Evidence Based Trauma Radiology

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Disclosure:

Book Royalties, Springer-Verlag

Evidence Based Imaging: Optimizing Imaging for Patient Care

Evidence Based Imaging in Pediatrics: Optimizing Imaging for Patient Care
Quality in Medicine

- IOM 1999 report:
  - “To err is human: Building a safer health system”
- Preventable deaths
  - 44,000 to 98,000 in medical centers/year in US
- Research
  - Omission, commission, communication

Rising Healthcare Costs
Health Care as % Gross Domestic Product (GDP)
What We Get for All Those Dollars

• U.S. over 17% of GDP for health care is:
  ▪ 2X developed country avg. of 8.3%
  ▪ 50% higher than #2 Switzerland

• WHO report, 2003 – U.S.:
  ▪ Has the 37th best health care in the world
  ▪ Ranks 47th in life expectancy
  ▪ Ranks 42nd in infant mortality
  ▪ Worse than all Nordic countries

Healthcare Expenditures

<table>
<thead>
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<th>% GDP 2003</th>
<th>Five year increase (%)</th>
<th>Per capita ($)</th>
<th>Life expectancy</th>
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Current State

- Cottage industry
  - Prior to industrial revolution
  - Individual artisans
  - Customized care
  - Fragmented
  - Only 50% evidence supported care
  - 20% of provided care unnecessary

Swensen, NEJM 2010

Growth in Imaging Procedures

Swensen, NEJM 2010
Radiation

• CT now largest source of medical radiation
  ▪ CT most rapidly rising
• Over 50% variation in imaging rates in US regions
• Increasing awareness and scrutiny
• Emergency radiology perceived as a major source of overutilization

Parker, AJR 2008

Objectives

• Introduce Evidence Based Imaging
• Apply EBI to trauma radiology
  ▪ Who should undergo imaging?
    • Clinical prediction rules
  ▪ How should we image?
• Future of EBI
Evidence Based Medicine

- McMaster/Oxford mid-1990s
- Medical decision making based on “integration of best research evidence with clinical expertise and patient values”

Sackett, et al. Evidence-Based Medicine 2000

Evidence Based Medicine

- Ask- answerable question
- Search- relevant literature
- Appraise- literature critically
- Summarize- evidence
- Apply- evidence to guide action
Ask

• “Is head CT useful in trauma patients?”

PICO

- Patient
- Intervention
- Comparison
- Outcome
Ask

• “Is head CT useful in trauma patients?”
• In young neurologically intact trauma victims, is unenhanced head CT superior to clinical exam for the detection of surgically important intracranial injury?

Search

• Comprehensive
• Unbiased
• Search is “subject recruitment”
• PubMed
• Embase
• Medical librarian
Appraise

- Critical assessment
- Predefined criteria
  - STARD
  - QUADAS
- New skill set
  - Limited experience in training
- Determine included papers

Summarize

- Meta-analysis
  - Requires multiple similar high quality studies
- Formal pooling of results
- Summary of differences
Apply

• Institute evidence based best practices

Evidence Based Medicine v. Eminence Based Medicine

• Systematic
• Critical
• Transparent
Challenges with EBM

- Too little evidence
  - 10-40% of medicine is backed by “evidence”
  - John Snow and cholera

- Too much evidence
  - Over 100 radiology journals
  - Radiology- 877,103 articles*

*April 26, 2010
Challenges with EBM

• Too little evidence
  ▪ 10-40% of medicine is backed by “evidence”
  ▪ John Snow and cholera, 1854

• Too much evidence
  ▪ Over 100 radiology journals
  ▪ Radiology- 877,103 articles

• Dissemination
  ▪ Attention of provider
  ▪ Disinformation
  ▪ Provider resistance

EBI Options

• Bottom-up
  ▪ Individually review literature
    • relevance
    • quality
    • timeliness
  ▪ Disadvantages
    • effort
    • expertise
EBI Options

• Top-down
  ▪ Published EBI reviews
    • fast and easy
    • EBM/I expertise
  ▪ Disadvantage
    • trust

Evidence Based Medicine

• Ask- answerable question
• Search- relevant literature
• Appraise- literature critically
• Summarize- evidence
• Apply- evidence to guide action
Imaging is Different

• Effect of imaging on outcome
• Testing v. Treatment
  ▪ Imaging is information
  ▪ Use diagnosis to guide action
• Challenges in measuring imaging effectiveness
  ▪ Effect of imaging is mediated (confounded) by treatment
  ▪ RCTs of imaging outcomes rare

Imaging “Outcomes”

• Accuracy (sensitivity/specificity)
• Medical decision making
  ▪ Before/after
• Diagnostic yield
  ▪ Imaging unnecessary
• Clinical Prediction Rules
Clinical Prediction Rule

- Decision making tool
  - Multiple factors
  - Define who should be imaged
- Validated
  - Shown to work
  - Multiple populations

Clinical guideline
Evidence based summary
Appropriateness criteria
Best practice
Meta-Analysis
Utilization guideline
Benchmark
Clinical decision tool
Consensus opinion
White paper
Clinical Prediction Rule

VALIDATED

Strength of Evidence

• Clinical Prediction Rules
• Evidence Based Guidelines
  ▪ Formal evidence synthesis
• Panel recommendations
  ▪ Experts, literature review
• Opinion
Strength of Evidence

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Clinical Prediction Rules

- Ottawa ankle rules
  - Ottawa Foot Rule, Ottawa Knee Rule
- Cervical spine
  - NEXUS, Canadian C-Spine rules
- Head CT
  - New Orleans, Canadian Head CT, CHIP
  - CHALICE, CATCH
- Thoracolumbar spine

Ottawa Ankle Rule
Ottawa Ankle Rules

- Unable to bear weight
- Tenderness at posterior edge or inferior tip of lateral malleolus
- Tenderness at medial malleolus

Stiell, JAMA, 1993; 269: 1127-1132

Ottawa Ankle Rule

- Developed and validated in Ottawa
- Subsequent validation in US, Germany, Asia
- Sensitivity 100%
- Decrease imaging by 34%
  - Site specific
- May be less successful with triage nurses
Ottawa Ankle Rule

• Ottawa Foot Rule
• Ottawa Knee Rule

Cervical Spine Imaging

• NEXUS
  ▪ Validated in 21 US medical centers
  ▪ Based on actual practice
  ▪ Sensitivity 100%
  ▪ Limited ability to decrease imaging
• Canadian Cervical Spine Rule
  ▪ Develop and validate in multi-institution study
  ▪ Sensitivity 100%
NEXUS

• Image if:
  ▪ Tenderness at posterior midline of c-spine
  ▪ Focal neurological deficit
  ▪ Abnormal level of alertness
  ▪ Evidence of intoxication
  ▪ Clinically apparent pain that might distract patient from pain of cervical spine injury

New Orleans Criteria (NOC)

• Clinical findings absent in patients without intracranial injury
• 100% Sensitive
• 22% Reduction in head CTs
• Validated in Holland

(Smits et al. JAMA Sept. 2005)
New Orleans Criteria

CT required if: >3 years old, with minor head injury, GCS 15, and 1 of the following:

1. Headache
2. Vomiting
3. Age >60 years
4. Drug or alcohol intoxication
5. Short term memory deficits
6. Visible trauma above the clavicles
7. Seizure (after the head injury)

Canadian Head CT Rule

• High risk factors (100% sensitive)
  ▪ GCS <15 within 2 hours
  ▪ Suspected open skull fracture
  ▪ Sign of basal skull fracture
  ▪ Vomiting at least 2 times
  ▪ Age >65
CT in Head Injury Patients (CHIP)

- Includes subjects with or without LOC
- For neurosurgical intervention
  - 100% sensitive
  - 30% specific
- 3364 patients
- Netherlands
- Likely cost-effective

Smits, M 2007 Ann Int Med

CHIP

- Major Criteria (any 1)
  - Pedestrian or bike struck by car
  - Ejected from vehicle
  - Vomiting
  - Amnesia>4hr
  - Clinical signs skull fx
  - GCS<15
  - Anticoagulants
  - Seizure
  - Age>60

- Minor criteria (any 2)
  - Fall
  - Anterograde amnesia
  - Skull contusion
  - LOC
  - GCS deterioration of 1 point
  - Age 40-60
CHALICE

- Children’s Head injury ALgorithm for the prediction of Important Clinical Events
- 10 hospitals in England
- Developed on 22,772 children
  - 281 abnormal head CT
  - Sensitivity of 98%
- Not yet validated
- History, exam, mechanism

CATCH

- Not Validated
- High risk factors
  - GCS<15 at 2 hours
  - Suspect open skull fracture
  - Worsening headache
  - Irritability
- Sensitivity 100%
- Specificity 30%

Osmond, MH 2010 CMAJ
Thoracolumbar Spine

- Limited evidence
- Validated clinical prediction rule
  - 2404 subjects
  - Sensitivity 100%
  - Specificity 4%
- Limited effect on utilization

Holmes, J Emerg Med 2003

Holmes Criteria

- Thoracolumbar spine pain
- Thoracolumbar midline spine tenderness
- Decreased level of consciousness
- Abnormal peripheral nerve examination
- Distracting injury
- Intoxication
Objectives

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How Should We Image?

• Competing modalities
• Comparison of accuracy
  ▪ Assume all other factors equal
• Cost-effectiveness analysis
  ▪ More assumptions
Comparison of Accuracy

- Blunt cerebrovascular injury
  - DSA-reference standard
  - CTA-high sensitivity and specificity
    - Imperfect
  - Confounding factors
    - Time, contrast, cost, radiation
- Accuracy insufficient

CT v. Radiography for Cervical Spine Trauma

- CT cost-effective if fracture risk > 4%
- Why?
  - Frequency of inadequate radiographs
  - Extreme cost of missed fracture
    - small percentage develop paralysis
  - Higher cost of radiography in high-risk
  - Higher radiation exposure from CT

Harborview Cervical Spine CT Criteria

- Focal neurological deficit
- Severe head injury
  - skull fracture
  - intracranial hemorrhage
  - unconscious
- High energy mechanism
  - MVC speed > 35mph
  - auto vs. pedestrian
- Head CT

Hanson, et al, AJR 2000:174:713-718

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Future

• Increased resources for practitioners
• Dilution of “Evidence”
• Increased emphasis on top-down EBI for payment decisions
• More appropriate use of healthcare resources
Resources

• Top down EBI
  ▪ Books, websites, journals
  ▪ Societies/organizations
    • NORDTER
  ▪ Governmental programs
  ▪ Awareness

NORDTER

• Validation of clinical pathways
• Experience with Evidence based Pathways
  ▪ Cervical spine imaging
  ▪ Cerebrovascular injury
• Implement and test
  ▪ Are correct patients being imaged with appropriate modality?
  ▪ Do clinical pathways work?
Head CT Guidelines

• Dutch Guidelines 2001
• World Federation of Neurosurgical Societies (WFNS) 2001
• European Federation of Neurological Societies (EFNS) 2002
• National Institute for Clinical Excellence (NICE) 2001
• Scottish Intercollegiate Guidelines Network (SIGN) 2000
• Scandinavian 2000

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Dilution

- Marketing of “Evidence-Based”
  - Sell product or viewpoint
- Quality of EBI is variable
  - Advertising
  - Appropriateness Criteria
- Trust/understand methods

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Washington State Health Technology Assessment Program

- Improve healthcare through EBM
  - Payment decisions (20% of population)
- Perform formal tech assessments
  - Outside consultant
- Healthcare Technology Clinical Committee (3/2007)
  - Coverage decisions
- Tests/ procedures

Washington HTAP

- Upright MRI for back pain
- Pediatric bariatric surgery
- Lumbar fusion surgery for back pain
- Discography for diagnosis
- CT colonography screening
- Drug eluting coronary stents
- Knee arthroscopy for osteoarthritis
Clinical Decision Support

- Computer interface with required indications for imaging studies
- Denial if not listed indication
- Effective
- Intrusive
- Generally limited to outpatient (not emergency)

Evidence Based Imaging
Clinical Decision Support

• Restrict imaging systematically
  ▪ Good-eliminate unnecessary imaging
  ▪ Bad-block effective imaging
  ▪ Criteria may or may not be evidence based
• Wide adoption in US within 3 years
  ▪ Driven by payers, health plans, American College of Radiology

Future

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Appropriate Imaging

• Focus on quality not cost
• Radiologist involvement
  ▪ Define quality
• Patient first
  ▪ Cannot be self-serving in defining appropriate
• Collaborative

Future of EBI

• More research/evidence
• Define value of radiology
• Financial pressures will outweigh physician preferences
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