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Case Report

Bilateral multiple ribs and sternum fracture causing central flail chest with respiratory failure

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ABSTRACT

Bilateral thoracic blunt injuries in a patient may present with central Flail chest, and acute respiratory failure which is one of the life-threatening complications. We present a case of central flail chest caused by blunt trauma, successfully managed with operative rib and sternum fixation. A 35-year male with a central flail chest with acute respiratory failure caused by road-traffic accident who was managed initially with bilateral intercostal chest-tube drainage for significant bilateral hemopneumothorax and lung contusions. The patient was intubated and connected to mechanical ventilatory support with positive pressure ventilation for the internal pneumatic stabilization. There were multiple rib fractures anteriorly (first to seventh rib bilaterally) and fracture of the sternum - the flail chest, for which he underwent bilateral rib fixation and fixation of sternum with titanium reconstruction plate and screws on the 9th postinjury day. Tracheostomy was done along with fixation in the same sitting. Post-operatively, after 48 hours of positive pressure mechanical ventilation, the weaning was started and by the 4-5th day, the patient was on room air with a tracheostomy tube. The patient recovered uneventfully and was discharged on the eighth postoperative day.

Keywords: Bilateral chest trauma, Flail chest, Acute respiratory failure, Osteosynthesis

INTRODUCTION

Worldwide, trauma is the sixth leading cause of death, leading to five million or 10% of all deaths annually.[1,2] It is the fifth leading cause of significant disability. About half of trauma deaths are in people aged between 15 and 45 years and trauma are the leading cause of death in this age group.[2] In India, the trauma patients are younger with male preponderance, with road traffic injuries as the leading cause, and significantly higher mortality.[3] 20% of patients presenting following trauma have thoracic injuries.[4] During the first hour in the hospital, the most common causes of death are thoracic and central nervous system injuries.

The clinical presentation and progression course of blunt chest trauma has a wide variability with different mortality rates in various reports ranging from 3% to 25% according to the severity of the trauma and the magnitude of the insult.[5] The impact of the blunt bilateral chest trauma on general health, its risks, strategies of management and outcome are not well understood.[6] Anterior Flail chest which includes the sternum are rare, and they clinically manifest as acute respiratory failure. The management of such patients poses challenges to clinicians and are evolving with evidence-based practice and surgical experience.

CASE REPORT

A 35-year male, driving a motorbike collided with a fast moving car, and was received in respiratory distress, pallor, tachycardia(112/min), tachypnea (38/min, shallow breathing, surgical emphysema over rt. chest wall, SpO2: 82-84% on room air, a blood pressure of 100/70 mmHg, and altered sensorium (GCS:E3V3M5). Immediately, intensive management was started. The Chest examination revealed a large antero-central flail chest - paradoxical motion of a segment (12×10 cm) involving the sternum. The percussion was dull, air entry was absent in the right lower third of the chest, and thoracocentesis confirmed hemothorax.

The flail segment was gently strapped for immediate stabilization. An intercostal chest tube was placed bedside immediately under local lidocaine anesthesia in the right 6th intercostal space, midaxillary line, which immediately drained 550 ml of blood. The haemoglobin was 6.4 gm/dl, ABG pH with mild acidosis, and other blood profiles were within normal limits. With ongoing management, including packed red-blood cells transfusion, oxygen therapy with venti masks the patient was clinically stabilized.

Abdomen was clinically normal. Chest CT scan revealed Bilateral Lung Contusions, in the upper and apical lobes with multiple rib fractures anteriorily (first to seventh rib bilaterally) and fracture of the sternum with the flail segment, the chest-tube on right side in-situ, pneumomediastinum with haemothorax on the left side (Figure 1 & 2). The CT scan of the Head was normal. The intercostal tube was placed in the left pleural cavity under local lidocaine anaesthesia. The chest-tube drained 350 ml of blood immediately (Figure 3).

Due to the acute respiratory failure, the patient was intubated and connected to ventilatory support (Mode: VC ACMV, TV: 500 ml, I:E:1:2, RR:18, PEEP: 5 cmH2O, FiO2: 100%, on midazolam+vecuronium infusion) with positive pressure ventilation. Gradually the drainage in the chest tubes bilaterally declined by the 5th day. Failure to wean-off from the ventilatory support, and in view of the significant anterocentral flail segment including the sternum, causing paradoxical movement of the chest wall leading to respiratory failure, the decision for surgical internal fixation (osteosynthesis) was taken in collaboration with the chest surgeon.

Surgery was performed under general anaesthesia with bronchial blocker for selective lung ventilation. Muscle splitting incision was given in posterolateral aspect at 5th intercostal space on both sides, broken ribs were dissected with help of C-arm. On rightside 4th, 5th and 7th rib were fractured and displaced while 3rd and 6th rib were having hairline fracture. 4th, 5th and 7th synthase rib fixation system and fixed with a precontoured titanium plate and interlocking screw of synthase rib fixation system (Figure 4). On the left side 4th rib was having a depressed fracture and 3rd, 5th and 6th rib were having non displaced hairline fracture. A recontoured titanium plate was used with interlocking screws to fix the 4th rib (Figure 5). There was also a transverse fracture in the sternum for which midline incision was given at site of fracture with help of C arm and universal titanium plate was used to fix it (Figure 6).

An epidural line was placed for pain relief during weaning from mechanical ventilation. Tracheostomy was done along with fixation in the same sitting. Post-operatively, after 48 hours of positive pressure mechanical ventilation, the weaning was started and by day 4-5 postop the patient was on room air with tracheostomy tube.

On the 7th day the tracheostomy tube was removed. The patient improved and recovered uneventfully and was discharged on the 8th postoperative day. His follow up at three months is normal and is back to his workplace job.

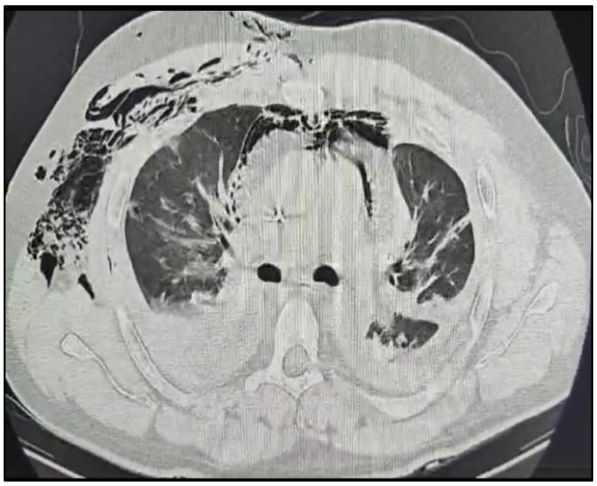

Figure 1: CT scan of the Chest - bilateral lung contusions, hemo-pneumothorax left side, and pneumomediastinum, with chest-tube in the right pleural cavity.

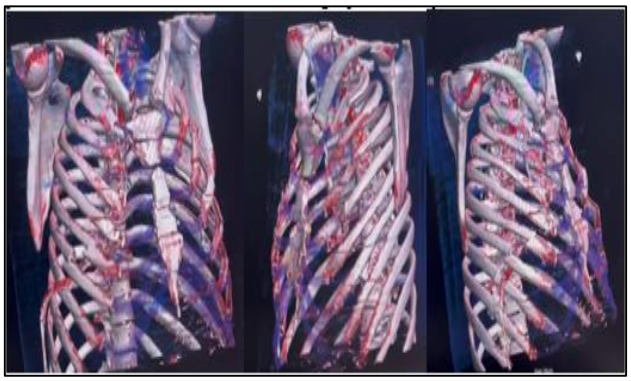

Figure 2: 3D reconstruction of the rib cage with multiple rib fractures anteriorly (first to seventh rib bilaterally) and fracture of the sternum, the chest-tube in the right pleural cavity.

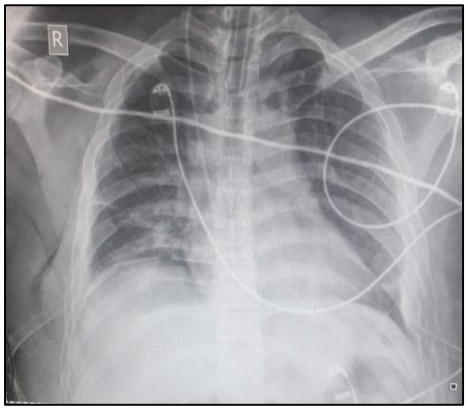

Figure 3: Post-chest tube insertion bilaterally, with expanded lungs on both sides.

Figure 4: Fixation of right ribs (4, 5, and 7).

Figure 5: Fixation of 4th rib left.

Figure 6: Fixation of sternum with implants in-situ.

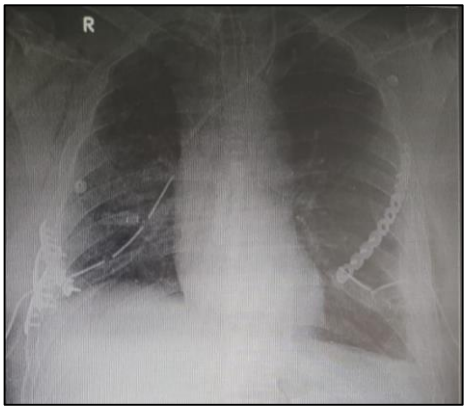

Figure 7: Post op radiogram with implants in-situ.

DISCUSSION

In bilateral chest and sternum trauma, flail chest is considered a serious complication. The paradoxical movement creates a negative inspiratory force on the side of the flail chest and prevents the expansion of the ipsilateral lung. Additionally, this also results in an intrapleural pressure gradient which may significantly compromise the venous return to the heart and produce hypotension leading to hemodynamic instability. The pulmonary dynamics changes adversely leading to reduced functional residual capacity, restricted ipsilateral lung expansion causing alveolar collapse, atelectasis, reduced gaseous exchange and hypoxemia.[7] Early mortality in flail chest is due to massive hemothorax, lung contusions or lacerations, whereas the acute respiratory distress syndrome takes over in the later days.

The traditional treatment of both rib and sternal fractures has been limited to pain control with narcotics, pulmonary toilet and internal pneumatic stabilization with mechanical ventilation in selected patients, while the fractures would heal conservatively.[8] By reducing the dead space with reduced work of breathing, the tracheostomy helps recovery, and facilitates effective tracheobronchial toilet. In literature, the timing of surgical interventions for the internal fixation have not reached a consensus. A multicenter study of time to surgical stabilization of rib fractures found that, the outcomes were improved when surgery was performed within 48 hours.[9]

There is little benefit in surgically fixing the chest wall for those patients who are beyond 8 to 10 days post-trauma.[10] In our patient the large anterocentral flail chest produced acute respiratory failure. The intubation of patient and mechanical ventilation addressed the twin objectives of managing the acute respiratory failure, and simultaneous internal pneumatic stabilization of the flail chest, which reversed the pulmonary adverse effects of paradoxical chest wall movements. Mechanical ventilation was required to be continued until the end of paradoxical movement, necessitating a long-term ventilatory support with morbidity and risks for

complications. The Surgical fixation of chest-wall bilaterally, and sternum facilitated the uneventful recovery and better surgical outcomes and quality care.

CONCLUSION

The surgical stabilization of the chest wall and sternum in cases of central flail chest is an effective treatment choice with successful treatment outcome to overcome the need for prolonged mechanical ventilation, and circumvent its potential complications.

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