Thoracic Discectomy Using Video Assisted Thoracoscopy

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Study Design. The applicability of using video assisted thoroscopic surgery (VATS) to resect thoracic discs was investigated. A laboratory study was conducted using two human cadavers and three live pigs as surgical specimens. A total of nine thoracic levels were decompressed.

Objective. To study the feasibility of performing thoracic resections using VATS.

Summary of Background Data. VATS has been used by thoracic surgeons since 1981 to resect pulmonary lesions. As far as we know, VATS has not yet been used to resect thoracic discs.

Methods. Surgical resections of nine disc levels were carried out in two human cadavers and three anesthetized pigs. VATS was used to provide the surgeon with visualization of the surgical site. Large thoracotomy incisions were not necessary.

Results. Five of seven cadaver disc spaces and two of three porcine disc spaces were adequately evacuated of disc material. One episode of duodenal violation occurred. One animal died during the procedure from anesthetic complication.

Conclusion. VATS provides a useful means of performing thoracic discectomies using a small thoracotomy incision. The decrease in invasiveness provided by this new technology may reduce operative morbidity, hospitalization time, and costs. More work is needed, especially in the design of instrumentation, before this becomes a viable alternative to current surgical procedures. (Key words: thoracic disc, thoracoscopic resection, video assisted thoracic surgery) Spine 1994;19: 1082–1086

Thoracic disc herniations represent 0.15%–0.30% of disc-related hospital admissions.14 To avoid cord retraction and manipulation, approaches to midline or lateral disc protrusions use posterolateral (transpseudicular), lateral (extrapleural transthoracic), and anterior (transpleural transthoracic) routes. Each of these procedures, whether extra- or intrapleural, requires a large incision and partial rib resection, both of which increase perioperative morbidity secondary to pain, difficult ventilation, and problems with wound healing. By minimiz-
under endoscopic visualization using a variety of instruments, including a hand-held drill, curettes, pituitary forceps, and Kerrison rongeurs (Figure 3). As more disc material was removed, the endoscope could be advanced to view the interior of the interspace while evacuation of disc material continued. Eventually, the fibers of the posterior longitudinal ligament were visualized and it could be seen that the disc had been removed across midline, decompressing the spinal cord.

Live Porcine Studies. Approval to use a live porcine model was obtained through the Institutional Animal Care and Use Committee at the University of Pittsburgh (study 0792007). Animals were sedated using atropine sulfate (0.07 mg/kg intramuscularly), xylazine (2.0 mg/kg intramuscularly), ketamine (20 mg/kg intramuscularly), and phenobarbital (25 mg/kg intravenously). They were endotracheally intubated and anesthetized with 2.75%-4% ethrane. Muscle paralysis was achieved with Pancuronium (0.02 mg/kg intravenously; Elkins-Sinn, Inc., Cherry Hill, NJ). Continuous electrocardiogram monitoring was carried out. Incisions were similar to those described for the human cadaver studies. Because of our inability to selectively intubate the left mainstem bronchus and thus collapse the lung, an endoscopic lung retractor was required throughout the procedure. The procedure used to expose the disc space and incise disc material was identical to that described for the cadaver except monopolar laparoscopic scissors were used to open the overlying parietal pleura. In no case was ligation of intercostal vessels required. The porcine disc space is quite narrow (2–3 mm), and to evacuate the disc and decompress the thecal sac anterior it was necessary to remove a portion of the superior end plate and vertebral body to enlarge the space.

Because blood from medullary bone and epidual veins tends to absorb the light emitted from the fiberoptic source, generous use of suction, irrigation, bone wax, and topical hemostatic agents was required. Nevertheless, we were able to resect disc and expose the thecal sac. One animal was awakened before it was killed to ensure that lower extremity movement remained intact. Animals were killed using Euthanasia-6 solution (0.1 ml/lb intravenously; Veterinary Laboratories, Lenexa, KS)

Figure 1. (Top) Instruments from left to right: curette, scalpel, vascular clip applier, pituitary forceps, rongeur. (Bottom) Instruments from top to bottom: endoscope, suction-irrigation hand piece, long endoscopic scissors, long cautering endoscopic scissors.

monitor. The ribs, intercostal veins, slightly bulging disc space annuli, vertebral bodies, and costovertebral joints were easily identified through the parietal pleura. After a disc space was chosen on which to perform the procedure, a third 3 cm intercostal incision was placed adjacent to the first two. The exact anterior-posterior lateral-medial location of this incision in relation to the disc space and previous incisions varied depending upon the subject's anatomy and the angle required to enter the disc space. Under endoscopic visualization, a long handled scalpel was introduced through the third incision into the thoracic cavity, and the parietal pleura overlying the rib head and anterior-lateral disc annulus was incised. A peristal elevator and curette were employed to scrape the pleura and periosteum from the underlying rib, disc space, and adjacent vertebral end plates.

Before the disc space was entered, approximately 2–3 cm of rib head was resected using a hand-held drill or an angled and straight Kerrison rongeur. This step provided better visualization of the posterior extent of the vertebral body. This resection was important later in the procedure when visualization of the posterior longitudinal ligament became necessary. After partial rib resection, the anterior-lateral annulus was incised using the long handled scalpel. Disc material then was resected

Figure 2. Demonstration of cadaver positioning with respect to the surgeon, assistant, and equipment.
Postoperative Evaluation. The spinal columns from all specimens were removed and placed in 10% formaldehyde for 1 week prior to examination. The specimens were photographed and then axially sectioned at the level of the end plate adjacent to the excised disc. The end plate was carefully removed to demonstrate the extent of disc resection, and photographs were taken.

■ Results

Seven cadaveric disc levels and two porcine levels were completed. Removal of disc material across midline and against the posterior longitudinal ligament to a degree that would have decompressed a thoracic cord compressed by a right lateral or midline disc herniation was achieved in five out of seven cadaveric levels and two out of three porcine levels (Figures 4A, B, C). In one case in which the cord was not decompressed, the cadaveric dura was violated. One animal died near the end of the procedure from an anesthetic complication. The second animal moved his legs before it was killed. We were able to complete the operation in both animals at two of the
three attempted levels. One level was abandoned because of equipment malfunction.

Discussion

Endoscopy began in 1806 when Bozzini invented the cystoscope and attempted to examine the urinary bladder using a candle as a light source. In 1883, Newman used the newly invented light bulb to endoscopically visualize the bladder. Kelling, in Dresden, is credited with first using the endoscope in the pleural cavity of dogs. In 1910, Jacobaeus used the thoracoscope to lyse pleural adhesions in tuberculous patients. Lewis used VATS in 1991 to resect a pulmonary bulla. Since that time, a number of thoracic procedures, including sympathectomy and lung biopsies and resections, have been carried out using VATS. Aside from permitting two surgeons to work simultaneously, it allows standard instruments to be introduced while the advantage of enhanced visualization is preserved, despite a minimally traumatic incision. In many ways, VATS is superior to standard thoracotomy in that it reduces the size of the incision and avoids the need for a large rib resection or spreading of the intercostal space. Both of these omissions may translate into reduced perioperative pain, improved perioperative ventilation, decreased wound size, shorter hospital stays, and reduced medical costs. Thoracoscopic surgery, however, is not indicated for all patients. VATS is contraindicated in patients with pleural symphysis, the inability to tolerate single lung ventilation, severe or acute respiratory insufficiency, and high airway pressures with positive pressure ventilation. Relative contraindications include previous tube thoracostomy and previous thoracotomy.

A number of difficulties with and questions concerning the present study and thoracoscopic discectomy need to be evaluated. First, surgical procedures in the porcine model and humans cannot be compared equally. Thoracoscopic discectomy was far more challenging in the pig than in the human cadaver. The animal's small thoracic volume made manipulation of the instruments cumbersome, and the narrow disc space made resection of disc and visualization of the intervertebral space and thecal sac difficult. Second, we have yet to determine whether a calcified disc or ligament can be safely removed using this method. It appears, however, that any perceived limitations are rooted in inadequate instrumentation. Visualization is as good as that obtained with the microscope, and the surgeon's ability to safely and completely resect disc is unhampered by the video approach.

We are currently investigating the use of hand-held drills for removing the thoracic disc, rib head, and vertebrae end plate and body in the hope that this provides a way to remove calcified lesions. We also have begun using a frequency doubled yttrium argon garnet laser (Laserscope, San Jose, CA) to incise the parietal pleura and anulus and a high speed drill to remove the rib head and disc. However, the laser, although it virtually eliminates blood loss during dissection, tends to char the underlying tissues, making anatomic orientation and visualization difficult. Additional practice is needed to ascertain whether such technology can be used to safely vaporize the disc material and decompress the cord. A third area of study is to determine whether left-sided lesions can be approached in a similar manner without endangering the heart and descending aorta.

All procedures included in the present study were performed using the combined efforts of neurosurgeons and individuals from the thoracic and general surgery subspecialties. If thoracoscopic disc resection becomes an accepted means of treating patients, it will need to be done as a combined procedure. Thoracotomy must remain an option should complications arise. In addition, it is in the patient's best interest to have a surgeon familiar with thoracic procedures make the initial chest wall incisions, insert endoscopes and retractors, and ensure that adhesions or abnormal anatomy do not exist. At that point, the neurosurgeon may expose the disc and proceed with the decompression.

Work on thoracoscopic discectomy is only beginning, but we believe that with the development of improved equipment, such procedures can be performed safely. The ability to resect diseased and traumatized vertebral bodies and insert stabilizing instrumentation also may be possible one day. Nevertheless, additional work is needed to ensure that results are as good or better than those obtained using current techniques.

References