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Clinical Study

Minimally invasive thoracic decompression for multi-level thoracic pathologies

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ABSTRACT

We describe our experience using a minimal access approach for multi-level dorsal decompression of the thoracic spine that may limit approach-related soft-tissue injury and spinal destabilization. Additionally, three patients, each with unique compressive thoracic pathology, are discussed. A single minimal access technique, using multi-level hemilaminotomies, was used to address these unique pathologies via a similar approach. The three patients in this study had a mean age of 49.3 years (range: 45–55 years), mean estimated blood loss of 750 cc (range: 350–1000 cc), mean operative time of 3.8 hours (range: 3–5 hours), and a mean post-operative hospital stay of 2.3 days (range: 2–3 days). Complete decompression was achieved with resolution of symptoms in all patients. Long-term follow-up averaged 26.7 months (range: 15–36 months). Radiographic decompression was demonstrated in all patients. Minimal access techniques using muscle-splitting tubular retractor systems can effectively treat multi-level dorsal compression of the thoracic cord, while potentially limiting morbidity and long-term spinal instability.

1. Introduction

The diagnosis and management of patients with compressive lesions of the thoracic spine can be challenging. Symptoms of thoracic stenosis can be vague, with a gradual onset and varied clinical manifestations; these characteristics may result in delayed diagnosis. Patients with thoracic myelopathy invariably have progressive symptoms, and conservative therapy is ineffective. Surgical intervention is considered the treatment of choice for thoracic myelopathy secondary to compressive lesions. Traditionally, laminectomy requires an extensive midline incision, significant dissection of the paraspinal musculature bilaterally, and a multi-level removal of bony elements. It is well recognized that this standard approach can be associated with chronic pain as well as iatrogenic spinal deformity [1–3].

The goal of minimal access spinal surgery is to limit approach-related morbidity without compromising the primary surgical goal [4,5]. Application of these techniques may be associated with decreased post-operative pain, reduced blood loss, and shorter recovery times. Equally as important, these techniques preserve the structural integrity of the spine [6]. The development of muscle-splitting tubular retractor systems as well as the necessary instruments for navigating these narrow surgical corridors has allowed surgeons to apply minimal access techniques to a multitude of spinal pathologies. Tredway et al. previously reported a minimally invasive approach to access one or two-level intradural spinal neoplasms via unilateral hemilaminectomies in the cervical and lumbar spine [7]. In this manuscript we describe a technique which can be used to resect extensive multi-level lesions through two unilateral hemilaminotomies in the thoracic spine.

2. Methods

Three patients presenting between January 2009 and July 2011 were found to have multi-level thoracic pathology causing symptomatic compression of the thoracic spinal cord. The extent of the structural compression and clinical myelopathy led to a recommendation for surgical intervention. Despite different pathologies in each of these three illustrative cases, each patient could be treated using a similar approach. Exposure and resection of the multi-level lesions was performed through a minimally invasive thoracic decompression (MITD) approach from two small entry points at cephalad and caudal ends of the pathology. Via each entry point, unilateral hemilaminotomies were performed. All three patients underwent operations by the same senior surgeon (R.G.F.) at the same institution.

Peri-operative data recorded for each patient included age, sex, pre-operative symptoms and neurologic exam, surgical levels, operative time, estimated blood loss, length of hospital stay, peri-

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operative complications, and post-operative neurological exam. Pre- and post-operative MRI was used to assess resection extent. Routine post-operative examinations and radiographic imaging were performed at standard intervals.

2.1. Minimally invasive surgical technique

MITD was performed under general anesthesia with monitoring of somatosensory and motor evoked potentials. The patient was placed in the prone position on a radiolucent operating table with the head secured in a Mayfield 3-point fixation holder. Lateral fluoroscopy was used to localize the surgical levels by counting cephalad from the sacrum and was confirmed with anterior-posterior fluoroscopy by counting thoracic ribs. For the surgical procedure, the skin was incised 1.5 cm lateral to the midline in a rostral-caudal direction. A series of muscle-splitting tubular dilators were docked onto the lamina located midway between the cephalad end of the lesion, and the midpoint of the lesion. A Quadrant retractor tube (Medtronic Inc., Memphis, TN, USA) was placed and secured to the operating table by a flexible arm. The Quadrant retractor was expanded in the rostral-caudal direction to expose the lamina of the superior and inferior surgical borders (for example, T3 to T5). Laminar edges were defined using curettes, followed by multi-level hemilaminotomies with Kerrison rongeurs and a high-speed drill. Contralateral exposure was achieved by drilling the ventral surface of the spinous process and contralateral lamina to the contralateral pedicle. These same surgical steps were repeated for the lower end of the lesion (for example, T7 to T9) on the contralateral side of the posterior tension band. See Figure 1 for imaging and illustration of the intra-operative setup and visualization of the thoracic pathology. Hemostasis was obtained with bipolar electrocautery, bone wax, and Surgifoam (Ethicon, Inc., Johnson & Johnson Medical Ltd., Piscataway, NJ, USA). The ligamentum flavum was identified and removed, exposing the dorsal epidural spinal pathology (Patient 1: extramedullary hematopoiesis; Patient 3: epidural lipomatosis).

In the cases of extradural pathology, the lesions were resected *en bloc* with a combination of bipolar electrocautery, pituitary forceps, and microsurgical dissectors. As the lesions were removed, hemostasis was obtained with bipolar electrocautery and Gelfoam (Pharmacia & Upjohn Company Division of Pfizer Inc., New York, NY, USA). For the treatment of the intradural arachnoid cyst (Patient 2), the dura was opened to expose the external wall of the cyst. The cyst was resected throughout its rostral-caudal borders. The dura was closed with 4-0 sutures and sealed with fibrin glue (Duraseal, Covidien, Mansfield, MA, USA). Hemostasis was obtained, antibiotic irrigation was performed, and the retractors were removed allowing the paraspinal muscles to reapproximate in normal anatomic alignment. The paraspinous fascia was closed using 1-0 Dexon suture (Coviden). The subcutaneous layer was reapproximated with 3-0 Vicryl sutures (Ethicon, Inc.) and the skin was closed using subcutaneous 4-0 sutures followed by Dermabond (Ethicon, Inc.) adhesive on the skin surface.

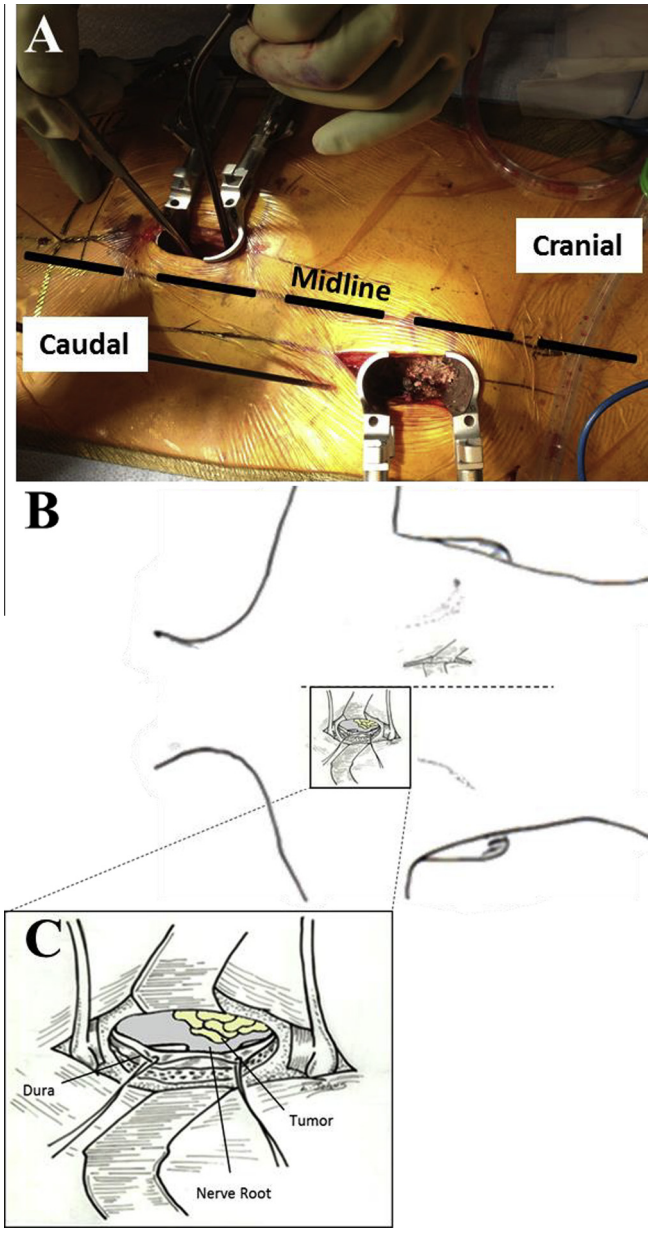

Fig. 1. Operative setup. (A) Intra-operative image of the Quadrant retractors (Medtronic Inc., Memphis, TN, USA) expanded in the rostral-caudal direction for exposure. (B) Illustration demonstrating the initial midline suprafascial incision, followed by bilateral paramedian incisions through the fascia at a distance of 1.5 cm lateral to the midline. (C) Magnified illustration demonstrating the unilateral paramedian approach after completion of the left T3–T5 hemilaminotomies and exposure of the dorsal thoracic pathology.

3. Results

Three patients presented with thoracic radiculopathy or myelopathy. Three unique, multi-level thoracic pathologies were treated: extramedullary hematopoiesis, intradural arachnoid cyst, and epidural lipomatosis (Table 1). All three pathologies demonstrated clinical and radiographic evidence of thoracic spinal cord compression spanning the T3–T8 or T3–T9 levels. The mean age of the patients was 49.3 years (range: 45–55 years). The average perioperative estimated blood loss was 750 cc (range: 350–1000 cc), operative time was 3.8 hours (range: 3–5 hours), and hospital stay was 2.3 days (range: 2–3 days) (Table 2). There were no perioperative complications or changes in the neurologic exam. Patients had complete relief of symptoms sustained at long-term follow-up; average follow-up was 26.7 months (Patient 1: 36 months, Patient 2: 29 months, Patient 3: 15 months).

3.1. Patient 1

A 45-year-old woman presented with 2 years of progressive thoracic radiculopathy, foot pain and numbness bilaterally, and gait imbalance. Thoracic MRI revealed an extensive epidural lesion dorsal to her thoracic spinal cord from T3 to T8 causing significant cord compression (Fig. 2A, B). The patient underwent minimally