Clinical Radiology: A Pragmatic Perspective

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Agenda

- Background
- Clinical Approach (Tool in your Toolbox)
- Inherent Limitations of Imaging
- Hierarchy of Imaging Utilization
- Review of Cases – Pragmatic Application
- Discussion

Clinical Practice – The Art of Hypothesis
Seeing Into the Black Box

Traditional Radiology Education

- Wilhelm Roentgen
- X-rays penetrate matter, and the physical density of the matter they penetrate dictate the lucency or opacity of the particular structures, creating in essence a relevant picture.
- MRI – (T1, T2, Fat-suppression, Stir-echo, etc)
- Focus on “Radiology” or the “Clinical Relevance” of Radiology?
Historical Perspectives

- Using a barium platinocyanide-treated screen and a Crookes tube, Roentgen produced an image of a lead disk—and the bones of his fingers holding the disk.
- His experiments showed that X rays pass through different materials to different degrees.

Scotty Dog

Didactic vs Pragmatic
Traditional Radiology Education: Case Presentation

- Radiology Vignettes
  - An imaging picture is provided
  - A case with clinical background is given
  - The area of interest is identified & discussed
  - Missed diagnosis
  - An unusual finding
  - Example of the value of imaging modality choice and multiple views

Radiology Vignettes

Kraig, 2012, University of Missouri Radiology Department

What is This?

Case Study on Helix
Vignette Case Drawback

- Clinical reasoning decisions during actual clinical encounters tend to follow a different process.
  - You aren’t sure if there even is pathology
  - There may be irrelevant pathology
  - Much more information is provided than just a focused section of a 2-dimensional image
  - The encounter is much more interactive
  - Retrospective review of a “singled out” case

Pragmatic Approach

- Requires that the user have a sound understanding of the limitations of imaging
- Stronger clinical skills usually results in better use of diagnostic imaging (highest yield, increased efficiency)

Would you Rely on this Alone?

- POSITIVE LACHMANS
Clinical Approach - Puzzle

- “Positive Lachman’s Test”
- 15 year old female vs a 66 year old male
- Recalls clear MOI versus unsure of MOI
- Complains of “giving way”, “locking”, or instability
- Progression of symptoms since onset
- Impact on function and ADLs

Segond Sign

- Do the questions in the prior slide bring relevance to this radiograph?

Degenerative Changes in the Tibiofemoral Joint
4 patients sustained C4-C5 or C5-C6 injuries

The unstable cervical spine injuries were only shown when the patients were in a loaded position.

Imaging for Screening

- Good screening tests should have high sensitivity. This helps you Rule Out the condition. While you might not know what the exact diagnosis is, you feel better that they DON’T have the condition you are screening for (fracture, neoplasm, etc)
- Many studies show that radiographs have less than optimal sensitivity. Ironically, we use radiographs often to screen for conditions.

Screening

Clinical Decision Rules
Sensitivity = 0.90 to 1.00
(SR of 15 studies – Michaleff, CMAJ, 2012)

1. Does the patient have any high-risk factor that mandates radiography?
   - Age ≥ 65
   - Dangerous mechanism
   - Paresthesias in extremities

   **No**

2. Does the patient have any of the following low-risk factors allow safe assessment of range of motion?
   - Simple rear-end MVA
   - Assumes sitting position in waiting room
   - Ambulatory at any time
   - Delayed onset of neck pain
   - Absence of midline C-spine tenderness

   **Yes**

3. Is the patient able to actively rotate the neck 45° to the left and right?

   **Yes**

**Dangerous mechanisms**
- Fall from ≥ 1 m or ≥ 5 stairs
- Axial load to head (e.g. diving)
- Motorized recreational vehicles
- Bicycle collision

**Non-Simple MVA**
- Pushed into oncoming traffic
- Hit by bus/large truck
- Hit by high-speed vehicle

**OTTAWA ANKLE RULES**

Sensitivity = almost 100%
(meta-analysis of 27 studies – Bachman, BMJ, 2003)

**Imaging for Screening**

- Most studies performed in ER setting
- Most studies related to trauma/fracture
Other Screening Examples

2 Important Questions

- Is the finding present?
- If so, is the finding relevant?

Maybe more important than not missing something is, what it means when you do find something.

Radiologist Bias

- Attribution Bias
- Availability Bias
- Commission/Omission Bias
- Conformation Bias
- Framing Bias
- Hindsight Bias
- Regret Bias
- Satisfaction of Search Bias

Gunderman, AJR, 2009
Radiologists shifted more of their diagnoses toward higher suspicion than expected by chance.

Mean sensitivity for diagnosing PE
GROUP A: 75%
GROUP B: 60%

Dangers of Imaging
- Other than things like ionizing radiation, imaging can significantly influence patient perception
  - Severity of problem
  - Nature of problem
  - Promote Fear Avoidance & Pain Catastrophizing Beliefs

So Why All the Imaging?
Does it Change the My Approach?

No clinically significant difference in pain or function between those who received immediate lumbar spine imaging vs usual care.

Guidelines

- CDR
- Ottawa Ankle Rules
- C-Spine
- Ottawa Knee Rules
- US Low Back Pain Management Guidelines
- Appropriateness Criteria
Despite guidelines – poor adherence
- 40% of family medicine physicians ordered imaging for LBP when not indicated
- 13% of internists did the same
- 1/3 of providers in another survey ordered even when they knew it wasn’t indicated.
Hierarchy

- Initial
  - X-ray
- Secondary
  - MRI
  - CT
  - Ultrasound
  - Bone Scan

Appropriateness Criteria

- American College of Radiology
- Musculoskeletal Imaging

This doesn't solve the problem of “WHEN” to order, but rather “WHAT” to order after the decision to order has already been made.
Appropriate Modality

- The construct is important to understand
- Reality is that your radiologist is equipped and trained in choosing the modality of choice.

Most Powerful Tools

- A carefully planned and executed subjective examination
- Objective examination

“Joke, but I only half joke, that if you come to one of our hospitals missing a limb, no one will believe you till they get a CAT scan, MRI or orthopedic consult.”

(Abraham Verghese – Ted Talk)

Case Review

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<tr>
<th>Combat Setting</th>
<th>CONUS</th>
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<tbody>
<tr>
<td>MT Fracture</td>
<td>TMJ Neoplasm</td>
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<tr>
<td>Radial Head Fracture</td>
<td>Hip Neoplasm</td>
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<tr>
<td>Maisonneuve Fracture</td>
<td>Back Pain - Report</td>
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<td>Shrapnel Injuries</td>
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