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Treatment of isolated sternal fracture with a vacuum bell in an 8-year-old boy

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Abstract

Isolated sternal fractures are very rare in children. Pain management is the method of choice, but surgery may be indicated in selected cases with dislocated fractures. However, the indication for open reduction of sternal fractures is discussed controversially. To the best of our knowledge, we present the first report of a child with displaced isolated sternal fracture who was successfully treated by conservative means using a vacuum bell.

Keywords: Isolated sternal fracture • Vacuum bell • Children • Conservative treatment

INTRODUCTION

Isolated sternal fractures (ISFs), defined as sternal fracture without any concomitant fracture, represent a very rare pattern of injury, especially in children, with incidences ranging from 0.5% to 3% [1]. In general, ISFs are managed without reduction [2]. Severely displaced sternal fractures may require surgical correction. The necessity and indication for surgical repair are discussed controversially. To the best of our knowledge, this is the first report of a displaced ISF in a young child treated successfully by closed reduction using a vacuum bell (VB).

CLINICAL SUMMARY

An 8-year-old boy with anterior chest pain after a fall during trampoline jumping was admitted to our emergency department. Physical examination revealed severe tenderness and local swelling around the sternal body. The child complained of dyspnoea when lying in the supine position. Auscultation of the lungs and the heart was normal. Anteroposterior and lateral chest X-rays were obtained and revealed an ISF with posterior dislocation of the distal fragment (Fig. 1). No additional osseous lesions were detected. Sonography confirmed dorsal displacement of the sternal fracture measuring 7–8 mm, located close to the manubrium, and pericardial effusion was excluded. Blood tests including myocardial creatine phosphokinase, troponin T and electrolytes were normal. Electrocardiogram and echocardiography revealed no pathological findings. Because of severe pain, the fracture was reduced using a VB under general anaesthesia (Fig. 1). Based on

the age of the patient and the area of contact surface, the smallest available model of a VB (16 cm in diameter) was used. After placing the centre of the VB directly over the ISF, the pump of the VB was activated several times until the contact was achieved between the skin of the patient and the window of the VB. After sternal reduction using the VB, the patient's pain was well controlled with oral non-opioid analgesics, and he was discharged on the first postinterventional day. Follow-up sonography after 1 week revealed a secondary displacement of 5 mm. The VB was applied to the patient temporarily for 6 weeks (30 min twice a day). During that time, the patient was recommended to refrain from any physical exercise. A special dressing to fix the chest wall was not necessary. Clinical and radiological follow-up examinations conducted 6 months after trauma showed a stable reduction and consolidation of the fracture in the sternum (Fig. 2).

DISCUSSION

ISF in children is very rare [1]. They occur as a result of forceful, blunt thoracic trauma caused by a motor vehicle crash or direct injuries inflicted to the sternum. Forced flexion of the sternum across the shoulder harness of the seat belt may cause ISF in children, whereas fractures of the sternum without direct trauma are extremely rare [2].

The ISF is diagnosed most accurately by lateral plain chest X-ray [1]. Anteroposterior chest X-ray helps to detect associated bone injuries and haemopneumothorax. As was the case in our patient, ISF occurs most frequently close to the sternal synchondrosis joining the manubrium to the sternal body [3].

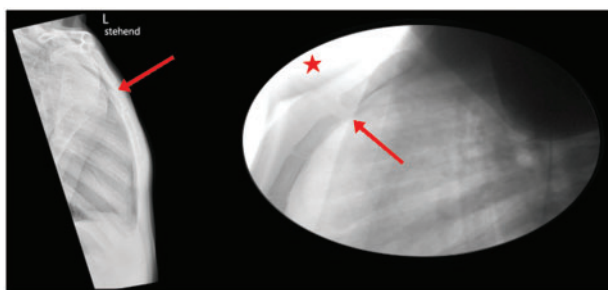


Figure 1: Complete reduction of the sternum fracture by using the vacuum bell (asterisk) during general anaesthesia in an 8-year-old boy. The isolated sternal fracture is exhibited on the left picture (arrow).



Figure 2: Ultrasound image (longitudinal view) showing adequate remodelling of the anterior outline of the sternum 6 months after isolated sternal fracture (arrow).

General treatment recommendations for the management of ISF in children are still lacking [3]. The extent of sternal fracture displacement, necessary pain relief for the child and the presence of myocardial injury and/or pulmonary contusion dictate further treatment steps. Furthermore, sonography reveals the extent of displacement more precisely and allows exclusion of the pericardial effusion. Our results are in line with the conclusions drawn by Kouritas *et al.* [2] that cardiac manifestations in patients with ISF are very rare, that patients with ISF usually are admitted for 24–48 h and that sonography should be performed in all sternal fracture patients. Cardiac monitoring is not mandatory in ISF as long as haemodynamic or cardiac instabilities are excluded [3].

Indications for surgery include compression of the heart, massive post-traumatic pain, risk of non-union and deformity of the

anterior chest wall with the risk of secondary pectus excavatum [3]. Open reduction and internal stabilization of the sternum is an invasive procedure not only requiring a disfiguring skin incision and osteosynthesis with pins, wires, sutures, plates or screws but also increasing the hospital length of stay [4]. On the basis of our experience with the VB for conservative treatment of pectus excavatum [5], we decided to use the VB for closed reduction of the ISF. Secondary displacement, as observed in our patient, has to be excluded during close follow-up and in case of suboptimal alignment of the sternum, a longer period of VB application might be advisable, similar to the treatment of pectus excavatum. Of course, this method of conservative treatment using a VB is not applicable in every patient. The degree of displacement of ISF, flexibility and rigidity of the patient's chest wall, which is age dependent, and the intensity of pain during VB application are some major aspects that might limit the application of this treatment method. Furthermore, the side effects described already while using the VB such as subcutaneous haematoma, petechial bleeding and transient paraesthesia of the upper extremities should be considered. These side effects may also limit the applicability of VB therapy to treat ISF.

CONCLUSION

In children, displaced sternal fractures without concomitant injuries may be reduced completely and cost-effectively using a VB, thus avoiding surgery.

Conflict of interest: none declared.

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