Radiological Evaluation of Thoracic Spinal Trauma

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Patient J.K.

18 y.o. male s/p high speed MVA rollover and ejection transferred from OSH
Unresponsive on arrival
GCS 2
BP: 80/30
Outline

- Imaging modalities
- Anatomy of thoracic spine: plain film, CT, MRI
- J.K.: plain film, CT, MRI
- Thoracic spine and cord injury
- Mechanisms of spinal injury
- DDx of thoracic spinal fractures
- Conclusion
# Imaging Modalities

<table>
<thead>
<tr>
<th></th>
<th>Basis</th>
<th>Views</th>
<th>Pros</th>
<th>Cons</th>
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<tbody>
<tr>
<td><strong>Plain Film</strong></td>
<td>■ Trauma: Initial imaging</td>
<td>■ AP</td>
<td>■ Fast</td>
<td>■ Positioning</td>
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<td></td>
<td></td>
<td>■ Lateral</td>
<td>■ Portable</td>
<td>■ Limited contrast</td>
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<td></td>
<td></td>
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<td>■ High resolution</td>
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<td><strong>CT</strong></td>
<td>■ Spinal injury</td>
<td>■ Axial</td>
<td>■ Evaluation of bony anatomy and pathology</td>
<td>■ Limited resolution of soft tissues</td>
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<td></td>
<td>■ Pain</td>
<td>■ Sagittal and coronal reformats</td>
<td>■ Time efficient</td>
<td>■ Motion and metal artifacts</td>
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<td></td>
<td>■ Neurologic deficit</td>
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<td></td>
<td>■ LOC</td>
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<td></td>
<td>■ Distracting injuries</td>
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<td><strong>MRI</strong></td>
<td>■ Same as CT</td>
<td>■ Any plane</td>
<td>■ Evaluation of soft tissues</td>
<td>■ MR compatible devices</td>
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<td>■ Ligament injury</td>
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<td>■ Metal artifacts</td>
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<td>■ Time consuming</td>
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Normal Spinal Anatomy: Plain Film

**ABCS**
- **A**lignment
- **B**one integrity
- **C**artilage spaces
- **S**oft tissues

**AP Lateral**
- **Intervertebral Disc Space**
  - **Spinous Process**
  - **Transverse Process**
  - **Pedicles**
  - **Articular Process**

PACS, BIDMC
J.K. Plain Film

- Apical Cap
- ET Tube
- NG Tube
- Fractures
- Widened Mediastinum
- Deep Sulcus Sign

Courtesy of Dr. Anne Catherine Kim
Normal Spinal Anatomy: CT

- **Vertebral Body**
- **Spinal Cord**
- **Transverse Process**
- **Spinous Process**
- **Pedicle**
- **Lamina**
- **Costovertebral Articulation**
- **Apophyseal Joint**
• Comminuted fracture of T6 vertebra
• Fracture of spinous and transverse process
• Associated paravertebral edema/hematoma
• Possible retropulsion of fragments into spinal canal
• Heterogeneity of spinal cord indicating injury vs artifact

Normal J.K. Axial CT

Courtesy of Dr. Anne Catherine Kim
• Anterior subluxation of T5 to T6
• Disruption of posterior elements
• Prevertebral Edema
• Retropulsion of Fragments into spinal cord
• Fakeout of sternum due to misalignment during reformatting
Normal Spinal Anatomy: MRI

Sagittal T2 Image

- CSF
- Spinal Cord
- Intervertebral Disc
- Anterior Longitudinal Ligament
- Posterior Longitudinal Ligament and Dura Mater
- Dura Mater
- Ligamentum Flavum
J.K. MRI

Sagittal T2

- Anterior subluxation of T5 to T6
- Prevertebral Edema
- Retropulsion of Fragments into spinal cord
- Transection of spinal cord with associated hemorrhage and edema
- Posterior musculature hemorrhage

Courtesy of Dr. Anne Catherine Kim
Thoracic Spine and Cord Injury

- Thoracic fractures uncommon
  - Large overlapping facet joints limit flexion and extension
  - Rib cage limits lateral movement and increases axial loading capacity
- Associated with spinal fracture at other levels and pulmonary, rib, and aortic injury
- Spinal Cord injury
  - MVA, falls, and violence
  - Thoracic spinal canal narrow compared to spinal cord
  - 50% of thoracic fractures
- Prompt radiologic evaluation vital for characterization and subsequent treatment
Mechanisms of Injury

- Compression (\(\downarrow\)) and Tension (\(\uparrow\)) Forces
  - Fracture – osseous disruption

- Rotary and Shear Forces
  - Dislocation – ligamentous disruption
  - Compromise spinal cord

- Hyperflexion and Hyperextension
  - Combination of intrinsic compression and tension forces
DDx of Thoracic Fracture

- Compression fractures of indeterminate age
  - Metastases
  - Osteopenia
- Sheuermann’s disease
  - Multi-level anterior vertebral wedging
  - End plate irregularity
- Kümmel’s disease
  - Delayed vertebral collapse
  - Etiology uncertain
- Physiologic wedging
- Trauma
Discussion

- Thoracic spine is a stable and rigid structure
- Compromise of stability increases risk for fracture
- Thoracic injury is caused by combination of forces
- Spinal cord injury is common with thoracic fracture
- Imaging modalities: plain film, CT, MRI
- Remember your ABCS
- Consider underlying pathologies for fracture
Acknowledgements

- Gillian Lieberman, MD
- Anne Catherine Kim, MD
- Pamela Lepkowski
- Larry Barbaras
References


