

Medicolegal Corner: When minimally invasive thoracic surgery leads to paraplegia

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Abstract

A patient with mild cervical myelopathy due to multilevel ossification of the posterior longitudinal ligament (OPLL) initially underwent a cervical C3-T1 laminectomy with C2-T2 fusion utilizing lateral mass screws. The patient's new postoperative right upper extremity paresis largely resolved within several postoperative months. However, approximately 6 months later, the patient developed increased paraparesis attributed to thoracic OPLL and Ossification of the yellow ligament (OYL) at the T2-T5 and T10-T11 levels. The patient underwent simultaneous minimally invasive (MIS) unilateral MetRx approaches to both regions. Postoperatively, the patient was paraplegic and never recovered function. Multiple mistakes led to permanent paraplegia due to MIS MetRx decompressions for T2-T5 and T10-11 OPLL/OYL in this patient. First, both thoracic procedures should have been performed "open" utilizing a full laminectomy rather than MIS; adequate visualization would have likely averted inadvertent cord injury, and the resultant CSF leak. Second, the surgeon should have used an operating microscope. Third, the operation should have been monitored with somatosensory evoked potentials (SEP), motor evoked potentials (MEP), and EMG (electromyography). Fourth, preoperatively the patient should have received a 1-gram dose of Solumedrol for cord "protection". Fifth, applying Gelfoam as part of the CSF leak repair is contraindicated (e.g. due to swelling in confined spaces- see insert). Sixth, if the patient had not stopped Excedrin prior to the surgery, the surgery should have been delayed to avoid the increased perioperative risk of bleeding/hematoma.

Key Words: Contraindications, minimally invasive surgery, ossification posterior longitudinal ligament, ossification of yellow ligament, paraplegia, spine surgery, thoracic stenosis

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INTRODUCTION

Clinical history and neurodiagnostic studies

A patient originally presented with headaches and electric shocks radiating into the upper and lower

extremities. Her neurological examination was normal except for bilateral Babinski responses. Her initial cervical MR and subsequent CT scan documented marked cervical cord compression attributed to disc/ossification of the posterior longitudinal

ligament (OPLL) at C3-C4 and continuous and segmental OPLL from C4-T1. A C3-T1 laminectomy and posterior lateral mass fusion was performed under fluoroscopy and Stealth CT-stereotactic guidance utilizing both SEP and MEP monitoring. Within 9-10 postoperative hours, the patient developed the new onset of weakness and numbness in the right upper extremity. However, no further surgery was warranted based on the absence of surgical pathology documented on the emergent postoperative combined CT and MR studies. The patient eventually improved to the point where her residual motor deficit improved to the 5-/5 level in the right upper extremity; she was able to return work. Furthermore, the long-term follow-up MR showed no residual cord compression, and only mild persistent narrowing at the C4-C5 level.

MR studies Documented T2-T2 and T10-T11 OPLL and ossification of the yellow ligament

Prior to the cervical surgery, the patient had an initial thoracic MR performed that demonstrated moderate cord compression attributed to both OPLL and OYL at the T2-T5 and T10-T11 levels. More than 6 months following the cervical surgery, the patient's continued thoracic myelopathy (4/5 motor function in the lower extremities, hyperactive lower extremity reflexes, bilateral Babinski signs, without a focal sensory deficit) led to a second thoracic MR that continued to document cord compression due to OPLL and OYL at the T2-T5 and T10-T11 levels. Additionally, a new hyperintense signal was observed in the upper thoracic cord between the T1-T3 levels. The patient underwent elective, minimally invasive (MIS) METRx unilateral thoracic laminectomies at the T2-T5 and T10-T11 levels. These laminectomies consisted of unilateral troughs in the laminae accompanied by bilateral "en-bloc" removal of the spinous processes and laminae under fluoroscopic guidance.

Postoperative paraplegia

Following the MIS METRx unilateral thoracic laminectomies at the T2-T5 and T10-T11 levels, the patient awakened paraplegic. She was given a stat dose of one gram of Solumedrol, and underwent an emergency follow-up MR scan. The MR documented a small extradural postoperative collection (hematoma/epidural mass) in the upper T2-T5 thoracic spine accompanied by a diffusely swollen cord (uniformly hyperintense signal) that now "filled" the spinal canal. As the patient's paralysis was attributed to cord contusion/infarction,

and not to hemostatic agents or epidural hematoma, no further surgery was deemed warranted.

Multiple mistakes made

Multiple mistakes contributed to this patient's permanent postoperative paraplegia. First, the biggest mistake was using a minimally invasive surgical (MIS) surgical approach to both thoracic levels. As there was marked cord compromise due to both significant OYL and OPLL at the T2-T5 and T10-T11 levels, an open procedure would have provided better visualization, and the cord contusions and CSF leak would probably have been avoided. Second, the surgeon failed to use an operating microscope and chose to use loupes alone; a microscope would have afforded better visualization which may have averted the resultant deficit. Third, both of these thoracic procedures were performed without intraoperative monitoring (no SEP, MEP or EMG monitoring); had these been utilized the onset of potential loss would likely have prompted the conversion to an open procedure, would therefore have resulted in adequate/safe cord decompression, reversal of these intraoperative monitoring changes, and may have helped avert cord infarction. Fourth, the patient should have received a 1-gram of Solumedrol prior to thoracic surgery for cord "protection". Fifth, applying Gelfoam in confined spinal spaces is contraindicated due to the increased risk of swelling (e.g. see insert). Sixth, if the patient had not stopped Excedrin prior to the surgery, the surgery should have been delayed to avoid the increased perioperative risk of bleeding/hematoma.

The subsequent suit message: never change the medical record

Following the thoracic surgery, the surgeon orally dictated the report of the operation into the medical facility's database. Shortly following the dictation, the surgeon was advised of the patient's inability to respond to commands, and ultimately it was determined that the patient was paraplegic. The surgeon then remotely accessed the database to alter the electronic medical record, and then finalized the record as edited. In litigation, the patient's attorney sought and obtained discovery of the facility's software program, and discovered the alteration. The plaintiff's attorneys argued, that once dictated, the operation record was a HIPPA protected electronic medical record, and the facility's HIPPA privacy officer agreed with that position.

Case outcome

The case was ultimately settled.

COMMENTS FROM THE SNI: SPINE BOARD

Doing many brain and spine reviews, what I commonly see is that a surgeon adopts an operative approach/

technique (which that person believes is good) and will use it regardless of the standard (old) procedures that have a proven track record. When there is ossification compressing and surrounding the spinal cord, what is

wrong with a maximally invasive approach? Admittedly, the combination of OYL/OPLL in two areas makes this a very dangerous case no matter what/how one chooses operatively to decompress. Would we have used monitoring, probably yes; would monitoring have helped, I do not know.

Signed: Thomas Ducker

In general I agree with Tom. It would be helpful to view the imaging to fully understand the situation. I would have performed this in an open fashion recognizing that there are skilled minimally invasive surgeons who would differ. I may have used monitoring (decision would require more data) but even if it were used, it may not have changed the outcome. To my knowledge there are no high level clinical studies, which provide solid support for the use of preoperative steroids. There are animal data which suggest that administration of steroids prior to an injury can be beneficial. Generally it is not my practice to use steroids. I agree that if a minimally invasive approach is used a microscope or endoscope would be optimal to provide the best illumination and magnification.

Signed: Vince Traynelis

I agree with your comments regarding the problematic areas of this case. I would add- why a unilateral decompression? If the spinal cord were truly compressed by OPLL and OYL as seems to be the case, why not a liberal bilateral decompression? I fail to see how the spinal cord could be adequately decompressed by a unilateral trough. As far as the EMR is concerned, sometimes one forgets to dictate an important point in an op report or a mistake is made in the typing. On those occasions, I have added just before my electronic signature, "Unless electronically corrected and signed, any earlier version of this document is/are a work in progress, and not a valid part of the permanent medical record." Whether or not that gives me protection I do not know, but at least it sets the record straight. Looking at the first surgery--the multilevel cervical-thoracic decompression/instrumentation/fusion--did the patient need instrumentation and fusion in addition to laminectomy decompression?

Signed: Howard Morgan

I strongly disagree with many of your contentions. First of all, I'll agree that a minimalist (note I'm not saying minimally invasive) approach was probably suboptimal. OPLL has a nasty tendency to erode the dura, and repair is extremely difficult. A full laminectomy and decompression would be recommended. Note that the use of EPs has never been validated for posterior compression of this type; the proof is limited to deformity and intramedullary lesions. Steroids treat the physician. I remember a comment Paul Cooper once made to me: That he couldn't sleep at night before doing an OPLL case. My personal experience with direct decompression of OPLL has been less than dazzling:

Under the best of circumstances, the risk of neurologic injury is high.

Signed: Dennis Maiman

I have never been excited to do these cases even under the best circumstances open, much less considering to do this with a minimally invasive technique. I do not use preoperative steroids as the only time it has been shown to be of benefit if it is administered prior to injury. In an open procedure with a headlight and loupes, visualization should be adequate. If a minimal approach is being used, one should probably consider using a microscope. Monitoring makes no difference at all in this case.

Signed: Robert McGuire

Interesting case. It was certainly poor judgment to use a minimally invasive technique in this case. Reasonably anticipated could have been the dural injury and the leak. One needs good exposure and light to avoid the injury and to repair one if it occurs because they are usually rather ragged. The microscope is acceptable, but loupes and head light are also. Gelfoam is OK if used where the lamina and yellow ligament are removed, and it is not packed into the "confined" spaces. I have never accepted the "proof" of the value of monitoring or preoperative steroids in a case like this. I neglected to comment on the issue of Excedrin. It and the NSAID should be stopped before spinal surgery, especially in elective cases. Although this did not seem to be an issue in the case, lack of attention to it might go to judgment and/or competency.

Signed: Clark Watts

Very few Neurosurgeons would like to be involved in the surgical management of this challenging case which raises the same questions dealing with the posterior surgical treatment of the thoracic herniated disk. As well known, the thoracic spinal cord has poor anastomotic arterial vascularization (1 radiculomedullary artery every 5 vertebrae compared to 1 every 2 vertebrae at cervical level), so after decompression haemodynamic disturbances can occur. It was certainly inadequate to use a minimally invasive technique in this case although the combination of OYL/OPLL in two areas made this a very dangerous case whatever the surgery performed. If a minimal approach is considered, I think that a microscope is mandatory since OPLL is frequently associated with dura erosion and a subsequent difficult repair. I do not think that Gelfoam is dangerous if put over the dura after laminectomy. Concerning the use of evoked potentials they are strongly advised mainly for medico-legal reasons since, frequently, when they disappear it is too late (are they really useful?). Since it has been shown to be of benefit, the preoperative use of steroids is strongly advised in cases like this although we have never had adequate confirmation.

Signed: Massimiliano Visocchi

Thoracic decompression: I have performed a number of thoracic decompressions without a serious complication over the years, but have several concerns about the technical issues in this case. I agree with point #1 (*Wrong to use MIS for OYL/OPLL*). I would have done this case open as well. I have done only one level thoracic decompressions with very focal stenosis with METRx. Agree with #2 (*Failed to use microscope*). I would consider it almost impossible to perform a METRx decompression without a microscope. Agree with #3 (*Performed without monitoring*). I always monitor thoracic decompressions. Agree with #4 (*Failed to use steroids*). Always use steroids. Agree with #5 (*Gelfoam contraindicated: swelling*). Surgiflow or a comparable agent could avoid this and control bleeding. Agree with #6 (*Failed to stop Excedrin*). It is essential to wait for the appropriate interval before performing elective surgery. The potential for post-operative seroma formation with the unilateral decompressive approach is an issue for lumbar (surgery) as well, but is better tolerated in the lumbar spine.

Signed: Donald Hilton

I find it exceedingly difficult to comment on a case without all of the details to view such as the imaging and details of the operation. As the previous panelists have pointed out, these cases are relatively high-risk for neurologic injury even when performed through a traditional open approach with magnification and neuromonitoring. How do we know this patient didn't have a cord infarct following the decompression or some other intrinsic cord problem that was unrelated to the technical factors of the operation? Generally, I would use a single pre-operative dose of steroids, and I like to have neuromonitoring so that if there were an evolving neurologic issue, I can work proactively with anesthesia, the patient's family, and radiology. I had a case a few weeks back of severe multi-level stenosis and cervical myelopathy in a rheumatoid patient in which we lost

all signals intra-operatively. Pre-operative steroids were given, we utilized an open approach, and we had loupe magnification; there were no surgical miscues. Thankfully the patient's signals recovered after 30 minutes or so. I was grateful to have had the monitoring, as I was able to mobilize critical care and notify the patient's family about what was happening in real time as well as keep a critical eye on mean arterial pressure even before the signals returned.

Signed: Paul Justin Tortolani

I partially agree with your opinion. MEP is beneficial for these kinds of patients by detecting early changes in spinal cord monitoring. We never do such operations without it. On the other hand, I think the effects of preoperative steroids and Gelfoam are not determined yet. We use Gelfoam, but not steroids.

Signed: Atsushi Okawa

I agree with all the comments. The common theme here is that this was an extremely high-risk patient regardless of the treatment method used. I would have used steroids and done the case with an adequate exposure to see the pathology with magnification and enhanced lighting. Monitoring may or may not be beneficial, but in this country, it would be hard to defend not using some sort of monitoring in a high-risk case such as this.

Signed: Glenn Rehtine

Pre-emptively, I do not consider myself expert enough with these two disorders to make a specific definitive commentary. I stopped operating in 1998. However, I agree with your critique of the technique on general neurosurgical principles. Wide decompression at every afflicted level and monitoring with evoke potentials, particularly motor potentials, is part and parcel of the approach to this problem, and likely would have prevented the permanent paraplegia.

Signed: Ronald Pawl