Bilateral first rib fractures with pseudoarthrosis in a weight lifter

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MJAFI 2011;67:184–186

INTRODUCTION

Fractures of the first rib from direct blunt trauma are quite rare and are usually associated with major chest and abdominal injuries.¹ Isolated fractures of the first rib as a result of various sports activities have been described in several reports.^{2,3} There are very few reports of stress fracture of the first rib in weight lifters.⁴ We report a rare case of bilateral first rib fracture with resultant pseudoarthrosis in a young weight lifter. We also discuss the role of multi-detector computed tomography (MDCT) in the evaluation of such cases and review pertinent literature.

CASE REPORT

A 17-year-old male sports cadet reported to OPD with complaints of vague pain bilateral supra-clavicular fossa right and left (Rt>Lt) for three months duration. He had been regularly practicing weight lifting (90 Kg, 'Snatch' as well as 'Clean and jerk') for an average of 2–3 hours per day for the last one and half years prior to the onset of pain. There was no history suggestive of any direct blunt trauma to the neck or chest. The pain was of moderate severity and prevented him from practicing weight lifting any more. He got only partial relief with common anti-inflammatory analgesics. General examination did not reveal any abnormality. On local examination, there was no swelling or deformity although there was mild supraclavicular tenderness bilaterally (Rt>Lt). Although painful, the shoulder movements were of full range bilaterally. There was no neurovascular deficit of any degree on either side. A chest radiograph revealed fractures involving bilateral first ribs (Figure 1). A limited non-contrast CT (NCCT) scan study (120KV, 0.75 mm

collimation; Somatom Sensation 16; Siemens; Germany) of the thoracic inlet was carried for further delineation of the fractures. The NCCT study revealed clear fracture lines with well defined and sclerotic margins with no evidence of callus formation suggestive of pseudoarthrosis. Axial oblique reconstructions along the plane of the first ribs were carried out which enabled complete delineation of the fracture lines (Figure 2A). A volume rendered image further enhanced the anatomical delineation of the rib cage clearly outlining the fractures (Figure 2B). An isotope bone scan (99m Tc MDP) confirmed focally increased uptake of the tracer (Rt>Lt) in the first ribs corresponding to the fracture sites (Figure 3). The fracture on the right side appeared to correspond to the site of subclavian sulcus whereas the fracture on the left side was situated posterior to the expected location of the subclavian sulcus. Based on the imaging findings, diagnosis of stress fracture of bilateral first rib with pseudoarthrosis was made. He has been advised rest and is being managed conservatively.

DISCUSSION

The first rib is protected on all sides by the shoulder girdle and its musculature. Hence first rib fracture due to direct trauma is

Figure 1 Frontal radiograph of the thoracic cage demonstrating fracture lines involving bilateral first ribs. The fracture lines are seen clearly without any obvious callus formation on either side. Note, the fracture line on the right side is located in the mid third and the fracture on the left side is located on the posterior third of the first ribs (white arrows).

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Received: 16.06.2010; Accepted: 14.09.2010

Figure 2 (A) Non-contrast CT scan of the upper thorax (120 KV, 0.75 mm collimation with dose modulation); bone window. Axial oblique reconstructions along the plane of first ribs delineate the fracture lines clearly. The fracture margins show sclerosis and there is no evidence of callus formation. (B) Volume rendered image (view from top) outlines the fractures very well.

Figure 3 Isotope bone scan (99m Tc MDP) demonstrating focally increased uptake of the tracer (Rt>Lt) in the first ribs corresponding to the fracture sites.

rare and is often a sign of severe injury associated with other serious thoracic injuries. Isolated first rib fracture due to direct trauma is extremely rare. Other mechanisms of isolated first rib fractures include indirect trauma, sudden contraction of the neck muscles and stress or fatigue fractures attributable to repeated pull of muscles during sporting activities. Isolated stress fractures of the first rib due to various sporting activities like throwing, soccer, basketball, weight lifting, rugby, kick boxing, tennis, etc have been documented in the literature.²⁻⁶ Bilateral first rib fractures due to indirect trauma are extremely rare. There are only a few such cases reported in the literature.⁷⁻⁹

Stress fracture of the first rib usually occurs at the thinnest and weakest anatomical point that is the groove for the subclavian artery, also known as subclavian sulcus. At this point, the bone is subject to opposing forces of scalenus anterior and serratus anterior. Sudden forceful contraction of the scalene muscle results in fracture of the first rib at the subclavian sulcus.^{5,6} This mechanism of injury can explain stress fractures of the first rib in weight lifters. Many a time, first rib fractures are found as an incidental finding during routine chest radiographs obtained for unrelated cause.

Most patients of first rib fracture present with non-specific shoulder pain. Traditionally, diagnosis of fracture of the first rib has been made from plain radiographs alone. Computed tomography (CT) and bone scans are occasionally carried out to confirm the diagnosis and also assess for complications especially injury to underlying vessels. Isolated first rib fractures usually heal with conservative treatment. Non-union or pseudoarthrosis may rarely follow and probably results from persistent overhead activities.

In cases of rib fracture, CT enables clear delineation of the fracture lines, assessment of callus formation if any, evaluation of underlying lung parenchyma and the adjacent thoracic cage. Because of the oblique orientation of the ribs, especially the first ribs, a conventional axial CT section may not demonstrate the entire extent of the fracture line in one plane. With the availability of MDCT, it is now possible to obtain multiplanar reconstructions in orthogonal as well as non-orthogonal planes with nearly isotropic resolution. Oblique/curved reconstructions along the plane of the ribs allow better delineation of the fracture lines as shown in Figure 2A. A volume rendered image further enhances the anatomical relationship of the fracture lines as demonstrated in Figure 2B. Further, evaluation of a volume rendered image is considerably faster when compared to axial images.¹⁰ Multi-planar reconstructions and volume rendered images are essentially post processing techniques available with all modern CT scanners and do not risk the patient with any additional radiation burden.

Our case demonstrated bilateral isolated first rib fractures with pseudoarthrosis in a weight lifter which, to the best of our knowledge, has not been described in the literature. Another unusual feature noted in our case is the posteriorly located fracture line much away from the expected location of the subclavian sulcus on the left side. Our case also highlights the utility of axial oblique reconstructions along the planes of ribs as an additional tool in the evaluation of rib fractures.

CONFLICTS OF INTEREST

None.

REFERENCES

1. Richardson JD, McElvein RB, Trinkle JK. First rib fracture: a hallmark of severe trauma. *Annals of Surg* 1975;181:251-254.
2. Coris EE, Higgins HW. First rib stress fractures in throwing athletes. *Am J Sports Med* 2005;33:1400-1404.
3. Matsumoto T, Fujita K, Fujioka H. Stress fracture of the first rib in a soccer player: a rare etiology of shoulder pain. *J Shoulder Elbow Surg* 2003;12:197-199.
4. Eng J, Westcott J, Better N. Stress fracture of the first rib in a weight lifter. *Clin Nucl Med* 2008;33:371-373.
5. Vikramaditya, Pritty P. Two cases of isolated first rib fracture. *Emerg Med J* 2001;18:498-499.

6. Sakellariadis T, Stamatelopoulos A, Andrianopoulos E, Kormas P. Isolated first rib fracture in athletes. *Br J Sports Med* 2004;38:1–3.
7. Dwivedi SC, Varma AN. Bilateral fracture of the first ribs. *J Trauma* 1983;23:538.
8. Qureshi T, Mander BJ, Wishart GC. Isolated bilateral first rib fractures—an unusual sequel of whiplash injury. *Injury* 1998;29: 397–398.
9. Tsukada A, Uchiyama S, Toriumi H, Nakagawa H, Miyasaka T. Non-traumatic bilateral first rib fractures. *Acta Orthop Belg* 1998;64: 406–408.
10. Alkadhi H, Wildermuth S, Marincek B, Boehm T. Accuracy and time efficiency for the detection of thoracic cage fractures: volume rendering compared with transverse computed tomography images. *J Comput Assist Tomogr* 2004;28:378–385.

Journal Scan

Hahm G, Glaser JJ, Elster EA. Biomarkers to predict wound healing: the future of complex war wound management. Plast Reconstr Surg 2011;127(Suppl 1):21S–26S.

Currently, no biological assay exists to objectively assess wounds to aid in timing of wound closure and guide therapy. In this article, the authors from Department of Surgery, National Naval Medical Center, Bethesda, MD, USA, review military investigations in biomarkers as a method of objectively determining acute traumatic wound physiology and their applicability in predicting healing of complex soft-tissue wounds. The civilian literature related to biomarkers and wound physiology related to chronic and acute wounds was reviewed as a basis for current research into acute traumatic soft-tissue wounds. Analysis of serum and wound effluent from traumatic extremity soft-tissue combat wounds revealed changes in specific pro-inflammatory matrix metalloproteinases associated with impaired wound healing. Forsberg et al analysed serum and wound effluent for chemokines and cytokines. An increase in serum procalcitonin levels correlated with wound dehiscence. Lastly, serum, wound effluent, and wound bed tissue

biopsy specimens were analysed by Hawksworth et al. Consistent with previous studies, elevation in pro-inflammatory cytokines was associated with wound dehiscence. The authors concluded that the changes in levels of proteases, protease inhibitors, and inflammatory markers have been correlated with wound healing. These findings further support the idea that inflammatory dysregulation and a persistent inflammatory state leads to failure of wound healing in the acute setting. These findings highlight potential targets for the development of a biological assay to individualise management of complex soft-tissue wounds, based on patient physiology and response that would be applicable to not only military trauma but also civilian trauma. Ultimately, this would result in earlier wound closure, reduction in the number of operating room trips, and reduced healthcare costs.

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