Minimally Invasive Treatment of Painful Spinal Tumors

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Thoracolumbar Tumors

• Intradural
  – Extradural
    • Meningiomas, schwannomas, conus ependymomas
  – Intramedullary
    • Astrocytomas, ependymomas, hemangioblastomas, gangliogliomas

• Extradural
  – mets

Spinal Tumors

Presenter: Praveen Mummaneni (b,e) DePuy Spine (b) Globus (e) Quality Medical Publishing (e) Thieme Publishers

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e. Other Financial Support

Differential Diagnosis: Imposters…

• Extradural:
  – Cyst and cyst like lesions: arachnoid cyst
  – Degenerative: herniated disc, synovial cyst
  – Inflammatory conditions: arachnoiditis, HIV-related neuritis, CIDP
  – Infectious: bacterial
  – Granulomatous: sarcoidosis

• Intradural:
  – MS
  – cord infarction
  – abscess
  – AVM
  – Sarcoidosis
Epidemiology of Intradural Tumors

- Extramedullary:
  - 80% of intraspinal tumors in adults
  - 65 - 70% of intraspinal tumors in children

- Intramedullary:
  - 20% of intraspinal in adults
  - 30 - 35% of intraspinal tumors in children

General Management

- Extent of resection guided by
  - anatomy of lesion
  - intraoperative monitoring
  - surgeon’s experience
  - preliminary histology

Intraoperative Management

- Intraoperative monitoring w/ SSEP and MEP

Intraspinal Tumor Removal Options

- Open Approach
  - Midline spinal incision
  - Muscle Retraction
  - Wide exposure of tumor

- Minimally Invasive (Tubular) and Mini-open (Expandable tube)
  - Smaller incision
  - More limited tumor access?
  - Muscles dilated
    - Less tissue retraction
    - Shorter hospitalization?
    - Less blood loss?
    - Decreased dead space for accumulation of pseudomeningoceles?
1. Large Intradural Spinal Tumors

Traditional Approach:
Intradural Spinal Tumor

+ Proven safety and Efficacy
  (McCormick Clin Neurosurg, 1994; Tobias: Childs Nerv Syst 2008)

- Concern for: chronic pain and post-laminectomy kyphosis (Ituichi, Spine 2000)
  Need for fusion?

Traditional Open Approach to Intradural Spinal Tumors

Traditional Approach:
- Midline incision (two levels rostral and caudal to pathology)
- Muscle Dissection, Laminectomy
- If near CT or TL jxn – May add fusion to prevent kyphosis

Location of the Minimally Invasive Incision

1 - Midline intradural tumors
2 – Paramedian intradural or extradural tumors
3 – Foraminal tumors
Intradural Spinal Tumor: Min Inv Tech

- Limited tissue destruction
- Achieving same surgical goal, possibly reducing incidence of iatrogenic instability
- Reduced blood loss
- Improved speed of recovery


Intradural Spinal Tumor

Mini-Open trans-spinous approach for intradural tumors in the thoracolumbar spine

Midline incision
- Utilizing expandable retractors
- Preserve lateral lamina, facets and muscle attachments

Steps for MIS Trans-Spinous approach

For Lesions Ventral to the Cord, May Add Transpedicular Approach
Cadaveric Study:

Comparison of MIS vs Open Exposure of the T6-7 levels:
MIS affords 50-75% smaller incision

Lu, Dhall, Mummaneni: World Neurosurgery 2010

Cadaver Findings: Incision length is **50% less** in thin patients and **75% less** in obese pts (BMI >30)

<table>
<thead>
<tr>
<th>Case No.</th>
<th>BMI</th>
<th>MIS Incision Length (cm)</th>
<th>Open Incision Length (cm)</th>
<th>Levels of Thoracic Lamina Accessed</th>
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<tbody>
<tr>
<td>1</td>
<td>18</td>
<td>4.2</td>
<td>8.0</td>
<td>3.0</td>
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<td>4.2</td>
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<td>28</td>
<td>4.5</td>
<td>11.0</td>
<td>3.0</td>
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<tr>
<td>4</td>
<td>30</td>
<td>4.5</td>
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<td>3.0</td>
</tr>
<tr>
<td>5</td>
<td>36</td>
<td>4.5 cm</td>
<td>14.0 cm</td>
<td>3.0</td>
</tr>
<tr>
<td>6</td>
<td>43</td>
<td>4.5 cm</td>
<td>15.0 cm</td>
<td>3.0</td>
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</tbody>
</table>


Case Illustration

- 40 y/o female with 3-months progressive paraparesis with urinary incontinence
- Neuro exam reveals 2/5 strength in bilateral lower extremity with hyper-reflexia and clonus

MRI: Intradural, Extramedullary Tumor at T4
MIS Trans-spinous T3-T5 tumor resection

Tumor
Spinal Cord

1 yr F/U: ambulates independently and regained bladder control

Preop
Postop

Trans-Spinous Mini-Open Intradural Tumor Experience

- Comparison of 12 Mini-open cases with 6 open cases
- Current Experience: 24 Mini-open Cases

Patient Demographics: Mini-Open vs Open Spine Tumor Cases

<table>
<thead>
<tr>
<th>Pt Number</th>
<th>Procedure Type</th>
<th>Age</th>
<th>Sex</th>
<th>Diagnosis</th>
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<tbody>
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<td>60</td>
<td>M</td>
<td>Meningioma</td>
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<tr>
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<td>Meningioma</td>
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<tr>
<td>3</td>
<td>MIS</td>
<td>63</td>
<td>M</td>
<td>Schwannoma</td>
</tr>
<tr>
<td>4</td>
<td>MIS</td>
<td>60</td>
<td>F</td>
<td>Meningioma</td>
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<tr>
<td>5</td>
<td>MIS</td>
<td>21</td>
<td>F</td>
<td>Epidermoid</td>
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<td>57</td>
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Table 1: Patient Profile
Patient Demographics

Patient Outcomes:
Mini-open vs. Open Spine Tumor Cases
(JNS Spine: June 2011)

Surgical Details

2. Paramedian Intradural Tumors

MIS Length of stay was ½ of Open cases
One complication in MIS group - pseudomeningocele
Min Inv. Hemilaminectomy

- Paramedian Incision
- Dilate paraspinal muscles
- Place retractor to expose hemilamina

Paramedian Intradural Spinal Tumors

MIS Technique

- Hemilaminectomy
- Leave Spinous Process and Interspinous Ligaments Intact
- Avoid Iatrogenic Instability

Minimally Invasive TL Jxn Hemi-Laminectomy: Avoids Fusion
Case Illustration: Hemilaminectomy for Intradural, Extramedullary Tumor

- 20 yo woman with back pain, bilateral leg radicular pain
- Unable to sit for 1 minute
- Urinary urgency

3. Mini-Open Foraminal Tumor Resection

Nerve Sheath Tumors account for one-third of all primary spinal neoplasms (Nittner, Acta Neurol Psych, 1968).

Mini-Open Removal of Intradural Spinal Tumor

Mini-Open Resection of Nerve Sheath Tumor

(Lu, Dhall, Mummaneni, JNS Spine 2009)

- Traditional surgical approach is laminectomy, unilateral facetectomy (if tumor extends beyond intervertebral foramen), and fusion
  - Jinnai Neurosurg 2005;
  - Ozawa J Neurosurg Spine 2007
- Disadvantage of traditional approach is possible destabilization, large incision, muscle dissection, pain.
Mini-Open Removal of Foraminal Tumors

Case Illustration

- 48 y/o obese male
  - h/o L3-S1 circumferential fixation with one year of knee pain and right knee flexion weakness
  - MRI - mass in left L3-4 foramen

Results

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Levels Instrumented</th>
<th>RRsp</th>
<th>OR Time (min)</th>
<th>Stay Time (min)</th>
<th>LOS (days)</th>
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<td>279</td>
<td>166</td>
<td>70</td>
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<tr>
<td>2</td>
<td>L3-S1</td>
<td>yes</td>
<td>160</td>
<td>160</td>
<td>70</td>
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</table>

* OR = operating room.

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Follow-Up Period (min)</th>
<th>Preop Modified PROTO Score</th>
<th>Postop Modified PROTO Score</th>
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</thead>
<tbody>
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<td>16</td>
<td>P1 F1 E2 M1</td>
<td>P1 F1 E2 M1</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>P1 F1 E2 M2</td>
<td>P1 F1 E2 M2</td>
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<tr>
<td>3</td>
<td>24</td>
<td>P1 F1 E2 M1</td>
<td>P1 F1 E2 M1</td>
</tr>
</tbody>
</table>

* The modified PROTO Scale score is composed of the following sub-scale: pain (P), functional status (F), sonoanatomy status (E), and medication (M).

Mini-open paramedian approach
- Pseudarthrosis found at L3-4 level.
- Tumor resection performed.
- L3-4 instrumentation and fusion performed.

Follow-up at 1 year demonstrated complete recovery of motor strength. Improving knee pain.

MRI showed GTR and no recurrence.
4. Epidural Mets Case

- 60 yo male
  - Obese
  - Prostate cancer hx
  - Became paraparetic with urine retention 6 hrs ago
  - Too big to fit into MRI
    - >300 pounds

MIS Cases in Obese Pts are More Difficult BUT It’s Worth the Effort… Need excellent flourooscope…

Must Localize Lesion: Intraop CT scan
Complications Can Strike When You Least Expect It…

- Localize the incision
  - No room for error in counting levels with MIS incision
- Close the dura with care to prevent CSF leaks with MIS cases

Conclusions

- Mini Open Approaches Combine Open Landmarks with Smaller Incisions
- Minimally invasive techniques for spinal tumors may:
  - Decrease hospitalization
  - Decrease blood loss
  - There is a learning curve