Acute Cord Compression: Most Efficient Approach to Diagnosis

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INTRODUCTION

Rationale for the Ongoing Project

Background

- Acute spinal cord compression is one of the few indications for STAT MRI. Results are used to determine emergency treatment.
- The use of emergency resources (staff, technologists, facilities) for non-emergent indications, have been shown to increase the cost to the patients and ultimately, society.

Problems

- Spine MRI as ordered on an emergent basis for diagnosis of suspected acute cord compression is over-utilized. The typical ordering of MRI of the brain, cervical, thoracic and lumbar spines with and with contrast reagent escalates cost substantially and results in suboptimal quality exams.
- There is a poor correlation between the “acute spinal cord compression” indication for the examination and the final radiologic diagnosis.

Preliminary work

- A retrospective study was performed to examine the efficacy of utilization of spine MRI as ordered by the ED for a suspected acute cord compression

PRELIMINARY DATA

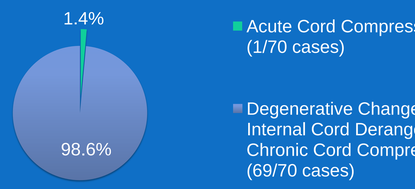
Materials and Methods

- 70 patients that received STAT MRIs ordered between May 1, 2010 and May 31, 2011 were retrospectively reviewed.

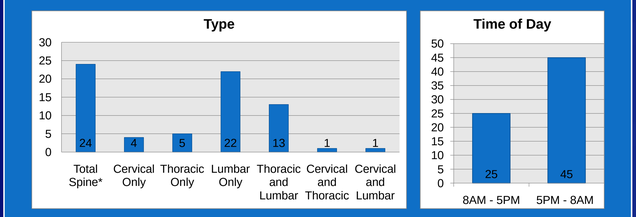
Results

- Consultants involved included
  - 30 cases Neurology/Neurosurgery
  - 40 cases No consultation

Frequency of Acute Cord Compression Diagnosis



MRI’s Performed by Type and Time of Day



Identified Problems and Resulting Actions

- Routine total spine MRI takes >3 hours and may delay crucial treatment
- Superfluous and non-focused MRI of complete spine and brain with and without contrast is ordered for most patients despite a wide spectrum of presenting symptoms
- Poor correlation between the exam indication, recorded symptoms and MRI findings
- Most exams were ordered between 5pm and 8am
- These findings prompted Interdisciplinary Institutional Review with representatives from radiology, emergency department, neurology, neurosurgery, internal medicine, and nursing
- A new institutional policy was formulated and approved by Medical Center Quality Committee and, ultimately, Medical Center Executive Committee

NEW INSTITUTIONAL POLICY

For Patients with Suspected ACUTE Cord Compression

- Based on clinical exam findings, the attending physician may order either a STAT focal spine MRI (L/S, T/S or C/S) or (if not confident of a level) a limited STAT Screening spinal MRI scan of the entire spine
- The RROC will immediately assess sagittal images for ACUTE cord compression
  - If there is none, the MR study will be terminated
  - If acute pathology is present, a routine MRI tailored to the level of abnormality will be completed
- If the attending physician requests a complete routine spinal MRI, they must consult with the Neuroradiologist on-call

For suspected sub-acute/chronic cord compression or for a mild suspicion of cord compression

- MRI should be scheduled for the next day or soon thereafter but not emergently
- Clinical Departments will conduct education on the Protocol for ACUTE Cord Compression at least annually
- The Medical Center Quality Committee will be responsible for the interpretation, review and revision of this Protocol

OBJECTIVES

1. Develop and evaluate a screening MRI protocol dedicated for detection of acute cord compression as an emergency.
2. Evaluate the efficacy of utilization of the proposed spine MRI screening protocol

MATERIALS AND METHODS

- **Patient selection**
  - Patients undergoing STAT spine MRI screening protocol ordered by ED, oncology, neurology or neurosurgery for acute cord compression between 07/01/2011 and 5/8/2012
- **Imaging with MRI Screening Protocol**
  - 8-channel cervical–thoracic–lumbar phased-array coil
  - Pre-contrast sagittal T1 and sagittal STIR sequences
- **Definition of acute cord compression**
  - Acute mass effect on the cord with edema
- **Imaging findings recorded:**
  - Acute cord compression
  - Not acute cord compression
  - No cord compression
- **Clinical symptoms and history for the subjects were obtained from the medical records in EPIC. The following were evaluated:**
  - Clinical exam findings leading to a STAT MRI.
  - Utilization of focused MRI according to symptomatology
  - Available MRI and/or clinical follow up
- **MRI was analyzed using the following criteria**:
  - Image acquisition time
  - Image quality
  - Diagnostic confidence

Proposed spine MRI screening protocol: 8-channel cervical–thoracic–lumbar phased-array coil and the screening protocol, consisting of non-contrast sag T1 and sag STIR (30min)

T1WI (a) and **T2 STIR** (b) images of a 10 vertebral compression fracture (arrow). There is good visualization of spinal fluid ventral and posterior to the spinal cord.

Screening Protocol Rationale

- **T1WI:** Bony metastases tend to contrast against a normal fatty marrow.
- **STIR T2:** Suppresses fat and allows MRI abnormalities such as edema, inflammation and neoplasia to stand out. Cord compression is readily identified if present.

Image Quality and Diagnostic Confidence

Comparison of image quality and diagnostic confidence between the screening and routine MRI spine (45 screening versus 30 routine exams) by two neuroradiologists:

- **Score 3:** satisfactory image quality and high diagnostic confidence
- **Score 2**: borderline image quality and moderate diagnostic confidence
- **Score 1**: poor image quality and low diagnostic confidence

Limitations

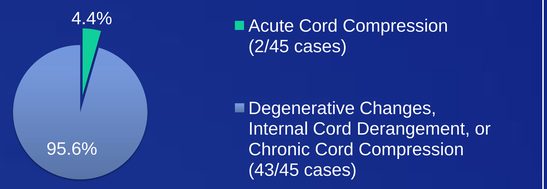
- The proposed MRI screening protocol is solely indicated for detection of acute spinal cord compression on an emergent setting at the University of Chicago Medical Center
- Diagnostic information obtained with the spine MRI routine protocol may not be fully demonstrated on this simplified screening examination.

RESULTS

45 patients (22 males and 23 females) underwent STAT spine MRI ordered by ED, oncology, neurology or neurosurgery for Acute cord compression between 07/01/2011 and 5/8/2012

- Mean age (SD): 59.7±19.4 years
- Age range: 12–97 years
- Clinical indications: Suspected Acute spinal cord compression.
- Consultants: 13 Neurology and/or Neurosurgery; 32 cases No consultation

Frequency of Acute Cord Compression Diagnosis



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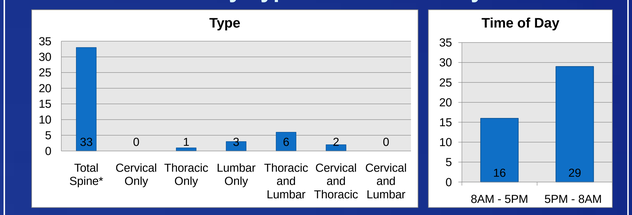

Comparison of image quality and diagnostic confidence between screening and routine MRI spine

Measures	Screening Protocol	Routine Protocol
Acquisition time	50% - 70% reduction	
Image Quality	2.62 ± 0.63	2.48 ± 0.67
Diagnostic confidence	2.68 ± 0.55	2.61 ± 0.50

An excellent score is defined as 3 and a poor score as 1.

*Image quality improvement is attributable to a decrease in motion artifact

Details

# of Patients	Diagnosis
7/45	Symptomatic Cord Compression
2/45	Acute Cord Compression • Demonstrated significant improvement with treatment
5/45	Non-Acute Cord Compression • 1/5- Hyperglycemia explained the symptoms of weakness • 1/5 -Trauma 1 year earlier, ESRD, progressive symptoms requiring surgery for spinal stenosis ultimately assoc w osteoporosis and hyperparathyroidism. Symptoms were not acute • 1/5 -Parkinsonism with extra-axial spinal cord mass without compression. Symptoms were not acute • 1/5- Malignant compression fracture – symptoms were subacute and without improvement. • 1/5- Chronic DDD

MRI follow up in 38 patients with screening MRI negative for cord compression

- MRI f/u obtained: 10/38 patients
- Additional cord findings on post-contrast sequences: 0/10

Clinical outcomes in 38 patients with screening spine MRI negative for cord compression

- No clinical follow up: 6/38
- 32/38 patients were followed up

Improved	Not improved	Worse
24	8	0

- All patients without improvement, had symptoms largely unrelated to cord compression (pelvic mass, brain lesion, spinal stenosis, neuropathy complicated by DVT, diffuse metastases, chronic post op changes, schwannoma, and paraspinous mass.

CONCLUSIONS

- A limited screening protocol for identification of acute spinal cord compression (ASCC) results in 50-70% reduction in scan time and a decrease in the incidence of significant motion artifact, while at the same time preserving adequate image quality and diagnostic confidence at least equivalent to routine imaging when identifying cord compression.
- Based on the available follow-up data, there was no evidence that cord compression was missed using a limited screening protocol for ASCC.
- *The screening MRI demonstrated high negative predictive value* for ruling out acute spinal cord compression
- Although there did not appear to be any presentation of acute intrinsic cord injury, such as spinal cord infarct or transverse myelitis, we expect the detection rate to be less and additional imaging of the spine may be necessary. However, limited short term follow up imaging does not demonstrate any additional findings.
- 11% (5/45) cord compressions were subacute or chronic. In these cases, a screening MRI was helpful but did not need to be performed on emergency basis.
- 73% (33/45) of all exams ordered to rule out acute spinal cord compression were total spine MRs despite the randomly localized symptoms. This finding suggests that there is room for improvement in clinical assessment and localization of the lesion during neurological examination
- Most emergency MRIs ordered for suspected acute cord compression continue to have chronic symptoms or unrelated symptoms that would not result in emergency spine treatment. We recommend revisiting criteria for ordering this exam.

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