesions

Precontrast  Late arterial  Portal venous  Equilibrium
CT CONTRAST AGENTS: TIMING IS EVERYTHING

Same patient: Two lesions

METASTATIC DISEASE

HEMANGIOMA
CT CONTRAST: VASCULAR IMAGING
CT CONTRAST: VASCULAR IMAGING

Filling defect = pulmonary emboli

Bowed interventricular septum = Right heart strain
CT CONTRAST: INFECTION/INFLAMMATION

- With contrast: Diverticulitis with intramural abscess
CT CONTRAST: NEOPLASM

- Pancreatic neuroendocrine tumor: Without and with contrast

No contrast: No tumor!  Pancreatic protocol CT: TUMOR
CT: IV CONTRAST: WHEN DON’T WE WANT IT?

• What is bright on CT?
  • Blood
  • Calcium
  • Iron
  • Foreign bodies
CT: IV CONTRAST: WHEN DON’T WE WANT IT?

- What is bright on CT?
  - Blood
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  - Iron
  - Foreign bodies
CT: IV CONTRAST: WHEN DON’T WE WANT IT?

• What is bright on CT?
  • Blood
  • Calcium
  • Iron
  • Foreign bodies

Retroperitoneal hematoma
CT: IV CONTRAST: WHEN DON'T WE WANT IT?

- What is bright on CT?
  - Blood
  - Calcium
  - Iron
  - Foreign bodies
CT: IV CONTRAST: WHEN DON’T WE WANT IT?

- What is bright on CT?
  - Blood
  - Calcium
  - Iron
  - Foreign bodies

Left UVJ stone
CT: IV CONTRAST: WHEN DON’T WE WANT IT?

- What is bright on CT?
  - Blood
  - Calcium
  - Iron
  - Foreign bodies
CT: IV CONTRAST: WHEN DON’T WE WANT IT?

- What is bright on CT?
  - Blood
  - Calcium
  - Iron
  - Foreign bodies
CT: SUMMARY

- **IV contrast useful...**
  - Vascular imaging
  - Infection/inflammation
  - Neoplasm

- **IV contrast not useful...**
  - Calcium (renal stones)
  - Blood (RPhematoma)
  - Iron/Foreign body

- A specific clinical history aids with scan protocolling
MAGNETIC RESONANCE IMAGING

Pros

- No radiation
- Highly diagnostic modality
- Excellent soft tissue contrast
- Histologic information: fat, water, iron, fibrosis
- Functional information: perfusion, peristalsis, cardiac output

Cons

- Costs
- Long scan times
- Limited accessibility
- IV contrast

Costs
- Long scan times
- Limited accessibility
- IV contrast
MRI: PROS AND CONS

• **Limitations: Patient**
  - Enclosed space for up to one hour?
  - Lying on their back
  - Loud noises

• **Limitations: Radiologist and system**
  - Subspecialized reading
  - Longer scan times
  - Limited availability/varying magnets

• **Solutions**
  - Stereovision
  - Gentle use of anxiolytics
  - More MR-trained radiologist/subspecialized reads

“OK, Mrs. Dunn. We’ll slide you in there, scan your brain, and see if we can find out why you’ve been having these spells of claustrophobia.”
MRI: CATEGORIES AND CONTRAST AGENTS

- **Multiple types of MRI**
  - Neurologic: Brain, neck and spine
  - Abdominopelvic
  - Musculoskeletal
  - Vascular imaging
  - Cardiac imaging
  - And more!

- **Pelvic MRI: Be specific!**
  - Prostate MRI?
  - Rectal MRI?
  - MSK MRI?
  - All three are ordered as a pelvic MRI
MRI CONTRAST AGENTS: NEPHROGENIC SYSTEMIC FIBROSIS

• “Fibrosing disease, predominantly of the skin and subcutaneous tissue, but also other organs, which may develop and progress rapidly, possibly causing death”

• Occurs with ESRD in association with gadolinium based IV contrast materials
  • Amount of gadolinium given (per scan and accumulated dose)
  • eGFR <30 have a 1-7% chance of developing NSF

• Has developed in patients with AKI even if renal function returned to normal

• Declining incidence with use of macrocyclic contrast agents

• Controversial topic! Be alert for changing literature

MRI CONTRAST AGENTS: NSF

- When can we give contrast?
  - ESRD on chronic HD:
    - Is CT possible instead of MR?
    - If MR must be performed, we choose least offensive contrast agent and lower dose
    - Consider hemodialysis ASAP
  - ESRD (GFR <15), not on HD
    - Avoid both MR and CT contrast agents if at all possible
    - If must be given, lower dose, etc

MRI CONTRAST AGENTS: NSF

- **Screening requirements:** require BUN/Creatinine within 30 days of exam
  - Age >60 years
  - Hypertension
  - Renal disease

- **GFR Guidelines**
  - GFR <15: No IV contrast
  - GFR 15-30: Use a lower risk contrast agent (Doderone, Multihance)
  - GFR >30: No problem!

- Certain contrast agents have few, if any reported cases of NSF
  - Multihance
  - Dotarem
  - Gadavist
  - Prohance
MRI CONTRAST AGENTS: NSF

• **Screening requirements:** require BUN/Creatinine within 30 days of exam¹
  - Age >60 years
  - Hypertension
  - Renal disease

• **GFR Guidelines**
  - GFR <15: No IV contrast
  - GFR 15-30: Use a lower risk contrast agent (Doderone, Multihance)
  - GFR >30: No problem!

• **Certain contrast agents have few, if any reported cases of NSF**
  - Multihance
  - Dotarem
  - Gadavist
  - Prohance
  - Used at UNC
GADOLINIUM DEPOSITIONAL DISORDER

- High signal in brain tissue in patients with normal renal function
  - Associated with repeated doses of gadolinium
  - No known adverse effects
- Certain contrast agents not associated with this
  - Dotarem (used at UNC)
  - Prohance

- However, as led to a more cautious use of gadolinium contrast agents

MRI CONTRAST AGENTS: PREGNANCY AND BREASTFEEDING

- **Pregnancy:**
  - “Present data has not conclusively document any deleterious effects of MR imaging on the developing fetus”\(^1\)
  - Avoid in first trimester (not evidence based)
  - IV contrast DOES cross the placenta and is not given at our institution in pregnancy

- **Breastfeeding:**
  - >0.04% of the IV dose in breast milk \(^2\)
  - >1% of the contrast in breast milk is absorbed across the GI tract\(^2\)
  - Expected dose to infant <0.0004% of IV dose\(^2\)
  - If the mother is concerned, she may abstain from breastfeeding for 24 hours

MRI CONTRAST AGENTS: WHEN AND WHICH ONE

• Varying contrast agents available
  • Dotarem
  • Multihance
  • Eovist

• Indications: similar to CT
  • Vascular imaging
  • Infection
  • Inflammation
  • Neoplasm
MR- BODY IMAGING

• Please keep in mind that this is problem solving modality, not a screening modality

• The more specific the clinical history, the better the exam will be!

• Common indications
  • Because the radiologist told you needed one
  • Characterization of a lesion
  • Evaluation of the biliary tree
  • Follow up of treated disease
  • GU: Female pelvis, prostate (NOT CT!)
  • Imaging the bowel (small bowel, rectum)

• Emerging indications
  • Tissue composition (iron, fat, fibrosis)
MRI: LESION CHARACTERIZATION

Indeterminate hepatic lesion
MRI: LESION CHARACTERIZATION

Focal steatosis
MRI: IMAGING THE BILIARY TREE

Pancreatic duct

Pancreatic divisum
MRI: IMAGING THE BILIARY TREE

Pancreatic divisum
Magnetic Resonance Imaging (MRI): Imaging the Biliary Tree

Pancreatic duct

Pancreatic divisum
MRT: IMAGING THE BILIARY TREE

Pancreatic duct

Pancreatic divisum
MRI: IMAGING THE BILIARY TREE

Pancreatic duct

Pancreatic divisum
MRI: IMAGING THE BILIARY TREE

Pancreatic duct

Pancreatic divisum
MRI: IMAGING THE BILIARY TREE

Pancreatic duct

Pancreatic divisum
MRI: IMAGING THE BILIARY TREE

Pancreatic divisum

Pancreatic duct
MRI: IMAGING THE BILIARY TREE

Pancreatic divisum
MRI: IMAGING THE BILIARY TREE

Pancreatic duct

Pancreatic divisum
Bicornuate uterus
MRI: IMAGING THE FEMALE PELVIS

Bicornuate uterus
MRI: IMAGING THE MALE PELVIS

PROSTATE CANCER
MRI: IMAGING THE MALE PELVIS

PROSTATE CANCER
MRI IMAGING: TISSUE COMPOSITION

• Liver
  • Fat content
  • Iron content
  • Fibrosis

• Bowel
  • MR enterography
  • Rectal MR

• MRI is a rapidly expanding and changing field. If you want to know if we can do it - just ask!!!
QUICK NOTE ABOUT FLUOROSCOPY

- Contrast agents:
  - Concern for intraperitoneal leak? → Use water soluble contrast
  - Routine, outpatient? → Barium “double contrast” with air

- Bowel:
  - Esophagram
  - UGI
  - UGI + SBFT
  - Barium enema
  - Defecogram

- Urinary tract:
  - VCUG
  - RUG
  - Loopograms
YOUR RADIOLOGIST

• Clinician feedback
  • Reports
    • Relevant? Unclear?
  • Imaging problems
    • Patient complaints?
    • Didn’t give you an answer
  • Pathology and/or clinical follow up
    • Were we right or wrong?

• You are our target population with our imaging and reports- let us know how we can improve and make your life easier!
TAKE HOME POINTS

• Overutilization is a real but solvable problem if a partnership exists between the clinician and radiologist

• There are many different imaging modalities at your disposal with varied resources to help advise you
  • ACR appropriateness criteria
  • Radiologist

• When considering appropriate scan for each patient
  • Appropriate radiation dose
  • Scan limitations
  • Patient limitations

• Clinician feedback is critical for imaging and service improvement.
QUIZ POST

QUESTION:
T/F: Background radiation in the US is typically ~3 mSv/yr

QUESTION:
Which is the correct order for least expensive to most expensive imaging?

<table>
<thead>
<tr>
<th>I: CT</th>
<th>II: MRI</th>
<th>III: US</th>
<th>IV: Radiographs</th>
</tr>
</thead>
</table>

A: I, II, III, IV
B: IV, III, II, I
C: IV, III, I, II
D: IV, II, III, I

QUESTION:
Which of the following modalities is first line imaging for the reproductive system (ovaries, uterus, testicles)?

A: CT
B: MRI
C: US
D: Radiographs

QUESTION:
For which indication would a noncontrast CT be appropriate?

A: Diverticulitis
B: Renal calculus
C: Aortic dissection
D: Concern for metastatic disease

QUESTION:
T/F: NSF (nephrogenic systemic fibrosis) is associated with iodinated CT contrast.

FALSE! MRI agents
THANK YOU!
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