Rare disease

Superior subluxation of an anterior end of the first rib in a trauma patient

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Summary

We present a case of a young man with a superior subluxation of an anterior end of the first rib following a road traffic accident. To the best of our knowledge, no similar case has so far been described in the literature. The patient presented with headache, backache and pain in the right anterior chest wall. After initial assessment, a chest radiograph was performed and it showed no abnormalities. A CT of the chest revealed an isolated hypermobile first rib at the anterior end owing to superior subluxation. The patient was treated conservatively.

BACKGROUND

Injuries to the first rib require a considerable force and may be associated with life- and limb-threatening injuries. The superior subluxation of the anterior end of the first rib reduces even further the tight anatomical space between the clavicle and the first rib, which can trap the subclavian artery (SCA) and lead to the disruption of the vessel. Therefore, prompt assessment and imaging are vital. A working knowledge of the mechanism of the injury and the associated anatomy are crucial for successful outcomes in the trauma victims. In this case, the injury did not pose any immediate threat, but it is important for clinicians to be aware that hypermobile ribs can cause serious complications and, in the long term, can lead to severe disability caused by chronic abdominal or thoracic pain in young people. No similar case has so far been described in the literature. We believe that it raises fundamental questions regarding the diagnosis, management and potential complications.

CASE PRESENTATION

A 25-year-old, healthy man was brought by an air ambulance after a road traffic accident. He had been driving a car with a speed of 40 mph. The car had skidded off the road, rolled over and hit a tree. The airbag was not deployed, but he had his seat belt on.

He complained of right-sided pleuritic chest pain, backache and headache. On the scene and on arrival at the emergency department (ED), all his vitals were normal, including Glasgow Comma Scale. He received oxygen along with analgesia from the paramedics and in the ED. Intravenous fluids were administered after haemorrhage was excluded clinically and radiologically.

The patient was assessed according to the advanced life trauma support using 'ABCDE' algorithm. Examination revealed a forehead laceration, a tender right upper anterior chest wall and a tender thoracic spine. The remainder of the examination was unremarkable.

There was no previous medical history. The patient was a non-smoker with alcohol consumption allowance below 21 units per week.

INVESTIGATIONS

Laboratory tests showed an elevated white cell count of $15 \times 10^9/l$ and C-reactive protein of 24 mg/l. The remaining biochemical markers, including liver function tests, amylase, urea and electrolytes, were within the normal range as were his haemoglobin and platelet levels.

Urinary dipstick was negative. FAST (focused assessment with sonography for trauma) was negative. Chest and pelvic radiographs were normal (figures 1 and 2). CT showed isolated subluxation of an anterior end of the right first rib surrounded by small locules of air (figures 3 and 4) with a small amount of dependent change at the right lung base (figure 5).

DIFFERENTIAL DIAGNOSIS

In view of the mechanism of injury, any bony, soft tissue, vascular and visceral injuries were possible. The right upper anterior chest wall tenderness corresponding to the above-described costochondral separation could have been caused by haemo/pneumothorax, rib fractures, mediastinal injury, lung contusion or musculoskeletal-soft tissue trauma.

TREATMENT

The patient remained haemodynamically normal throughout; therefore, in line with the principles of damage control resuscitation, no intravenous fluids were given during the initial assessment phase. Once the CT excluded haemorrhage, the patient received 1000 ml of Hartman's solution.

OUTCOME AND FOLLOW-UP

The patient was admitted for 24 h observations and was subsequently discharged home with a simple analgesia.

Figure 1 Chest radiograph.

He was reassured regarding potential problems with the subluxation of the first rib. He remains asymptomatic.

DISCUSSION

To our knowledge, there have been no published reports describing the superior subluxation of an anterior end of the first rib. In previous reports, authors described different types of subluxations or dislocations of the first rib. In one of the two published cases, investigators described the posterior subluxation of the first rib costal cartilage in a rugby player. This injury is similar to the posterior dislocation of the sterno-clavicular joint.¹ In the other published case, authors reported on the SCA disruption following the first rib dislocation in a trauma case, which proves that the SCA can be disrupted even in the absence of the first rib fracture.²

To date, the only superior subluxation of the first rib was described at the costovertebral and costotransverse joints.³ The mechanism of an injury involves a force, which is applied posteriorly, which along with the insertion of the scalene medius (acting as a fulcrum)

Figure 3 Small locules of the air surrounding the subluxed anterior end of the first rib.

subsequently displaces the rib in an upward direction against clavicle.²⁻⁴ However, this is quite different from the direct antero-lateral force applied in our case scenario leading to the increased mobility of the anterior end of the first rib.

Hypermobility predominantly affects false ribs (8th, 9th and 10th) because of their increased mobility caused by anterior attachment to each other.⁴⁻⁶ Hypermobility was described in 1919 by Cyriax and was officially named so by Davies-Colley in 1922.^{5 6} In the literature, it has also been described as the 'Davies-Colley's syndrome', slipping rib syndrome, rib-tip syndrome, painful rib syndrome, costochondral separation and clicking or moving rib syndrome.⁵⁻⁷ The condition is characterised by hypermobility at sterno-costal, costochondral or rib-vertebral sites that is caused by weakness or damage of the associated ligaments.^{5 7} It comprises of pain in the lower chest or upper abdomen and tenderness at the costal margin. This, however, does not include the tenderness at the upper costal cartilages; hence, this (painful rib syndrome) should not be confused with the subluxation of an anterior end of the first rib.⁶

Figure 2 Pelvic radiograph.

Figure 4 Subluxation of an anterior end of the right first rib at the costochondral junction.

Figure 5 Dependent changes at the base of the right lung.

The affected hypermobile rib can temporarily move out of the anatomical position stretching the ligaments and adding further to the instability.^{3–5 7} In general, the painful rib syndrome remains under-diagnosed and has been described in a handful of case reports, mainly in athletes. The diagnosis is made by a simple clinical test-hooking manoeuvre, during which the clinician's fingers are placed under the affected costal margin and pulled anteriorly.^{6 7} If this reproduces the pain, clicking or moving sensation the test is deemed positive. Ring block is subsequently performed to assess if the pain is relieved.⁷ Described treatment options include conservative and surgical techniques. The conservative approach includes activity modification, ice packs, non-steroidal anti-inflammatory drugs (NSAIDs) and a physiotherapy.^{3 5 7 8} Unfortunately, in all the reported cases, conservative management failed and led to surgical resection of the portions of the symptomatic ribs.^{5 7}

The hypermobility of the first rib is complex for a number of reasons. Firstly, the first rib is short, thick, flat in a horizontal plane and slopes inferiorly.^{2 4} It forms articulation with the thoracic T1 vertebra and manubrium of the sternum via fibrocartilaginous joint.⁴ In normal circumstances no movement occurs at these sites. More importantly, the first rib, costal cartilage and sternum are all covered by continuous periosteum and perichondrium,^{1 4} adding to the stability of the rib cage. Being well protected by the shoulder bony framework and muscles, a considerable force is required in order to cause first rib injury.⁴ In effect, the 'hook manoeuvre' cannot be used in such a clinical scenario. The major complications following the first rib injuries include injuries to the SCA, brachial plexus and superior mediastinum structures, such as brachiocephalic veins, superior vena cava, aortic arch with major branches, trachea, oesophagus, thoracic duct, phrenic and vagus nerves.^{1 2 4}

Another rare complication is a possible thoracic outlet syndrome (TOS).⁸ TOS results from the compression on the brachial plexus or subclavian vessels in the region of the thoracic outlet. The most important anatomical space in the thoracic outlet is the interscalene triangle, which is bounded by the anterior and middle scalene muscles,

which constitute the sides of the scalene triangle with the first rib forming the base of the triangle.⁴ This relatively small space accommodates the SCA, vein and nerves of brachial plexus. Subsequent symptoms depend on which neurovascular structures are compressed. Hence the most common is neurogenic and then venous and arterial TOS. The subluxation of the first rib can irritate the neurovascular structures (mainly C8, T1) by narrowing further the space within the interscalene triangle.⁸ It also produces a hinge-like mechanism where the subclavian vessels are trapped between the clavicle and the first rib.^{1 4 8} Treatment algorithm depends on the type, severity of symptoms and response to conservative management (physiotherapy). Patients who fail the conservative treatment can benefit from surgical decompression of the TOS by excision of the first rib and scalectomy.

The increased mobility of the first rib can lead to serious complications. Management of subluxation regardless of the anatomical site includes physiotherapy, therapeutic exercises and NSAIDs.^{1 3 5} If the conservative approach fails, the surgical option is to excise the affected rib.

Learning points

- ▶ The mechanism of injury helps to anticipate potential injuries and problems in trauma.
- ▶ Use the MIST approach in order to gather information about the road traffic accident: M = mechanism of injury, I = apparent injuries, S = signs at the scene and on arrival at emergency department, T = the treatment so far (oxygen, fluids, analgesia).
- ▶ Clinical examination and routine radiographs lack sensitivity in providing definitive diagnosis in fractures occurring at costal cartilages.
- ▶ CT is the most appropriate modality in a trauma scenario.

Competing interests None.

Patient consent Obtained.

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