Case report

Traumatic costovertebral joint dislocation

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SUMMARY

Rib fractures due to blunt trauma are a common chest injury seen at the emergency department; however, injuries to the costovertebral joints are very rare. We present a case of a 24-year-old man who was admitted after a high-speed car collision and was assessed in a level 1 trauma centre in Amsterdam. He had multiple injuries, including dislocation of the costovertebral joint of ribs 7–10. After performing a literature search we concluded that patients with traumatic costovertebral joint dislocations have a high incidence of vertebral fractures, neurological deficits and additional fractures. We believe that isolated dislocation of one or multiple costovertebral joint(s) can safely be treated conservatively. Close monitoring of the patients is advisable as these injuries are caused by high impact and are associated with other injuries.

BACKGROUND

Rib fractures due to blunt trauma are a common chest injury seen at the emergency department; however, injuries to the costovertebral joints are very rare. This injury has been described in association with child abuse, but there is limited knowledge about traumatic costovertebral dislocations in adults.

The costovertebral joints and its ligaments are involved in both respiratory function and thoracic spine stability, but its anatomy is relatively unknown and therefore frequently overlooked during the clinical practice.

All 12 ribs articulate to the vertebral column with two gliding type synovial joints; the costocentral and the costotransverse joint. The costocentral joint is located between the head of the rib and the lateral portion of the vertebral centrum, and the costotransverse is located between the tubercle of the rib and the tip of the transverse process. In recent literature the term ‘costovertebral’ is interchangeably used to describe either the costocentral or the costotransverse joint, or both. In this case report we will refer to the combination of these two joints when describing the costovertebral articulation. There are multiple ligaments that attach a rib to the vertebræ on most levels; however, the 1st, 10th, 11th and 12th rib have no intra-articular ligament. Furthermore, the first rib also has no superior costotransverse ligament. Because of its position at the top of the rib cage and the lack of stabilising ligaments, the first rib is more prone to fracture or dislocation, just as the 10th, 11th and 12th. Due to its close relation to the spinal cord thorough assessment and imaging to rule out neurological damage is strongly advised when treating a patient with a costovertebral dislocation.

To the best of our knowledge, no similar case involving a dislocation of the costovertebral joint that dislocated to anterior has been described in the literature yet.

CASE PRESENTATION

A 24-year-old man was admitted after a high-speed car collision into a highway guardrail. The car was severely damaged and all airbags were out. Immediately after the collision he climbed out of his car by himself and started to walk around seemingly distraught and not adequately responding to questions from the paramedics.

He was assessed in a level 1 trauma centre in Amsterdam according the Advanced Trauma Life Support (ATLS) principles. During the primary survey there were no signs of airway problems and his C-spine was immobilised. He had no respiratory problems and with oxygen supplementation through a non-rebreathing mask he had a saturation of 99%. He had no clinical signs of a (tension)pneumothorax or haemothorax. On the left side of this chest a seat belt sign was seen. His pulse was 114/min with a blood pressure of 98/60 mm Hg. There were some excoriations on his abdomen, but when palpated it was non-rigid and not painful. There was no suspicion of a pelvic or femur fracture. He was sedated because of agitation due to possible head injury or drug or alcohol intoxication. Pupils were equal and reactive to light. Furthermore, during the log-roll and spinal palpation no haematoma or other signs of fractures were seen and our now lightly sedated patient did not have symptoms of pain and wounds were not seen.

During secondary survey a small head wound on the back of the head was seen, as well as multiple excoriations on the thorax, abdomen, pelvic area and right knee. A Morell-Lavallee lesion on the right hip was also noted. Because of the vertebral fractures and possible head injury a neurologist was consulted to perform a neurological examination at the trauma room during the secondary survey. The neurological examination took place after 5 mg midazolam was intravenously given because the patient was exhibiting motor restlessness. No major neurological deficit was found during the examination. It was noted that the patient moved his arms and legs spontaneously and that the plantar reflex was normal on both sides.
which showed no intracranial bleeding or fractures of the skull. A brain CT was repeated 1 day after the initial trauma assessment. 

- A L4 and spinal process fracture with a lateral wedge transverse process fractures of the thoracic spine at level 5–9 (Th5-9) on the left side and lumbar spine level 2–3 bilateral (L2-3).
- A non-displaced sternal fracture.
- Fractures of ribs 3–8, 11 and 12 on the left side; all posterior and most of them displaced and closely related to the costovertebral joint (figure 1).
- Dislocation of the costovertebral joint of ribs 7–10 on the left side (figures 1 and 2).
- Transverse process fractures of the thoracic spine at level 5–9 (Th5-9) on the left side and lumbar spine level 2–3 bilateral (L2-3).
- A L4 and spinal process fracture with a lateral wedge causing displacement in the coronal plane (AO classification AO_A1-N0-M1).

Due to fact that the patient kept exhibiting motor restlessness a brain CT was repeated 1 day after the initial trauma assessment which showed no intracranial bleeding or fractures of the skull.

**TREATMENT**

The patient was successfully treated with a chest drain on the left side of his chest. He also underwent an angiography and a successful coiling of the paravertebral blush. The following day the lumbar fracture was stabilised using spinal fusion. The rib fractures and costovertebral rib dislocations were treated non-operatively and the pain was managed with opioid analgesia.

**OUTCOME AND FOLLOW-UP**

After being admitted to the surgical ward for 7 days, the patient was discharged. The patient visited the outpatient clinic 2 and 6 weeks after discharge and showed little symptoms of pain. He did appear to have a winged scapula on the left side. The winged scapula improved spontaneously so it was possibly caused by compression from a local haematoma on the long thoracic nerve or accessory nerve or by the haematoma itself. After 3 months, the electromyography did not show any nerve injury and the clinical signs of the winged scapula were improving. He regained a full range of motion of the left shoulder.

**DISCUSSION**

As described earlier, the anatomy of the costovertebral joint consists of two joints named the costocentral and costotransverse joint and several ligaments. For this joint to dislocate either concomitant rib fractures have to occur or ligamentous injury. The majority of posterior rib fractures occur at the rib neck due to the strong costovertebral ligamentous attachment to the rib head and tubercle, this kind of stress fracture is also well described as a rowers and swimmers injury. The costovertebral ligaments are innervated by the lateral branch of the thoracic dorsal rami of C8 and Th1-Th11, and some studies suggest that these ligaments add a protective mechanism against traction and compression of the nerves by maintaining proper positioning of the nerves in the intervertebral foramen. Since the ligaments often get injured during the dislocation of the costovertebral joints, it is not surprising that neurological damage would occur in a patient with a costovertebral dislocation. There are multiple causes for scapular winging, including iatrogenic, idiopathic and traumatic injuries. While injury of the long thoracic nerve resulting in paralysis of the serratus anterior is the most common traumatic cause, direct traumatic injury to the insertion of the serratus anterior or scapular fractures have also been described to cause scapular winging. If neurological deficits are found, further work-up is necessary to determine the cause and possible treatment of it.

Despite the fact that most dislocations, such as sternoclavicular joint dislocations are relocated, we feel that an isolated dislocation of the costovertebral articulation can safely be managed conservative. We support our statement that costovertebral dislocation can be safely treated conservatively with findings from a literature search we performed on 3 January 2019 using the electronic databases of Pubmed, the Cochrane library and EMBASE. The keywords and MeSH terms Costovertebral AND injury OR fracture OR dislocation OR subluxation were used which resulted in a total of 42 articles of which 3 described cases of costovertebral dislocation in adults with a traumatic aetiology.

A total of eight cases of costovertebral dislocation were described in these three articles. The most common mechanism of injury was a motor vehicle collision (n=7). The lower costovertebral joints were most often involved, although two cases of a first costovertebral joint dislocation were described. Almost all cases had vertebral fractures accompanying the dislocation.

**Figure 1** Coronal three-dimensional CT-scan. The arrows show the costovertebral dislocation of rib 7–10 on the left side. Fractures of the left rib 3–8, 11 and 12 can also be seen.

**Figure 2** Transverse CT-scan made during the initial trauma assessment. The arrow shows the costovertebral dislocation of the left seventh rib.
Injuries (4/7) occurred after several days, while during the initial trauma assessment there was no sign of vascular damage. Close monitoring during admission is therefore strongly advised, and at the first signs of haemodynamic instability or increased chest tube drainage this kind of complication should be considered. While rib fractures in the left side of the chest are currently not an indication for surgical stabilisation, in recent literature costotransverse screw placement is described as a feasible technique for management of paraspinal rib fractures to prevent the development of aortic injury. 

Learning points

- Patients with traumatic costovertebral joint dislocations have a high incidence of vertebral fractures, neurological deficits and additional fractures.
- We believe that isolated dislocation of one or multiple costovertebral joint(s) can safely be treated conservatively.
- Close monitoring of the patients is advisable as these injuries are caused by high impact and are associated with other injuries.

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REFERENCES

1 Edgecombe L, Angus LD. Thoracic trauma, in StatPearls. Treasure Island (FL, 2018.
2 Bixby SD, Abo A, Kleinman PK. High-Impact trauma causing multiple posteroventral rib fractures in a child. Pediatr Emerg Care 2011;27:218–9.
3 Tsai A, Coats B, Kleinman PK. Stress profile of infant rib in the setting of child abuse: a finite element parametric study. J Biomech 2012;45:1861–8.
4 Saker E, Graham RA, Nicholas R, et al. Ligaments of the Costovertebral joints including biomechanics, Innervations, and clinical applications: a comprehensive review with application to approaches to the thoracic spine. Cureus 2016;8:e874.
5 Christensen EE, Dietz GW. Injuries of the first costovertebral articulation. Radiology 1980;134:41–3.
6 Schmalke KJ, Schroeder GD, Vaccaro AR, et al. AOSpine classification systems (subaxial, thoracolumbar). J Orthop Trauma 2017;31:154–23.
7 Hosea TM, Hannafin JA. Rowing injuries. Sports Health 2012;4:236–45.
8 Low S, Kiem M, Atanda A. First-rib stress fracture in two adolescent swimmers: a case report. J Sports Sci 2016;34:1266–70.
9 Kraan GA, Hoogland PVJM, Wuisman PUM. Extramittal ligament attachments of the thoracic spinal nerves in humans. Eur Spine J 2009;18:490–8.
10 Speigler B, Verborgt O, Deckers G, et al. Medial scapular winging following trauma - a case report. Acta Orthop 2016;87:203–4.
11 Mansha M, Middleton A, Rangan A. An unusual cause of scapular winging following trauma in an army personnel. J Shoulder Elbow Surg 2010;19:e24–7.
12 Morell DI, Thiyagarajan DS. Sternoclavicular joint dislocation and its management: a review of the literature. World J Orthop 2016;7:244–50.
13 O’Brien SD, Bui-Mansfield LT. Costovertebral fracture dislocations: important radiographically difficult diagnosis. J Comput Assist Tomogr 2009;33:748–51.
14 Groves AC, Moseley HF. Pulmonary hernia and abdominal wall evagination; two rare complications of rib trauma. J Trauma 1968;8:1065–70.
15 Park H-S, Ryu S-M, Cho S-J, et al. A treatment case of delayed aortic injury: the patient with posterior rib fracture. Korean J Thorac Cardiovasc Surg 2014;47:406–8.
16 Ashrafian H, Kumar P, Sarkar PK, et al. Delayed penetrating intrathoracic injury from multiple rib fractures. J Trauma 2005;58:858–9.
17 Bruno VD, Batchelor TIP. Late aortic injury: a rare complication of a posterior rib fracture. Ann Thorac Surg 2009;87:301–3.
18 Iyoda A, Sato H, Yamakawa H, et al. Rupture of the descending thoracic aorta caused by blunt chest trauma: report of a case. Surg Today 2003;33:795–7.
19 Kabiri E, Arsalane A, Zidane A, et al. Abtypical traumatic thoracic aorta after rib fractures. Asian Cardiovasc Thorac Ann 2007;15:180–1.
20 Bartscherer A, Stolarski AE, Miller CP, et al. Costotransverse screws in repair of paraspinal rib fractures-a novel approach for rib fractures threatening the aorta. J Thorac Dis 2019;11:51090–5.