An Unusual Complication of Anterior Spinal Instrumentation: Hemothorax Contralateral to the Side of the Incision

A CASE REPORT*

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Anterior procedures on the spine, initially popularized for the treatment of spinal tuberculosis[8], are now frequently used for the treatment of a variety of complex spinal disorders. Several authors have discussed the perioperative complications of such procedures[5,10,12,17-19,22]; however, to our knowledge, development of a hemothorax contralateral to the side of the incision has not been reported.

We report such a complication in a patient who had a burst fracture of the twelfth thoracic vertebra, which was osteoporotic. The patient was managed with a decompression and arthrodesis from the eleventh thoracic to the first lumbar vertebra. The procedure was performed through a left thoracoabdominal approach and consisted of corpectomy of the twelfth thoracic vertebra, placement of a strut graft, and internal fixation with screws and a plate. Postoperatively, a hemothorax developed on the right side and necessitated a second procedure. This unexpected, serious complication was iatrogenic; it developed because a protruding screw tip lacerated the diaphragm on the contralateral side.

Case Report

A seventy-four-year-old woman was first seen by us because of a two-month history of back pain following a motor-vehicle accident. The patient reported that the pain had been increasing during the previous two weeks and that there was progressive motor weakness of the lower extremities. Neurological examination revealed a symmetrical decrease in the strength of the muscles of the lower extremities, with the patient having a full range of motion against gravity but not against resistance. There was a sensory loss distal to the inguinal level. The neurological deficit was recorded as grade C on the scale of Frankel et al.[6]. A magnetic resonance imaging scan revealed a burst fracture of the twelfth thoracic vertebra, which was osteoporotic, and an associated loss of vertebral body height of 60 percent. The anteroposterior diameter of the neural canal was narrowed by the retropulsed fragments of the twelfth thoracic vertebra (Fig. 1).

The patient was managed with decompression and corpectomy of the twelfth thoracic vertebra through a left anterior thoracoabdominal approach. The segments were stabilized by means of an arthrodesis from the eleventh thoracic to the first lumbar vertebra with use of a strut graft from the iliac crest and the Reduction-Fixation (RF) screw-plate system (AST, Oakland, California) (Figs. 2-A and 2-B). The appropriate screw length was determined to be fifty millimeters, or five millimeters longer than the transverse diameter of the vertebral bodies as measured with calipers. An awl was used to create a hole in the midlateral border of each involved vertebra; the holes were not tapped. Each screw was passed transversely through the vertebral body and was allowed to penetrate the contralateral cortex in order to obtain maximum fixation. Intraoperative radiographs were not made. The initial postoperative course was uneventful; the lung was well inflated, and there was minimum drainage from the chest.

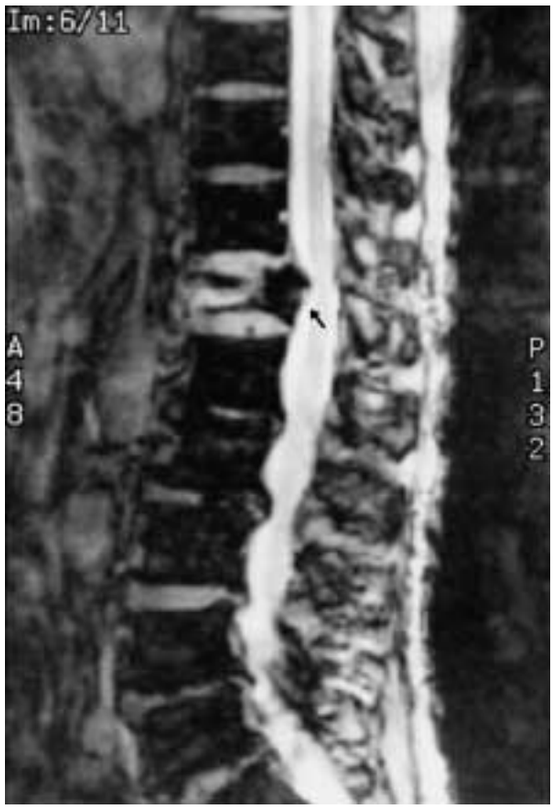

FIG. 1

Magnetic resonance image showing a burst fracture of the twelfth thoracic vertebra, with collapse of the vertebral body and narrowing of the neural canal (arrow).

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FIG. 2-A

FIG. 2-B

Figs. 2-A and 2-B: Postoperative radiographs of the thoracolumbar spine.
Fig. 2-A: Anteroposterior radiograph showing protrusion of the screw tips beyond the vertebral borders.
Fig. 2-B: Lateral radiograph showing that the vertebral height has been maintained with the iliac strut graft.

On the third postoperative day, signs of cardiac and respiratory distress were noted. The patient had a pulse rate of 130 beats per minute, a respiratory rate of thirty-two breaths per minute, and a blood pressure of 70/50 millimeters of mercury (9.33/6.67 kilopascals). A stable hemodynamic status could not be achieved despite the administration of four units of whole blood and 1500 milliliters of Ringer's lactate solution through a central venous line. A radiograph of the chest showed a large hydrothorax on the right side, with shifting of the mediastinum to the left (Fig. 3). A tube thoracostomy was performed immediately, resulting in the removal of 900 milliliters of blood and clots. An additional 1500 milliliters of blood was drained over the next six hours. A computed tomographic scan demonstrated that the screw tips penetrated approximately one centimeter beyond the right lateral cortex of the vertebral bodies (Fig. 4).

The patient immediately was taken to the operating room for a right thoracotomy, and 800 milliliters of blood and clots was evacuated. It was apparent that, with each respiratory movement, the diaphragm rubbed against the screw tip that was protruding from the body of the eleventh thoracic vertebra. A laceration over the diaphragm, with signs of active bleeding, was found near the screw tip. The most likely source of the bleeding was from an intramuscular branch of the phrenic or musculophrenic artery. The screw tip was cut with a high-speed drill, the bleeding artery was ligated, and the laceration was repaired. A chest tube was maintained for five days, by which time the drainage had decreased to less than fifty milliliters every twenty-four hours.

At the six-month follow-up examination, the lung was clinically and radiographically clear. The patient eventually recovered neurological function.

Discussion

The anterior approach to the spine has become an integral component in the treatment of a variety of spinal disorders. This approach first gained popularity after

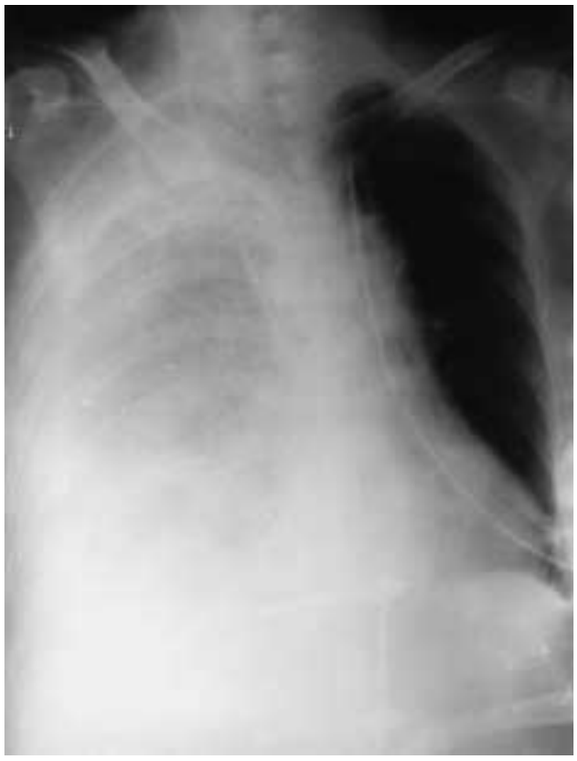

FIG. 3

Anteroposterior radiograph of the chest, showing a massive hydrothorax on the right side.

FIG. 4

Computed tomographic scan showing that the screw tip penetrated approximately one centimeter beyond the lateral cortex of the eleventh thoracic vertebra, contralateral to the point of entry of the screw.

it was described by Hodgson and Stock[8] in 1960 for the treatment of tuberculosis of the spine. Currently, anterior procedures are used for the treatment of a variety of spinal disorders, including congenital and idiopathic deformities[1,9], fractures[2,16], tumors[11,21], and infectious processes[3,4]. Strut grafts and instrumentation have made it possible to stabilize the involved segments[2].

Despite reports that anterior procedures on the spine are relatively safe, some surgeons avoid these procedures because of the perceived risks. Faciszewski et al.[5] reported a rate of major complications of 1 percent (thirteen of 1223 patients, of whom four died, two had paraplegia, and seven had a deep wound infection), and McDonnell et al.[17] reported a rate of major complications of 11 percent (forty-seven of 447 patients). McDonnell et al. noted that pulmonary complications were the most common type of major complication (5 percent; twenty-two of 447 patients); they usually were related to the extensive dissection and occurred on the side of the operative approach. Some authors have described complications such as erosion of the aorta by an impinging prosthesis[2,10,12]. We were unable to find documentation of delayed complications on the contralateral side of the incision or instrumentation.

Matsuzaki et al.[18] reported the case of a patient in whom the thoracic aorta was penetrated by a screw that had been inserted from the right side. Although the patient remained asymptomatic, the protruding screw tip was cut and removed six months after the initial procedure. An aortoplasty was performed with the use of a graft, to prevent the possible development of thrombosis or other delayed complications.

The present report documents the occurrence of a hemothorax contralateral to the side of the incision due to penetration of the diaphragm by a screw that protruded too far beyond the margins of the vertebra. We had intended for the screws to project just out of the vertebral bodies and to engage two cortices, thereby providing more stable fixation. We inadvertently left the screw tips protruding too far beyond the cortical margins because of inaccurate measurement of the widths of the vertebral bodies and failure to confirm the position of the screws on radiographs. Continuous irritation of the diaphragm by the sharp device, secondary to respiratory movements, resulted in a laceration that led to the development of a hemothorax.

When performing anterior spinal procedures in the thoracic and thoracolumbar regions, it is important to remember the anatomical features of the diaphragm. This musculotendinous, dome-shaped structure separates the thoracic and abdominal cavities and has a rich blood supply. Depending on the stage of the respiratory cycle, the diaphragm may be situated in a number of different positions in the chest. The central tendon may descend to the level of the ninth rib and migrate superiorly to the level of the fourth rib with each forceful respiration. Because of its unique shape, mobility, and close relationship with the thoracolumbar spine, the diaphragm is vulnerable to injury during a variety of thoracic and anterior spinal procedures[7].

Bone that has a low mineral density is associated with a higher prevalence of failure of instrumentation[14,15,20]. It is possible to obtain stronger and more rigid fixation of such bone with bicortical fixation of the screws[20]. It is generally recommended[13] that the screw tip extend approximately two millimeters beyond the contralateral cortex to ensure a secure bicortical purchase. However, the biomechanical benefits of bicortical fixation during anterior procedures on the spine should be weighed against potential risks.

In the case of our patient, the major concern was the possibility of an unexpected injury of the contralateral vital structures secondary to protrusion of a vertebral screw. The structures that are at risk following fixation at the eleventh thoracic level include the segmental vessels of the vertebra, the azygos and hemiazygos veins, the descending aorta, the lungs, and the diaphragm. Although we do not know the precise amount of protrusion that may endanger a patient, this issue warrants attention in view of the possibility of life-threatening complications.

We emphasize the importance of a correct determination of the appropriate screw length by means of a careful assessment of preoperative images combined with intraoperative measurement of the transverse diameter of the vertebral body with use of calipers. Screws should be inserted parallel to the vertebral end plate, and each screw should just penetrate the contralateral cortex for maximum fixation. The surgeon must confirm that the screw tip is just palpable beyond the cortex of the vertebral body, and the position of the screws must

be confirmed on radiographs. The use of low-profile, smooth-tipped screws and the application of a layer of viable soft tissue or a Teflon (polytetrafluoroethylene) sheet over the instrumentation may prevent abrasion and irritation of vital structures by the protruding screw tip. Additional stability of fixation should not be gained at the expense of an increased risk of complications. A rapidly progressive perioperative deterioration in the hemodynamic status of the patient after an anterior spinal procedure should alert the surgeon to the possibility of injury of the contralateral structures so that prompt and appropriate treatment can be provided.

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