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Comminuted Sternal Fracture – A Sternotomy Wire Fixation: Report of 2 Cases

Dr. Ramzisham

Mohd Ramzisham Abdul-Rahman, MS, Ngoo Kay Seong, MBChB, Tan Guan Hee, MRCS, Mohd Eyad Aljada, MBBS, Talal Ahmed Reda, PhD, Joanna Ooi SuMin, MMed, Mohd Zamrin Dimon, MS

Heart and Lung Centre, Universiti Kebangsaaan Malaysia Medical Centre, Jalan Yaacob Latif, Cheras, Kuala Lumpur, Malaysia

ABSTRACT

Various techniques of sternal stabilization via either metal plates or wires have been described. We describe an alternative technique of simple median sternotomy followed by reduction and wire fixation of the sternal fracture. The 2 patients described in this report had traumatic comminuted and displaced sternal fractures. Even though wire repair was deemed to be tedious and achieved poor approximation of the bone, we performed median sternotomy and achieved simple wire fixation with an excellent result.

INTRODUCTION

Isolated sternal fractures are almost always benign and heal spontaneously [Velissaris 2003]. Surgery is indicated if the fracture is displaced and overlapping [Molina 2005]. Many surgical techniques have been described for repair, either with metal plates or with wires [Richardson 2007]. Many of these procedures require specialized skills and instruments and are inevitably expensive. Therefore, treatment tends to be conservative and delayed, especially in regions lacking the necessary surgical expertise and advanced instruments. We describe 2 exemplary cases of simple sternotomy, open reduction with direct mediastinal inspection, and fixation with stainless steel wire, which produced excellent fixation.

CASE REPORT

Case 1

A 64-year-old man was referred for a sternal fracture after a road traffic accident. Apart from central chest pain, he was stable with a normal electrocardiogram. A chest radiograph and a computed tomography scan revealed a sternal fracture at 7 cm below the manubriosternal junction (Figure 1). There was a comminuted fracture with the superior segment of the sternum displaced inward and downward toward the mediastinum. In view of its fracture segments, surgical fixation was chosen. A standard midline skin incision was performed. The fracture segments were comminuted and had brittle edges. This feature made fracture reduction very difficult without causing more damage to the fracture edges. Part of the inner cortex of the inferior segment and part of the outer cortex of the superior segment had been shaved off because of the shearing force as they slid past each other. We debrided the fractured sternal ends and then evacuated the substernal

Figure 1. Computed tomography scan of the patient in case 1.

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Correspondence: Dr. Mohd Ramzisham Abdul-Rahman, Lecturer/Specialist in Cardiothoracic Surgery, Department of Surgery, Universiti Kebangsaan Malaysia Medical Centre, Jalan Yaacob Latif, 56000 Cheras, Kuala Lumpur, Malaysia; 00603-91456201/2; fax: 00603-91737831 (e-mail: ramzisham@hotmail.com).

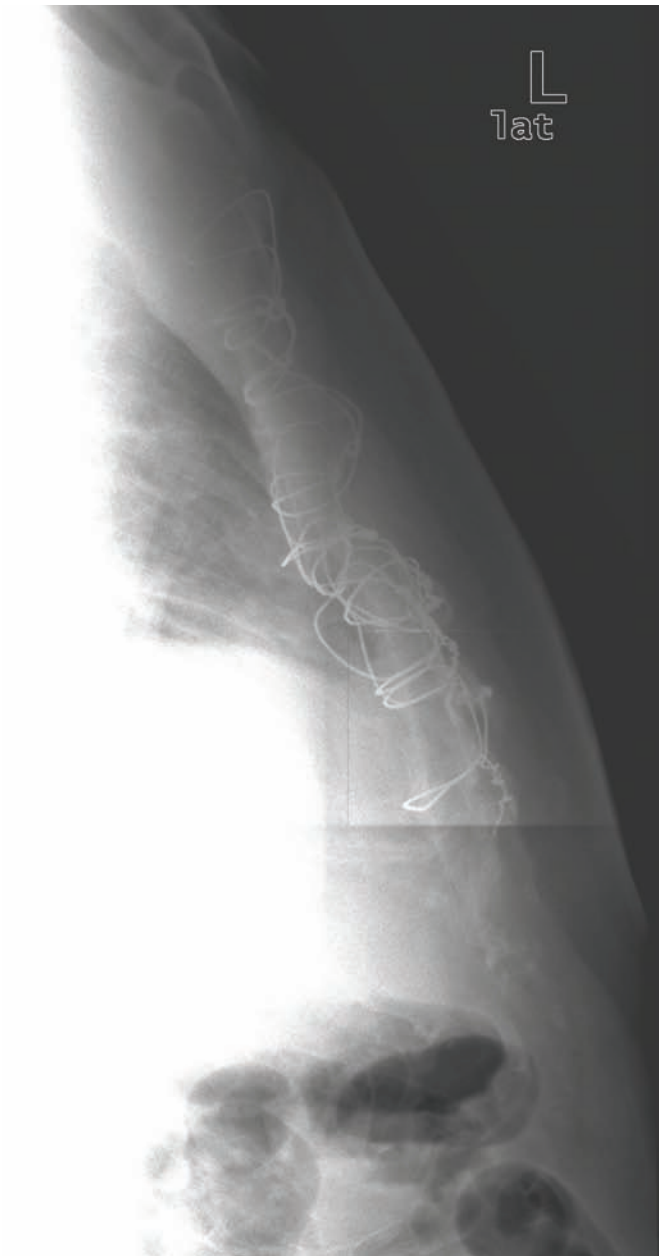

Figure 2. Postoperative radiograph (lateral view) of the patient in case 1.

hematoma. We proceeded with a midline sternotomy. The pericardium was noted to be intact. The sternotomy made the sternum much more mobile, thereby allowing the fracture to be easily reduced. After debridement, the sternum was noted to be effectively in a few pieces. The comminuted fracture was stabilized with multiple steel wires (size 6). The 2 comminuted pieces in the middle were secured to the upper segment and the lower segment with sternal wires. The upper and lower segments were then secured to each other with one sternal wire on each side of the sternotomy. Finally, the sternotomy was closed in the usual figure-of-eight fashion (Figure 2). The reduction and fixation were clinically and

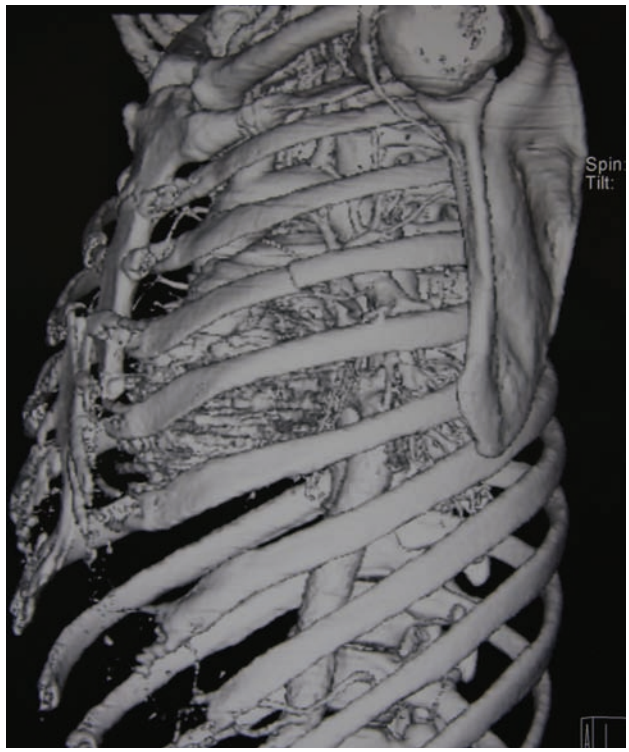

Figure 3. Computed tomography scan of the patient in case 2.

Figure 4. Postoperative radiograph (oblique view of the patient in case 2.

radiologically sound. The patient made an uneventful recovery and was discharged home after 2 days. A follow-up at 8 weeks was satisfactory.

Case 2

A 45-year-old gentleman sustained a sternal fracture after a fall from a ladder. An electrocardiogram showed ST-segment depression, and an echocardiographic evaluation revealed a pericardial effusion. A computed tomography scan showed an oblique fracture of the sternum approximately 10 cm from the sternal notch with comminuted fragments, one of which pierced the pericardium (Figure 3). The patient was otherwise stable with no other injuries. Operative fixation was chosen because of the nature of the fracture and the associated ischemic changes. Intraoperative findings included a communicated fracture at the level of the right fourth intercostal space extending down to the left fifth space, with the superior segment displaced posteriorly and inferiorly, tearing the pericardium. We collected 150 mL of hemoserous fluid. Again, a median sternotomy was performed, and the fracture was stabilized with steel wires in a manner similar to that of the case previously described. A mediastinal drain was placed, and the sternum was closed in the usual manner (Figure 4). The fixation was satisfactory with complete stability at the 8-week follow-up examination.

DISCUSSION

Uncomplicated traumatic sternal fractures are commonly managed conservatively; however, a subset of patients will benefit from corrective surgery, despite initial complaints of pain. In fact, surgical repair may be underused because of the lack of a standard approach, lack of experience among surgeons in implementing specific operative technique, a lack of detailed sternal assessment of the degree of deformity, and a paucity of data on the sequelae of sternal fractures. In one series, up to 11% of traumatic sternal fractures required surgical fixation. Of these cases, half had delayed surgical fixation [Richardson 2007]. Although there is as yet no evidence for differentiating surgical outcomes on the basis of the timing of surgery, a delayed intervention may lead to morbidities, such as pain and fracture nonunions [Chiu 1997]. To our knowledge, there has been no clear consensus on early correction of comminuted fractures. Surgery is normally reserved only in cases of displacement and overlap of the fractured segment ends. Surgery is indicated in such cases to prevent such complications as chronic pain, chest wall deformity, kyphosis, and respiratory insufficiency [Athanassiadi 2002; Molina 2005].

Various techniques of sternal stabilization, either with metal plates or with wires, have been described [Molina 2005; Richardson 2007]. Fixation with wires was first introduced 30 years ago; however, this practice has largely been superseded by open reduction with plate fixation, because wire repair was deemed to be tedious and to achieve poor approximation of the bone segments [Richardson 2007]. Interestingly, not only was our first patient's fractured sternum displaced with overlapping ends, but the edges were also comminuted. Plating was therefore not suitable because of the brittle comminuted edges. Approximately 1.5 cm of the lower segment overlapped the upper segment. It was impossible to grasp and reduce the fractured segments without causing more damage. We performed a sternotomy to allow easier reduction of these comminuted fractures. This technique also had the advantage of providing better exposure and visibility for assessing the substernal region and pericardium; it definitely facilitated debridement of the small broken pieces caused by the shearing motion of the injury. Closure with simple sternal wires, as opposed to metal plates, is probably the most appropriate way to stabilize such comminuted pieces in place. This approach is simple, cheap, easily available, and, most importantly, readily reproducible by any surgeon. We therefore suggest the use of sternotomy and metal wires as a feasible and effective adjunct for comminuted sternal stabilization.

REFERENCES

Athanassiadi K, Gerazounis M, Moustardas M, et al. 2002. Sternal fractures: retrospective analysis of 100 cases. World J Surg 26:1243-6.

Chiu WC, D'Amelio LF, Hammond JS. 1997. Sternal fractures in blunt chest trauma: a practical algorithm for management. Am J Emerg Med 15:252-5.

Molina JE. 2005. Evaluation and operative technique to repair isolated sternal fractures. J Thorac Cardiovasc Surg 130:445-8.

Richardson JD, Franklin GA, Heffley S. 2007. Operative fixation of chest wall fractures: an underused procedure. Am Surg 73:591-7.

Velissaris T, Tang ATM, Patel A, Khallifa K, Weeden DF. 2003. Traumatic sternal fracture: outcome following admission to a thoracic surgical unit. Injury 34:924-7.