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Thoracoscopic technique of anterior discectomy and interbody fusion (ATIF)

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Learning objectives

To describe the technique of anterior discectomy and interbody fusion (ATIF) in the thoracic spine performed via a transthoracic, thoracoscopic approach.

General information

The development of video assisted thoracoscopic surgeries (VATS) has opened the platform to perform an anterior stabilization and fusion of the thoracic spine in a minimally invasive fashion. The technique was developed in the early 1990s, and since then, thoracoscopic procedures have been used on an increasingly widespread scale.

In the beginning of the 1990s, Rosenthal and colleagues from Germany developed the thoracoscopic approaches for the treatment of various spinal pathologies [1]. Likewise, Mack et al. and Regan et al. established the technique of thoracoscopic spine surgery in the United States [2, 3].

As a result of further technical advancements, i.e. the Bozzini light conductor, the thoracoscopic technique has undergone a remarkable evolution since the introduction [4].

To date, thoracoscopic interventions have been established as a safe surgical technique in the spine surgeon's armamentarium, which serve to address a wide variety of indications and pathologies from degenerative disc disease to tumor and deformity surgery. Surgical procedures include anterior thoracic interbody fusion (ATIF), (hemi-) corpectomy, and vertebral body replacement, anterior discectomies of thoracic disc herniations or sympathectomies in selected cases.

At the same time, thoracoscopic surgeries follow the principles of minimally invasive, MIS-surgery, with significantly reduced access trauma in comparison to classic open techniques.

Case description/patient history with imaging

The patient is a 65-year old female with adjacent segment degeneration and concomitant spinal stenosis with severe compression of the neural structures at the level T12/L1 following previous fusion of L1 to the sacralized L5 vertebra.

An increasing kyphotic deformity at the thoracolumbar junction led to an additional stable T12 fracture, defined as type A3 according to the AO classification system [5].

Clinically, the patient presented with intractable back pain and signs of cauda equina compression syndrome. The neurological examination revealed an ataxia with broad-based gait, hypoesthesia in both legs and anterior thighs.

Based on the clinical and radiological findings, a combined posterior-anterior fusion procedure was indicated with an extension of the fusion from T10 to L5, including a microsurgical decompression of the neural structures at the affected level T12/L1.

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In order to achieve a solid support of the anterior column, an additional ATIF was performed via a transthoracic, thoracoscopic approach.

Surgical strategy

The patient is fixed in a stable lateral position with a four-point support at the symphysis, sacrum, scapula and with additional arm-rest. Oxygenation is maintained via a single lung ventilation through a double-lumen intubation. In accordance with the patient's vascular anatomy of the aorta and the V. cava, the patient positioning and single lung ventilation was performed on the right, whilst the surgical approach was performed from the left side.

The preoperative localization of the target area is determined under image intensifier in both ap- and lateral projection. The 4 portals such as the main working portal, portal for light source, for retractor, and for the suction system are placed in a standardized fashion in relation to the main target area. A slightly wider, approx. 25 mm skin incision is chosen for the working portal in order to enable the transthoracic introduction of the implants, whilst an approx. 10 mm skin incision will suffice for the remaining portals and instruments. The surgical procedure routinely starts with the most cranial, intercostal approach and placement of the optical channel following deflation of the lung on the ipsilateral side.

The thoracoscope with its 30° optics is inserted at a shallow angle, aiming in the direction of the second trocar for the retractor system, which is placed on the contralateral side of the ipsilateral thoracic cavity. The transthoracic intercostal insertion of the remaining trocars is performed under direct visualization through the endoscope with an "inside-out" view.

The anterior circumference of the motion segment, the course of the spine as well as the aorta are palpated and identified with a blunt probe. After exposing the target area, two K-wires are inserted into the adjacent vertebral bodies under fluoroscopic guidance. The optimal position of the K-wire is in between the middle to the posterior third of the vertebral body in the lateral plane, in proximity to the disc space in order to avoid a laceration of the segmental vessels. The positioning of the K-wires will serve as landmarks for orientation in the due surgical course and will assist to create a "safety working zone" for the surgeon.

The pleura is detached, starting from posterior into an anterior direction, directly over the disc space T11/12 with the aid of monopolar cauterization. The annulus is incised, and a complete discectomy is performed with meticulous removal of the cartilage from the adjacent endplates. Following the insertion of trial implants, an adequately sized Mesh-Cage is inserted press-fit into the cavity of the disc space. Both cages as well as the remaining disc space are packed with allogenic bone graft substitute (calcium phosphate silicate). Fluoroscopic control confirms adequate implant positioning.

The due surgical course revealed that at the cranially adjacent segment T10/11 the aorta overlapped the access to the targeted disc space to a large extent and it was not possibly to achieve a sufficient mobilization in order to permit an adequate access to the disc space. Thus, an additional ATIF was not performed at this level.

After thorough irrigation of the thoracic cavity and removal of blood clots, the chest tube is inserted in the caudal recess. The instruments and portals are then removed, and the lung is fully re-inflated under visual control to confirm full ventilation and in order to prevent atelectasis and/or the development of effusions during the postoperative course.

The final steps of the surgery are completed with suturing of the subcutaneous tissue and skin closure.

Postoperative information

The patient is extubated after surgery and supervised on the ICU for 24 h. Following removal of the chest tube on the first postoperative day, the patient is mobilized and early pulmonary ventilation training is started.

Postoperative i.v. antibiotics (2nd generation cephalosporine) are administered for a 24-h period on a routine basis.

Fractionated heparin was administered for thromboembolic prophylaxis until full mobilization. A 4-point brace may be prescribed for a 6–12-week period for additional external support depending on the surgeon's preference.

At the first follow-up examination 4 weeks postoperatively, the patient presented in a satisfactory condition with adequate mobility, significant pain reduction (VAS 2) and signs of recovery of the preoperative neurological symptoms.

Discussion and conclusion

The minimally invasive, transthoracic, thoracoscopic surgery of thoracic and thoracolumbar pathologies bears a number of advantages in comparison to "classic" procedures such as open thoracotomies. Benefits include decreased postoperative pain, lesser disruption of the anatomy due to reduced access trauma, outstanding intraoperative visualization of the patient's anatomy, high patient safety due to highly standardized intraoperative surgical steps, reduced postoperative scar tissue, shorter hospitalization as well as immediate mobilization and enhanced recovery of the patients.

Complication rates associated with the thoracoscopic procedure are comparable or even reduced to those that have previously been published for open procedures, whilst maintaining the full range of benefits of MIS surgery [6–8].

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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