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Thoracic lateral extracavitary corpectomy for anterior column reconstruction with expandable and static titanium cages: Clinical outcomes and surgical considerations in a consecutive case series

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ABSTRACT

Objective: Many surgical interventions have emerged as effective means of restoring mechanical stability of the anterior column of the spine. The lateral extracavitary approach (LECA) allows for broad visualization and circumferential reconstruction of the spinal column. However, early reports demonstrated significant complication rates, protracted operative times, and prolonged hospitalizations. More recent reports have highlighted concerns for subsidence, particularly with expandable cages. Our work seeks to describe a single-surgeon consecutive series of patients undergoing LECA for thoracic corpectomy. Specifically, the objective was to explore the surgical considerations, clinical and radiographic outcomes, and complication profile of this approach.
Methods: A retrospective study examined data from 17 consecutive patients in whom single or multi-level corpectomy was performed via a LECA by a single surgeon. Vertebral body replacement was achieved with either a static or expandable titanium cage. The Karnofsky Performance Scale (KPS) was utilized to assess patient functional status before and after surgery. Radiographic outcomes, particularly footplate-to-body ratio and subsidence, were assessed on CT imaging at 6 weeks after surgery and at follow-up of at least 6 months.
Results: The majority of patients had post-operative KPS scores consistent with functional independence (≥70, 12/17 patients, 71%). Fourteen patients had improved or maintained function by last follow-up. In both groups, all patients had a favorable footplate-to-body ratio, and rates of subsidence were similar at both time points. Notably, the overall complication rate (24%) was significantly lower than that published in the literature, and no patient suffered a pneumothorax that required placement of a thoracostomy tube.
Conclusion: The LECA approach for anterior column reconstruction with static or expandable cages is an important surgical consideration with favorable surgical parameters and complication rates. Further, use of expandable cages may allow for reconstruction over a larger segment without increased risk of subsidence.

1. Introduction

The anterior column of the spine can be compromised by infection, metastatic tumors, trauma, progressive or congenital deformities, and a host of degenerative processes [7,14,21,23]. In extreme cases, these insults destabilize the spinal column and lead to progressive neurologic deficits [19]. Surgical approaches to reconstruct the anterior column have emerged as an effective means to restore mechanical stability and prevent further neurologic decline. In many cases, surgery can even restore neurologic function [21]. Historically, reconstruction of the thoracic spine has been performed via an anterior approach through the pleural cavity as this affords broad visualization and facilitates placement of large grafts and titanium cages [7,21]. However, drawbacks to this approach include a high risk of complication and iatrogenic neurologic deficits due to late visualization of the nerve roots [4,7,20].

Abbreviations: BMI, body mass index; CT, computed tomography; EBL, estimated blood loss; LECA, lateral extracavitary; KPS, Karnofsky performance scale; MEPs, motor evoked potentials; SEM, standard error of the mean; SSEPs, somatosensory evoked potentials.

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Furthermore, an additional posterior procedure is often required for circumferential stabilization [20].

The lateral extracavitary approach (LECA), first introduced by Larson [10], is a posterior approach lateral to the erector spinae muscles. This approach affords excellent, unilateral exposure of all three spinal columns and early visualization of spinal nerve roots [7,14,15,21,22]. The surgical window eliminates the need for a 2-stage approach for anterior column reconstruction and circumferential stabilization [20]. The LECA has previously been limited to single-level procedures as only small grafts and cages could safely fit between adjacent nerve roots [7,15,17,22]. However, the advent of the expandable cage has broadened the application of the LECA [7,14,21]. A collapsed expandable cage is passed between adjacent rib heads and subsequently expanded in situ to provide anterior column support.

We present a retrospective, case series of 17 consecutive patients that underwent reconstruction of the thoracic anterior column via a LECA with either expandable or static titanium cage placement. The goal of this series is to explore the surgical considerations, clinical outcomes, and complication rates in this population. Furthermore, we analyzed the footplate to endplate ratios and subsidence [11]. This is the first series, to our knowledge, that examines these parameters exclusively in thoracic lateral extracavitary corpectomies.

2. Methods

2.1. Patient selection

Demographic and clinical data were retrospectively collected, for consecutive patients who underwent thoracic corpectomy and interbody cage placement by a LECA between October 2010 and July 2013. The primary clinical outcome measure for all patients was post-operative Karnofsky Performance Scale (KPS) score [8]. Scores were assessed for all patients. A single surgeon (D.R.) performed all surgical procedures at a single institution.

2.2. Surgical technique

After induction of general anesthesia, patients were positioned prone on a radiolucent Jackson Table. Somatosensory evoked potentials (SSEPs) and motor evoke potentials (MEPs) were obtained throughout the surgical procedure in all but three cases. A midline vertical posterior incision, typically 6–8 in. in length, was made, in contrast to the standard lateral extracavitary hockey stick incision [9,18]. A subperiosteal dissection was performed to expose the spinous processes and lamina of the appropriate levels. The dissection was carried laterally to expose the transverse processes as necessary for posterolateral fusion. Pedicle screws were placed bilaterally in the standard fashion several segments above and below the level(s) of the planned corpectomy. No pedicle screws were placed at the level(s) of intended corpectomy.

A separate fascial incision was then made to expose the rib(s) to be resected. Approximately 4–5 cm of rib were resected and, where possible, this bone was morselized for autologous bone graft. In the event of pleurotomy, the defect was primarily repaired with Vicryl suture with muscle graft augmentation as necessary. Unilateral nerve root sacrifice was performed by first ligating and then transecting the root proximal to the dorsal root ganglion. A decompressive laminectomy was then performed using a high-speed drill and Kerrison rogeurs. The transverse process and facet joint were then removed at the level(s) of the corpectomy on the side of the rib ostectomy. Subsequently, the pedicle of the planned corpectomy level was removed unilaterally using the high-speed drill and rongeurs. The corpectomy was ultimately performed using the high-speed drill and Kerrison punch. The adjacent intervertebral discs were removed using curette and rasp instruments. In cases of en bloc resection, the corpectomy was performed with a Tomita Wire (Medtronic – Minneapolis, MN USA) [5].

The vertebral body replacement device was packed with morselized, autologous bone and inserted into the corpectomy site under fluoroscopic guidance. Following placement of a static (VBOSS™, Stryker Spine, Allendale, NJ, USA) or expandable (VLIFT™, Stryker Spine) titanium cage, titanium rods were contoured and secured to the pedicle screw heads with set screws. Cross connectors were placed at the level of the corpectomy.

A Hemovac drain was placed below the fascia and tunneled out through the skin lateral to the incision. The fascial and dermal layers were closed using braided, absorbable suture (Vicryl™, Ethicon, Rutherford, NJ, USA). A running subcuticular stitch was performed using a non-braided, synthetic, absorbable suture (Monocryl™, Ethicon), and ultimate skin closure was performed using Dermabond® (Ethicon).

2.3. Outcomes and statistics

Clinical and demographic characteristics for each patient are summarized and descriptive statistics were applied where appropriate. However, the limited sample size precluded robust statistical analysis with parametric methods. Measurement of the vertebral body endplate was made on pre-operative axial CT images. The average largest diameter measurement of the superior and inferior endplates was used to calculate the footplate to body ratio as described previously [11].

Subsidence was measured on post-operative plain radiograph or computed tomography imaging obtained 1–6 weeks postoperatively and again at last follow-up when available. The reported value is the summation of the measured subsidence at the superior and inferior endplates in millimeters. Subsidence was considered present if the total measurement was greater than 2 mm [11]. Subsidence was unable to be reported in three subjects (one patient died during a bronchoscopy procedure on post-operative day 10; one patient lived out of state and was lost to follow-up, and the third patient has not yet had sufficient postoperative follow-up). A chi-squared test was performed to compare rates of subsidence between groups at both time points.

A two way mixed ANOVA was used to compare changes in KPS between groups (expandable vs. static), and independent-samples *t*-tests were performed to identify other between-group differences. Given the small cohort size in the present and prior studies, Fisher's exact test was utilized to compare the complication rate herein with previously published work. A p-value of 0.05 was utilized as a threshold for statistical significance except where otherwise noted.

3. Results

Table 1 summarizes the clinical and demographic data for the 17 patients (12 females, 5 males) who underwent single or multilevel corpectomy via a LECA. The patient cohort had a mean age of 56 years (range: 30–78 years) and a mean BMI of 28.7 ± 1.3 (SEM). Two patients were active smokers and 65% of patients presented with additional comorbidities, including atrial fibrillation, chronic obstructive pulmonary disease, diabetes, gastroesophageal reflux, hypercholesterolemia, hypothyroidism, and mental illness (Table 2). Hypertension was the most common comorbidity and was present in 41% of patients. The most common indication for surgery was oncologic disease, which accounted for 14/17 cases (88%). Eleven of these cases were the result of metastatic disease, while three cases were for hemangioma. Fig. 1 illustrates the