CASE REPORT

Surgical stabilisation in a 13-year-old boy with traumatic flail chest

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SUMMARY

Flail chest after blunt trauma to the chest has a high morbidity and mortality rate. Traumatic flail chest in children rarely occurs due to flexibility of the ribcage. We describe the case of a 13-year-old boy sustaining a flail chest after a high-energy trauma. Conservative treatment with proper mechanical ventilation and pain management was unsuccessful, and was followed by operative rib fixation. The patient was discharged home 17 days after surgery and, at 4 months follow-up, had fully recovered. This case report shows the possibility of operative rib fixation as treatment for flail chest in children.

BACKGROUND

Flail chest occurs when multiple rib fractures cause a loss of stability of the ribcage, resulting in a paradoxical movement of a segment of the chest wall during respiration. Flail chest is usually caused by direct impact or compression on the chest wall and is associated with a high mortality rate.^{1–2} Significant short-term and long-term morbidity including sepsis, pneumonia as well as decreased lung volume and chronic pain have been reported.^{2–5} In adult patients, studies show that operative rib fixation may be beneficial compared to conservative treatment, in terms of mortality, ventilation requirement and hospital stay.^{3–6} In children, the situation differs from adults because of greater ribcage flexibility. This is reflected in the lower incidence of flail chest and rib fractures in children.⁷ To date, only one report describing surgery as a treatment for an adolescent male who sustained blunt trauma to the chest has been published.⁸ The present case report describes the surgical treatment and outcome of a child with traumatic flail chest.

CASE PRESENTATION

A 13-year-old boy was transferred to our tertiary trauma referral centre after an accident between a car and a bike. The patient received initial screening in a nearby hospital, demonstrating a right-sided flail chest, an associated pulmonary contusion on both sides and haemopneumothorax on the right side, with oxygen saturation of 85%, a pulse of 115 bpm and normal blood pressure. After insertion of a chest drain, oxygen saturation increased to 100%. A chest X-ray (figure 1) and a three-dimensional (3D)-CT of the thorax (figure 2) was performed, showing multiple rib fractures in ribs 1–9 on the right and ribs 2–4 on the left, a left-sided displaced clavicle fracture, a right-sided

scapula fracture and a 9 cm laceration of the liver without active blush. There was no intracranial, spinal or pelvic injury. After initial stabilisation, the patient was transferred to a level I trauma centre where he required mechanical ventilation with 10 cm H₂O positive end-expiratory pressure (PEEP) and FiO₂ of 35%. He was subsequently admitted to the paediatric intensive care unit. In the following week, several attempts to wean the patient off mechanical ventilation were unsuccessful due to increased oxygen and PEEP requirements with reappearance of the flailed segment. Owing to his persistent mechanical ventilation dependency (PEEP 8 FiO₂ 30% and pressure support 12 cm H₂O), we decided to proceed with open reduction and internal fixation. On the ninth day of admission, the surgery was carried out through a right lateral thoracotomy on the fourth rib. The latissimus dorsi muscle was mobilised and then split, with preservation of the dorsal thoracic nerves. The third and fourth ribs showed dislocated fractures without signs of early callus. The intrathoracic fascia was opened and the thickness of the fourth rib was measured. The fourth rib was fixated with a 3 mm intramedullary splint (DePuy Synthes). The same procedure was followed for the third rib (figure 3). After fixation, the chest wall was considered stable on manual manipulation, after which the thoracic cavity was flushed and a chest drain was placed. Postoperatively, a mucus plug developed in the left main bronchus, presumably due to thoracic surgery, when the patient had been positioned on his left side. As a result, he developed an obstructive atelectasis of the left lung, for which he was treated with bronchoscopic mucus removal and antibiotics. In the next 6 days, he occasionally showed distress with respiratory insufficiency and

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Figure 1 Chest X-ray at the emergency department.

Figure 2 Three-dimensional view of CT scan of the chest at admission.

increased mechanical ventilation requirement (PEEP 8 and FiO₂ 50–90%). Subsequently, he was successfully weaned off the ventilator, and could be extubated 7 days postoperatively and transferred to the paediatric ward, with an average oxygen saturation of 99% and respiratory rate of 17. The further course of admission was uneventful. The patient was transferred to his local hospital 12 days after surgery and was discharged home 5 days later.

OUTCOME AND FOLLOW-UP

At 4-month follow-up, the patient had fully recovered, with no respiratory problems. The rib fractures and clavicle fracture had healed completely. He returned to school and resumed his normal sport activities.

DISCUSSION

This case report shows that an operative rib fixation of a flail segment in a child may provide an additional treatment option for the management of flail chest in cases of failed weaning. Rib fractures can be overlooked and estimating the severity of the fracture is sometimes difficult with X-ray or CT. In case of thorax trauma, a 3D reconstruction provides useful additional

information to estimate the number, location and severity of rib fractures.

Owing to the lack of guidelines and studies on surgical rib fixation in children, mechanical ventilation is the current primary treatment. Therefore, in the case presented, surgical stabilisation was performed only on the ninth day of admission. In adults, early surgical fixation of ribs is generally recommended. Fortunately, the postponement did not influence the procedure in terms of difficulty.

A stable thorax is needed for adequate respiration. The third to sixth ribs play a key role in the stability of the ribcage. In this case, a stable thorax was obtained after fixation of the third and fourth ribs on the right. Therefore there was no further need for fixation of the ribs on the left or fixation of the fractured clavicle bone.

We presented the case of a young patient with flail chest, a haemopneumothorax and pulmonary contusion, who failed to be weaned off mechanical ventilation, and who had a full recovery after surgical stabilisation of the flail segment.

Learning points

- ▶ Flail chest after blunt trauma to the chest has a high morbidity and mortality rate.
- ▶ Traumatic flail chest in children rarely occurs due to the flexibility of the ribcage at young ages.
- ▶ Three-dimensional reconstruction of the ribcage provides a good overview to estimate the number and location of rib fractures.
- ▶ In case of a flail chest, not all fractured ribs require surgical fixation to create a stable thorax.
- ▶ Operative rib fixation of a flail segment in a child may provide an additional treatment option for the management of flail chest in cases of failed weaning.

Contributors MP, the guarantor, was the surgeon who treated the patient; he also gave the proposal for this case report, adjusted the draft and gave final approval of the version to be published. AS revised the report critically and made adjustments. BSL wrote the article and performed the literature search.

Competing interests None declared.

Patient consent Obtained.

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Figure 3 Chest X-ray of the patient day 6 post operation.

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