

Case Report

Intracranial pressure monitoring during adult spinal deformity correction in a patient with critical venous occlusive disease and superior vena cava syndrome: A technical note

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Abstract

Background: Intracranial pressure (ICP) monitoring is not routinely used during complex spinal deformity correction surgery. The authors report a 66-year-old male who during thoracolumbar deformity surgery required the placement of an ICP monitor due to the underlying history of a superior vena cava syndrome (e.g., s/p right jugular stent).

Case Description: A 66-year-old male with multiple prior lumbar spinal procedures presented with lower back and bilateral lower extremity pain, paresthesias, and weakness. He had a history of chronic left internal jugular and brachiocephalic venous occlusion (e.g., he had a right internal jugular stent). During deformity surgery, a frontal intraparenchymal ICP monitor was placed. During the early portion of the operation, bed adjustments (increasing reverse trendelenburg position) were required to compensate for ICP elevations as high as 30 mm Hg. A subsequent inadvertent durotomy during decompression lowered the ICP to <5 mm Hg; no further ICP spikes occurred. His postoperative course was uneventful, and 14-month later, he was dramatically improved.

Conclusion: ICP monitoring may be a useful adjunct for patient safety in selected patients who are at risk for developing intracranial hypertension during extensive spinal deformity surgery.

Key Words: Deformity correction, intracranial pressure monitoring, superior vena cava syndrome

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INTRODUCTION

Intracranial pressure (ICP) monitoring is frequently used by neurosurgeons for the management of multiple pathologies including traumatic brain injury, hydrocephalus, and idiopathic intracranial hypertension.^[1,2,10,11,13] Placement of the monitor is a relatively safe and quick procedure that is often done in the Intensive Care Unit or operating room. Numerous types of monitors exist to measure ICP in the subarachnoid space, the epidural space, the subdural space, or the brain parenchyma itself. We report

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a case in which an ICP monitor was required during adult spinal deformity surgery for in a patient with a history of a superior vena cava (SVC) syndrome and right internal jugular occlusion/stent placement.

CASE REPORT

Presentation

A 66-year-old male with multiple prior lumbar spine surgeries presented with intractable, disabling low back and radicular pain, and neurogenic claudication with severe sagittal imbalance refractory to conservative measures. He was unable to walk more than 20 yards at a time and experienced severe pain and cramping with any movement. His quality of life had been severely affected by his symptoms. He had a history of SVC syndrome (right internal jugular stent), managed with long-term warfarin anticoagulation; he also had chronic left internal jugular and brachiocephalic veins occlusions.

Physical examination demonstrated normal motor strength in the upper extremities. No pathologic reflexes were noted in any extremity. He had a slight weakness in the right gastrocnemius and extensor hallucis longus (EHL) graded at 4+/5 strength.

Computed tomography (CT) and plain radiographics indicated pseudarthrosis of his prior construct [Figure 1]. CT myelography confirmed his neurogenic claudication by demonstrating severe spinal stenosis. He was scheduled

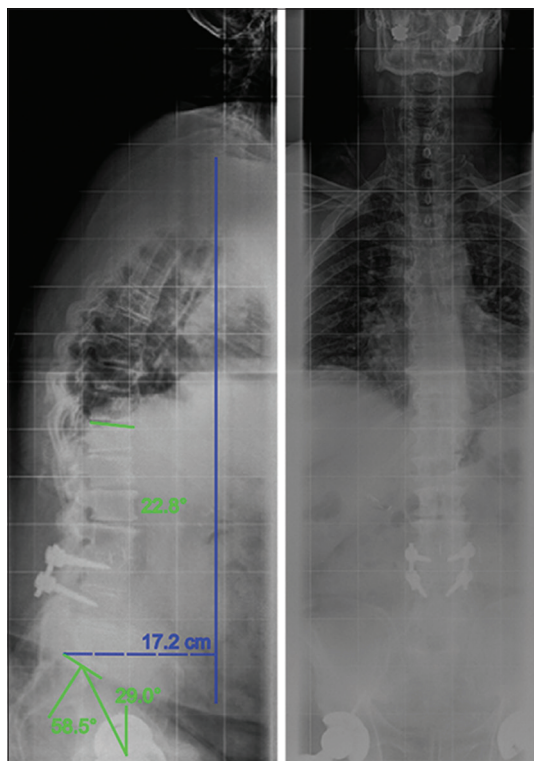


Figure 1: Preoperative plain films

for T10-pelvis instrumentation with L2–L3 interbody placement, L2 pedicle subtraction osteotomy (PSO), and T12–L2 two-column osteotomies and decompression.

Description of intraoperative procedures

After induction of general endotracheal anesthesia, electrodes were placed for routine neuromonitoring including somatosensory and motor evoked potentials as well as electromyography. Subsequently, a right frontal ICP monitor was placed. The initial pressure reading from the ICP monitor was 6 mm Hg (normal ICP <20 mm Hg). Once all lines and monitors were in place, the patient was then carefully turned prone onto the Jackson frame. The prone-view facial padding device notably needed to be modified to accommodate the anchor of the pressure monitor. A semicircular cut was made, so the anchor would rest without strain on the device. The pressure reading after turning the patient prone was 30 mm Hg. The decision was made to only proceed with the case if the ICP could be maintained <15 mm Hg at rest since surgical manipulation would likely lead to elevation of the ICP. The Jackson frame was then elevated to 30° of reverse Trendelenburg position. The patient's ICP gradually decreased over the next 10 min and stabilized at 14–15 mm Hg [Figure 2]; therefore, the decision was made to proceed with surgery. After exposure of the previous construct, the instrumentation portion of the operation began. There were no changes to neuromonitoring signals during the instrumentation portion of the procedure, and the ICP monitor demonstrated intermittent pressure elevation to approximately 18–19 mm Hg from a baseline of 15 mm Hg.

After successful instrumentation, laminectomies and a discectomy were performed. Next, an interbody spacer was then placed at the L2–L3 level via a transforaminal approach. A PSO was then performed at L2. During the exposure and removal of scar in preparation for the PSO, a durotomy occurred on the right side (approximately 5 h into the procedure) [Figure 2]. Cerebrospinal fluid (CSF) egress was controlled with cottonoid patties until full exposure was obtained. The dural defect was repaired primarily with suture and dural sealant. Incidentally, the ICP fluctuated between 0 and 3 mm Hg during this

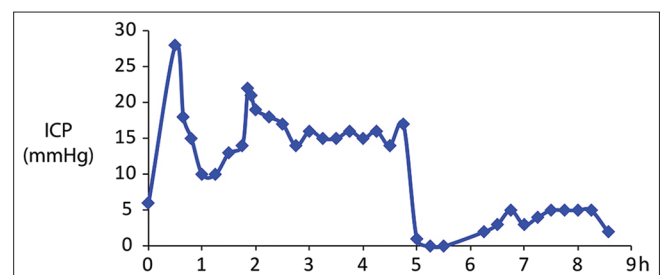


Figure 2: Intraoperative intracranial pressure monitoring

time. The monitor was checked at its entry site and noted to be in an ideal position. There were no changes in neuromonitoring signals during this period of time.

Once the PSO was closed, intraoperative long-cassette radiographs were obtained demonstrating significant improvement in lordosis. Two-column Smith-Petersen type osteotomies were then carried out, long segment rods were contoured, cap screws were placed and tightened, and the wound was closed expeditiously.

The patient was then carefully turned back supine onto the bed and taken directly to the Intensive Care Unit still intubated and in stable condition. The head of the bed was maintained at 30° as a compromise between improving cerebral venous drainage and protecting the dural closure.

Postoperative course

ICPs were monitored overnight to evaluate for intracranial hypertension; however, the pressures remained in the normal range. His postoperative examination was grossly stable compared with his preoperative examination. The ICP monitor was removed, and he was extubated shortly thereafter. On discharge, he had significant improvement in his preoperative pain, and he continued to have stable slight weakness of the right EHL and gastrocnemius.

Standing long-cassette radiographs were obtained at his 3-month postoperative visit and revealed slight proximal junctional kyphosis. His postoperative pelvic incidence was 58.5°, his pelvic tilt was 29°, and his sagittal vertical axis (SVA) was 13.7 cm [Figure 3]. These deformity parameters were similar at 14-months postoperatively with further improvement of his sagittal deformity, and his SVA further improved to 11.7 cm. He reported dramatic improvement in his preoperative pain symptoms, and these improvements were maintained at his 14-month follow-up visit. He continues to have stable slight weakness involving the right EHL and plantarflexion.

DISCUSSION

Several traditional etiologies such as infections, tumors, and fibrosing mediastinitis can cause varying degrees of central venous system obstruction leading to the diagnosis of SVC syndrome. More recently, accurate diagnosis of hypercoagulable states, placement of indwelling central venous devices or pacemaker leads as a cause of SVC syndrome has drawn more attention to the diagnosis.^[4,8,9] SVC syndrome and cerebral venous congestion can lead to morbidities such as facial edema, blindness, and intracranial hemorrhage.^[3,7,15,18]

During a prone procedure with limited ability for standard maneuvers to increase venous return (such as elevating the head), the ICP monitor, in this case, was a very useful monitoring adjunct to ensure safety.^[5,17] The ICP monitor allowed the surgical team to monitor

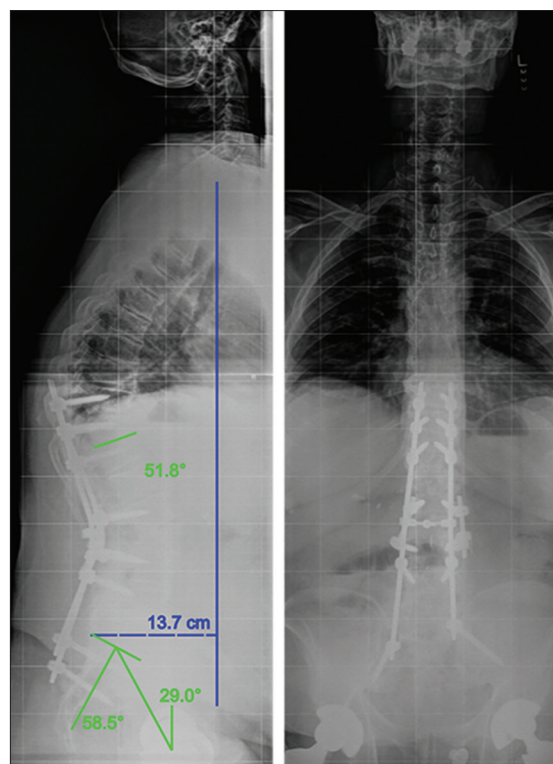


Figure 3: Three month postoperative plain films

the patient's ICP response to positioning in real time and served as a major determining factor when deciding whether or not to proceed with surgery. However, a prospective study of 1000 consecutive patients with intraparenchymal ICP monitors showed a 8% hemorrhage in patients with an abnormality of at least one coagulation parameter.^[6] None of the hemorrhages were deemed to be clinically significant. In patients without coagulopathy, the hemorrhage rate was 0.66%. Several other studies have reported similarly low hemorrhage rates.^[12,14,16] This case also demonstrates a serendipitous opportunity for emergent CSF drainage in the setting of increased ICP during spinal surgery in patients with known venous congestion during spinal surgery. In this case, the durotomy and CSF egress were inadvertent; however, this observation may be helpful in future cases complicated by reduced venous return to the heart. ICP monitoring during complex spinal deformity surgery may necessitate intraoperative CSF drainage to facilitate surgery.

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Conflicts of interest

There are no conflicts of interest.

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