Fracture of the manubrium with posterior displacement of the clavicle and first rib

A case report

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Summary. *This report describes a patient with a fracture of the manubrium of the sternum of a type which has not been reported previously. We discuss the incidence, the mechanism of production and the site of these fractures, and their treatment and prognosis.*

Resumé. *Ce rapport présente un cas de fracture du manubrium sternal qui semble unique dans la littérature mondiale. Nous rapportons une évaluation complète des fractures du sternum, suggérons un traitement, analysons leur fréquence, mécanisme de production, localisation et pronostique.*

Introduction

In 1964 Helal reported a 0.5% incidence of sternal fractures of all fractures and, of these, one out of 20 was a fracture of the manubrium [9]. Brookes et al. reported, in a study carried out over 6.5 years, that of all the patients admitted as a result of a road traffic accident (RTA), 0.8% showed fractures of the sternum, and of these only 6 involved the manubrium [2]. In a comparable period, Hills et al. found sternal fractures in only 1.3% of 2226 RTAs [11]. Gibson et al. reported 80 fractures of the sternum out of 18000 cases over a period of 11 years; of these, 61 survived, among them 2 with manubrial fractures; there were 19 deaths and 3 of these had fractures of the manubrium [7]. Retrosternal dislocation of the clavicle is extremely rare [4, 6–8, 16–21]; only 3 such injuries were seen at the Mayo Clinic during 50 years [16].

There are three ways in which fractures of the sternum may be produced. Firstly, by direct force from impact against the steering wheel, or the effect of a seat belt [2, 9–11, 15, 18, 19]; these fractures occur mainly at the level of the sternal body with posterior displacement. Secondly, by flexion-compression with the head thrust forward with forced flexion at the cervicothoracic junction, resulting in a fracture of the manubrium, or a fracture between it and the body of the sternum, and frequently associated with vertebral body compression [6] and thirdly, by lateral application of force to the shoulder which usually dislocates the sternoclavicular joint, but without an associated

Fig. 1. Chest radiograph before operation. There are multiple fractures of the left ribs and asymmetry between the medial ends of the clavicles. A haemopneumothorax is present with subcutaneous emphysema on the left side (arrows)

Fig. 2. CT scans at the level of the sternoclavicular joint and manubrium **a–b** before and **a'–b'** after operation. **a** shows the abnormal shape of the sternoclavicular joint on the left; **a'** the normal appearance after reduction and fixation. **b** demonstrates the fracture of the manubrium, and **b'** reconstitution of the normal anatomy (black arrows). **a–b** the white arrows show the shape of the pectoral muscle and the skin line before operation; **a'–b'** the change after stabilisation

Fig. 3. Drawing showing the fracture line which runs slightly obliquely from medial and proximal to lateral and distal, and is slanted inwards in an anteroposterior direction. The anterior sternoclavicular ligament is partly torn, the costoclavicular ligament is intact. *sc*, sternoclavicular ligament; *ccl*, costoclavicular ligament; *fr*, first rib; *c* clavicle

Fig. 4. Radiograph after operation showing the realignment of the clavicles after reduction of the fracture, and fixation with K-wires and a 4 mm screw

fracture [1, 4, 8, 16, 21]. This was the mechanism in our case.

Case report

A man, 33 years of age, was admitted after a traffic accident. His left shoulder had struck a wall. On admission, he was conscious, had severe pain in the left chest and diffuse abdominal pain. He had difficulty in speaking due to pain and subcutaneous emphysema in the neck, shoulder and the left side of the thorax. He also had abrasions on his right thumb.

A radiograph of the chest showed anteromedial fractures of the 3rd to the 6th costal arches, and the 5th to the 10th posteri-

or arches (Fig. 1). A water-seal pleural catheter was inserted for his haemo-pneumothorax. After laparoscopy, a median supra- and infraumbilical laparotomy was carried out, evacuating 30 ml of blood from the peritoneum; two spleen lacerations were sutured.

Due to severe pain and limitation of neck movement, he had shallow superficial respiration and did not try to expectorate. On the 4th day, a deformity of the vertex of the left upper chest was observed with depression of the clavicle, disappearance of the supraclavicular hollow and prominence of the left edge of the sternum. Radiographs taken in various positions did not clarify the situation. CT showed a fracture of the manubrium (Fig. 2).

We decided to operate to stabilise the fracture. The antero-superior part of the sternoclavicular ligament was torn. The

medial end of the clavicle and the first rib, with an irregular triangular osseous fragment of manubrium about 4 cm×2 cm, was occupying the retrosternal space (Fig. 3). A towel clip in the bony fragment was used to pull the clavicle and first rib forward, achieving an anatomical reduction of the manubrium. A Kirschner wire was inserted from the clavicle to the body of the manubrium, and another from the notch of the manubrium to the tip of the fractured fragment. Interfragmentary fixation was achieved with a 4 mm cancellous screw placed on the lateral edge of the fragment and directed towards the manubrium (Fig. 4). The ligament was repaired.

After operation, his pain decreased and he was able to lift his head and brace his shoulders; he could expand his chest and pulmonary function improved. He was discharged from the hospital 5 days after operation. The Kirschner wires were removed after 4 weeks [17]. After 2 months, he was able to return to his normal activities.

Discussion

The fracture was produced by a force transmitted through the clavicle directly to the articular surface of the manubrium. Contact between the two bones occurs during clavicular rotation [18, 19], and the left arm must have been in extension or flexion at shoulder level. The impact of the two bones and the resistance of the posterior sternoclavicular ligament and the costoclavicular ligament, caused the fracture. The abrasion on the right thumb supports this assumption since he probably attempted to lessen the impact with his hand.

There is a low incidence of associated injuries to the mediastinum or large blood vessels [2, 11, 12, 20]. In our case, the only indirect evidence data of cardiac contusion was a slight alteration of enzymes detected when he was first admitted.

Clinical and radiological evaluation of these injuries is difficult. Routine radiographs do not always show the fractures which are suspected clinically. The Heining projection for the sternoclavicular area [8] should not be used in patients with severe thoracic trauma because of the movement which is necessary to obtain the required view. Ultrasound studies are a good alternative, and the speed which they can be carried out is an advantage [5]. Fenkl described the value of CT for studying the sternoclavicular region and the sternum [3]. Jurik used a 3-dimensional spiral CT scan to evaluate the bones and joints of the anterior wall of the thorax [14]. This is costly and not available in many hospitals.

No specific treatment is required in the great majority of sternal fractures, and cardiovascular complications are rare.

In our case, we were faced with the difficulty of establishing a radiographic diagnosis, despite the CT scan which was only correctly interpreted after operation. The clinical findings, based on the deformity of the chest, the instability of the sternoclavicular joint,

the inability of the patient to move his arm because of pain, as well as compromised pulmonary function, led to the decision to operate. Once the sternoclavicular joint was stabilised, the rapid recovery of function demonstrated the importance of this joint and its relationship to thoracic stability in rib fractures.

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