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Case Report

Intraoperative tension pneumothorax during posterior vertebral column resection in a child with congenital scoliosis

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ABSTRACT

Background: Intraoperative tension pneumothorax (TPT) is extremely rare in spinal surgery overall and particularly in extensive deformity procedures. Here, we report a TPT occurring in conjunction with posterior vertebral column resection (pVCR) for the treatment of congenital scoliosis.

Case Description: A 12-year-old female undergoing congenital thoracic scoliosis surgery (e.g., pVCR) developed abrupt intraoperative increases in airway pressure and compromised hemodynamics that led to a TPT. This was directly attributed to an inadvertent pleural tear. Temporary drainage of the accumulated air was accomplished with a urethral catheter inserted directly into the pleural cavity. This was later supplemented with a standard chest tube. The child quickly improved and was routinely discharged a few days later.

Conclusion: In patients undergoing pVCR, if the surgical team is faced with unexplained hemodynamic instability and increased airway resistance, a TPT should be strongly suspected and appropriately managed.

Keywords: Complications, Congenital kyphoscoliosis, Posterior vertebral column resection, Spinal deformity, Tension pneumothorax

INTRODUCTION

Suk *et al.* (2002), Lenke *et al.*, and Xie *et al.* reported on how to manage congenital kyphoscoliosis utilizing the posterior vertebral column resection (pVCR) technique.[1-11,13-20] With pVCR, deep dissection between the transverses processes and the chest wall, with release/resection of the corresponding rib at the costovertebral junction on the convex side, may result in a pleural breach resulting in a tension pneumothorax (TPT).[5,6,12,13,17,20] Only five cases with TPT during scoliosis surgery have been reported.[7,14,18] Here, we contribute 6th case to the literature which is the first example occuring with pVCR technique.

CASE REPORT

Over a 2-year period, a 12-year-old female with thoracic scoliosis failed conservative management. Dorsal spine X-rays documented thoracic scoliosis of 50° due to an abnormal T6 hemivertebra

diagnosed on coronal computed tomography (CT) studies [Figure 1]. With the patient in the prone position, the T6 posterior vertebral column was resected, and pediatric pedicle screws were inserted in T4 and T5 vertebral levels proximally and T7 and T8 levels distally. This was followed by anterior reconstruction with a tricortical iliac allograft graft (e.g., from the right side).

TPT/Chest tube

Suddenly the anesthesiologist noticed hemodynamic instability and asked us to close the wound. But, with removal of the retractor blade, we noticed a pleural tear through which the bubbles of air coming out. Using a size 14 urethral catheter, the trapped air in the pleural cavity was decompressed temporarily. As the result the ventilation improved, the blood pressure stabilized, and the cardiac status normalized., letting us the finish the job and close the wound. Then, the patient was turned to supine position and a chest radiograph was obtained showing a TPT on the right side with complete collapse of the right lung warranting chest tube placement [Figure 2a]. Next chest radiographs showed re-expansion of the right lung [Figure 2b]. The TPT resolved allowing for chest tube removal 3 days later [Figure 2c]. The child was discharged on the 6th post-operative day. One year later, dorsal spine radiographs and reconstructed CT images documented adequate fusion of the scoliotic deformity [Figure 3].

DISCUSSION

Pathogenesis

TPT is defined by an extensive, trapped, accumulation of air within the pleural space.[2,8,11,14,18] It is extremely rare during spinal surgery and may be attributed to three different mechanisms. Most commonly, it occurs with the re-expansion of a pre-existing occult pneumothorax (e.g., with trauma resulting in vertebral column injuries). The second

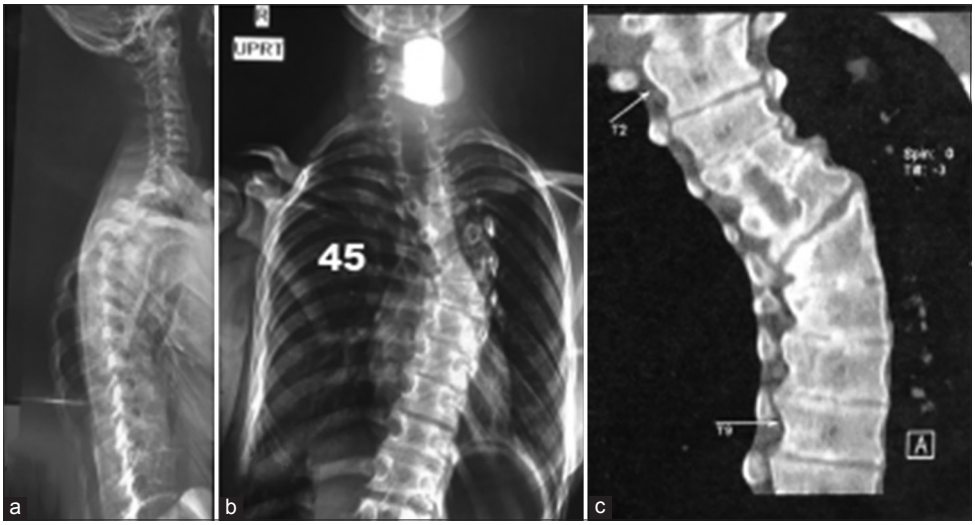

Figure 1: Pre-operative imaging, (a) lateral thoracic X-ray, shows normal kyphosis, (b) AP radiograph, scoliosis is 40°, (c) reconstructed coronal CT shows that an abnormal vertebra is responsible for congenital scoliosis.

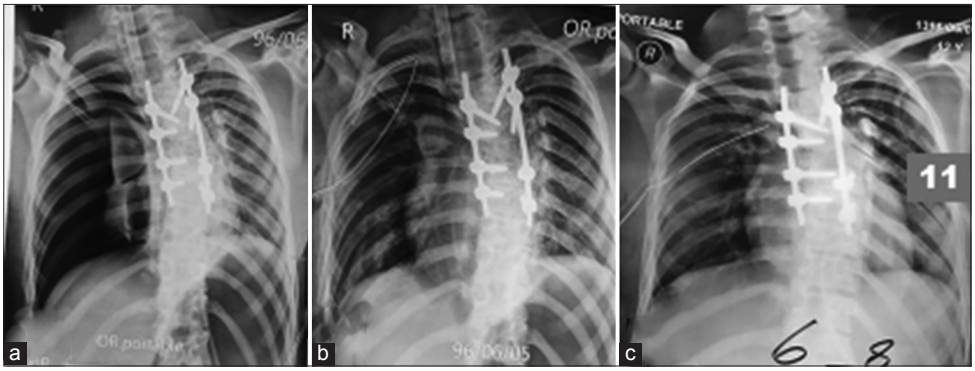

Figure 2: Intra and post-operative portable chest X-rays; (a) OR – X-ray shows right-sided TPT and shrinkage of right lung (white arrows), (b) X-ray in OR, with a chest tube, the right lung is shrunken yet (white arrows), the tip of the chest tube is kinked, but a few minutes later, it was replaced; (c) a few days later, the lung is expanded and no pneumothorax is seen.

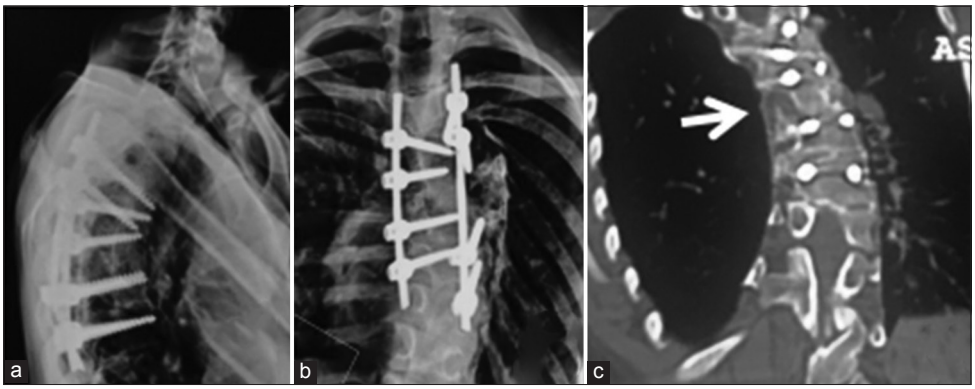

Figure 3: Post-OP imaging, (a) lateral view normal kyphosis is obtained, (b) AP radiographs showing the correction of scoliosis, (c) reformatted coronal CT, note all screws are in ideal place and a tricortical iliac graft (white arrow).

most common etiology is elevated peak inspiratory pressures. The third most common, and the one involved in this case, was attributed to an inadvertent pleural tear occurring during the surgical procedure (e.g., one-way entrance of air into the pleural cavity).[4,7,14,18]

Clinical picture

With a TPT, mediastinal shift results in acute decreased cardiac output as the venous circulation is blocked due to compression of the vena cava, atrium, and large veins.[2,4,7,14,18] These results in loss of pulmonary compliance, increases airway pressures, and fosters arterial hypotension. This series of events can result in a life-threatening circulatory collapse and hypoxia.[2,4,7,13,14,18]

Diagnosis of TPT

TPT may occur with various etiologies that include airway disconnection, a plug in the airway, an allergic reaction, pulmonary emboli, an occult vascular injury, over-bleeding, and here, scoliosis surgery. The diagnosis of TPT in a patient under general anesthesia and in the prone position is challenging. TPT should be suspected by the anesthesiologist observing unexplained elevated airway pressures, the sudden fall of oxygen saturation, unilateral absence of breath sounds, and hypotension disproportionate to the intraoperative blood loss and is typically resistant to replacement therapy and inotropic drugs.[2,4,7,13,14,18] Notably, an intraoperative chest X-ray might be very time-consuming. Therefore, if available, an intraoperative ultrasound should be considered to more rapidly obtain critically valuable diagnostic information to promote immediate treatment.[2,4,7,13,14,18]

Treatment

Emergent decompression of TPT is critical. Swift drainage of intrapleural air may utilize a large bore needle (e.g., performed through the second intercostal interspace in the midclavicular line).[2,4,7,13,14,18] If needle aspiration is not feasible, the wound can be emergently closed, and the patient turned into the supine position, allowing for a chest X-ray to be obtained. Once TPT is confirmed, a chest tube can be inserted.[2,4,7,13,14,18] After the re-expansion of the lung and attachment of the pleura to the chest wall, the chest tube should be continued for at least an additional 3 days.

CONCLUSION

During congenital scoliosis surgery with pVCR technique, the pleura is typically exposed bilaterally. This increases the risk of TPT as pleural tearing may occur during disarticulation/partial resection of the rib head at the corresponding costovertebral joints. Once TPT is suspected, it is imperative to immediately remove the trapped air from the lung cavity. This case report should reinforce recognition of TPT by both neurosurgeons and anesthesiologists involved in the surgical management of scoliosis.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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