

## Intercostal bleeding that developed during thoracic epidural catheterization

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*To the editor:* Various complications related to thoracic epidural catheterization have been reported, including epidural hematoma or abscess, dural puncture, nerve injuries, intrapleural catheter placement, and pneumothorax [1,2]. However, to our knowledge, intercostal bleeding has not been reported; this complication may be rare. We report a case of intercostal bleeding associated with hemothorax and a hematoma external to the parietal pleura after a complicated Tuohy needle insertion procedure, which was visualized just after the start of video-assisted thoracoscopic surgery (VATS).

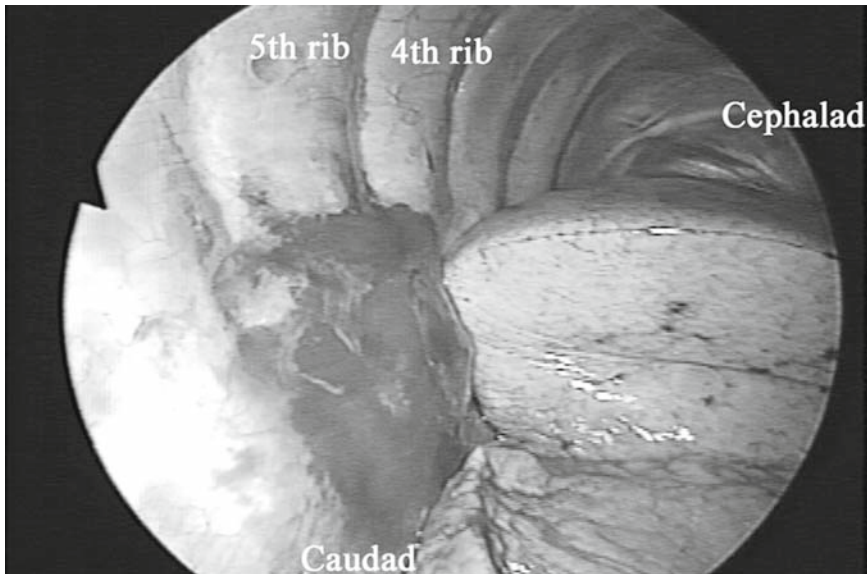
A 72-year-old woman (weight, 50 kg; height, 133 cm) was scheduled for wedge resection of the right lung by VATS. Her perioperative coagulation parameters were normal. Before the induction of general anesthesia, she was placed in the right lateral decubitus position for epidural catheterization. A Tuohy needle was inserted from a paramedian approach at the T4-5 intervertebral space. The skin insertion site was 1 cm downward to the right side of her back and 1 cm caudad to the tip of the T4 vertebral spinous process. At the initial insertion, the needle came into contact with the T5 vertebral lamina. The needle was withdrawn slightly and redirected cephalad incrementally, and was inserted in a cephalomedial direction toward the midline on the vertebral canal. Several attempts were made to insert the Tuohy needle. The needle was advanced maximally 8 cm from her skin, but loss of resistance was not obtained. An epidural catheter was placed in the T3-4 intervertebral space from a median approach. Neither blood nor air was detected during needle insertion. The patient did not complain of back pain or paresthesia.

Forty minutes after the placement of the epidural catheter, surgeons inserted a thoracoscope into the right pleural cavity. They immediately noticed an accumulation of uncoagulated blood in the cavity. A hematoma external to the parietal pleura was subsequently revealed after the suctioning of approximately 100 ml of blood. The hematoma was located outside the parietal pleura on the paravertebral fringes of the T4-5 intercostals, which was consistent with the intervertebral space in which the Tuohy needle insertions had failed. The

source of bleeding was not identified, because active bleeding was not observed. At the end of the surgical procedure, we confirmed that the hematoma was not bleeding or further enlarged (Fig. 1). The operation was performed without further complications and the patient was discharged without any neurological deficits. In this patient, hemothorax and hematoma formation caused by the insertion of the Tuohy needle were recognized because the surgery was a VATS procedure. The multiple attempts to insert a Tuohy needle were suspected to have caused injuries to the intercostal vessels and pleural perforation [3].

The intercostal artery arises from the descending thoracic aorta and divides into the anterior and posterior intercostal arteries [4]. The posterior intercostal artery subdivides into the posterior branch and the spinal branch. Together with the spinal nerve, the spinal branch enters the spinal canal via the intervertebral foramen, and subdivides into the dorsal somatic branch and the radiculomedullary artery. The radiculomedullary artery further subdivides into the anterior and posterior segmental medullary arteries, which are accompanied by the anterior and posterior nerve roots, respectively. The anterior and posterior segmental medullary arteries supply the anterior and posterior spinal arteries. The artery of Adamkiewicz is the great anterior segmental medullary artery, the most important feeding vessel of the thoracolumbar spinal cord. The spinal-cord circulation is susceptible to intraoperative ischemic damage. Thoracic operations, such as the repair of aortic aneurysms, esophagectomy, and chest wall resection, pose a potential risk to the spinal-cord circulation. An epidural needle inserted in an inappropriate direction toward the paravertebral fringes may injure the intercostal vessels. Causes of hypoperfusion include aortic cross-clamping, rib retraction, intercostal artery interruption or compression, and costo-vertebral junctional bleeding [5]. Anesthesiologists and surgeons should be aware that bleeding from the intercostal vessels and hematoma formation can reduce or interrupt spinal blood flow, including that in the artery of Adamkiewicz, resulting in a serious outcome [6].

In order to prevent intercostal vascular injury during a thoracic epidural insertion, anesthesiologists should picture a three-dimensional image of the neuraxial anatomy and the vertebral midline, and decide on an appropriate entry site, followed by insertion at an oblique angle toward the vertebral midline. The following precautions may also help to reduce complications: (1) avoid repeated needle insertions into a single intervertebral space; (2) avoid advancing the needle deeply; (3) ensure that the patient is in an appropriate lateral decubitus position or a sitting position, which facilitates location of the vertebral midline; (4) use a transparent drape; and (5) use a median approach if possible.



**Fig. 1.** At the end of the surgery, the hematoma was located on the paravertebral fringes of the fourth and fifth ribs, at the site of the failed Tuohy needle insertions. No bleeding and no further enlargement of the hematoma were observed compared with earlier findings

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