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Case Report

Cardiopulmonary Resuscitation-induced Thoracic Vertebral Fracture: A Case Report

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Thoracic vertebral fractures are very unusual complications of cardiopulmonary resuscitation (CPR). A 78-year-old man developed cardiac arrest after aspirating and conventional CPR was performed. After recovery, the patient had complete paraplegia (Frankel grade A). Magnetic resonance image of spine showed a dislocation fracture with hematoma at T6 thoracic level. Computed tomography scan of chest revealed the fracture of sternum. After the patient's condition became stable with subsequent medical treatment, posterior decompression and pedicle screw fixation was performed. The patient had uneventful postoperative course with continued rehabilitation. Thus, this report emphasizes that care should be taken especially in elderly patients with fragile bone to recognize such rare complication of chest compression; however, adequate compressions to ensure circulation should be maintained.

Keywords: vertebral fracture, cardiopulmonary resuscitation, chest compression, elderly

Introduction

Since 1960 when closed chest cardiac massage was reported by Kouwenhoven et al.,[1)] chest compression has been a vital component of cardiopulmonary resuscitation (CPR). Although CPR is potentially life-saving, it is a traumatic procedure which may result in unanticipated complications. Skeletal injuries, especially fractures of rib and sternum, have been the most frequently reported complications of chest compression.[2)] However, spine fracture as a complication of chest compression is very unusual and has rarely been reported in the literature.[2–5)] We here report a rare case of thoracic vertebral fracture associated with sternal fracture diagnosed after successful CPR in a 78-year-old man who later underwent surgery for decompression and fixation.

Case Report

A 78-year-old man had a bicycle accident and was found to have pelvic fracture in a hospital nearby where he was admitted and underwent conservative treatment. The patient had no history of pain or swelling in the thoracic spine or any associated neurological deficit. During the period, deep vein thrombosis developed which was treated with inferior vena cava filter placement. After the procedure, the patient developed sepsis that was being successfully managed. Meanwhile, he aspirated while eating bread leading to airway obstruction and cardiac arrest. Conventional CPR was performed and the patient recovered. He became conscious after extubation, and then he was found to be paraplegic. Radiological investigations of the spine were performed, which revealed dislocation fracture with hematoma at T6 thoracic level with severe spinal cord compression (Fig. 1a, b). The patient was then referred to our department. Computed tomography (CT) scan of chest demonstrated the fracture of sternum (Fig. 1c). On neurological examination, he showed Frankel grade A paraplegia. Spine surgery was performed 56 days after the cardiopulmonary resuscitation. The patient was transferred to our hospital after 9 days of the incident. Since the patient was diagnosed with sepsis caused by *Staphylococcus aureus*, he was medically treated until the infection was controlled and the blood culture was negative for three times, and his general condition was improved to be able to undergo instrumentation surgery. Posterior decompression was performed at T6 level by laminectomy, followed by pedicle screw fixation at T4–T8 levels (Fig. 2a). Intraoperatively, we found destruction of interspinous ligaments and the vertebral body was completely collapsed. Severe instability was observed at the affected level. But, there was no facet dislocation. We performed pedicle subtraction osteotomy (PSO) but did not employ reduction or any anterior reconstruction methods. After laminectomy and PSO, we aimed for in-situ fusion with segmental pedicle screw instrumentation. Postoperative CT scan at 5 months after surgery demonstrated good fracture healing with bony fusion (Fig. 2b) and postoperative T_2-weighted MRI showed decompression of the spinal cord (Fig. 2c). The postoperative period (8 months as of this writing) has been uneventful. The patient recovered from Frankel grade A to C postoperatively. Unfortunately, the motor function could not be completely recovered and he has been undergoing rehabilitation.

Discussion

Chest compression is an integral part of CPR procedure. Although it is life-saving and undoubtedly the risks are acceptable for the survival value offered by it, the knowledge of possible complications is important so as to perform CPR as correctly as possible to prevent the avoidable complications.

The most common complications of chest compression

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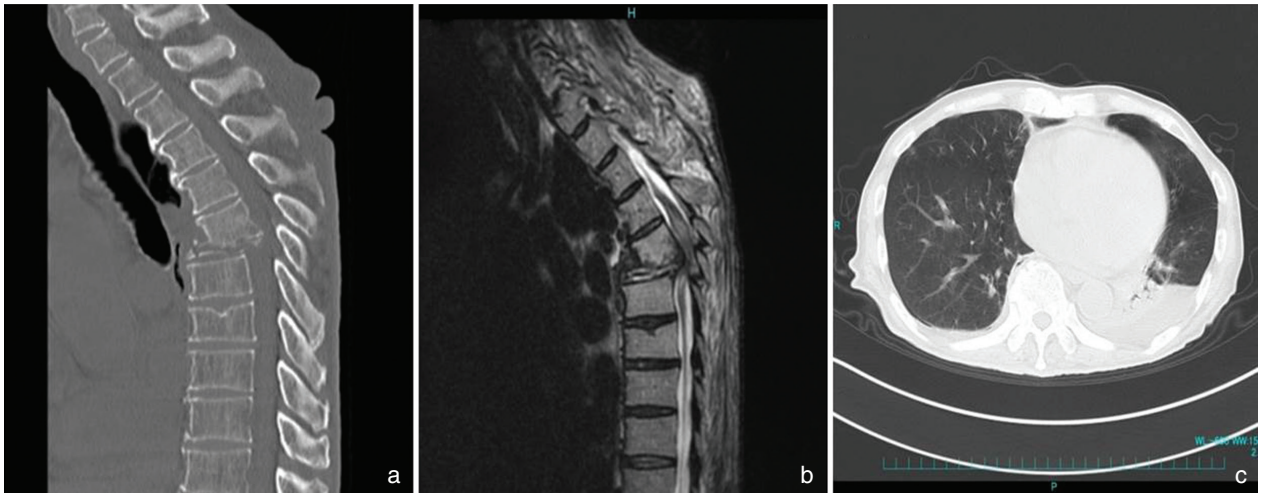

Fig. 1 Preoperative imaging. a: Sagittal computed tomography (CT) scan of spine demonstrating the dislocation fracture at T6 thoracic level. b: Sagittal T_2-weighted magnetic resonance imaging (MRI) of spine showing severe spinal cord compression due to dislocation fracture at T6 thoracic level with hematoma. c: Axial CT scan of chest revealing the fracture of sternum.

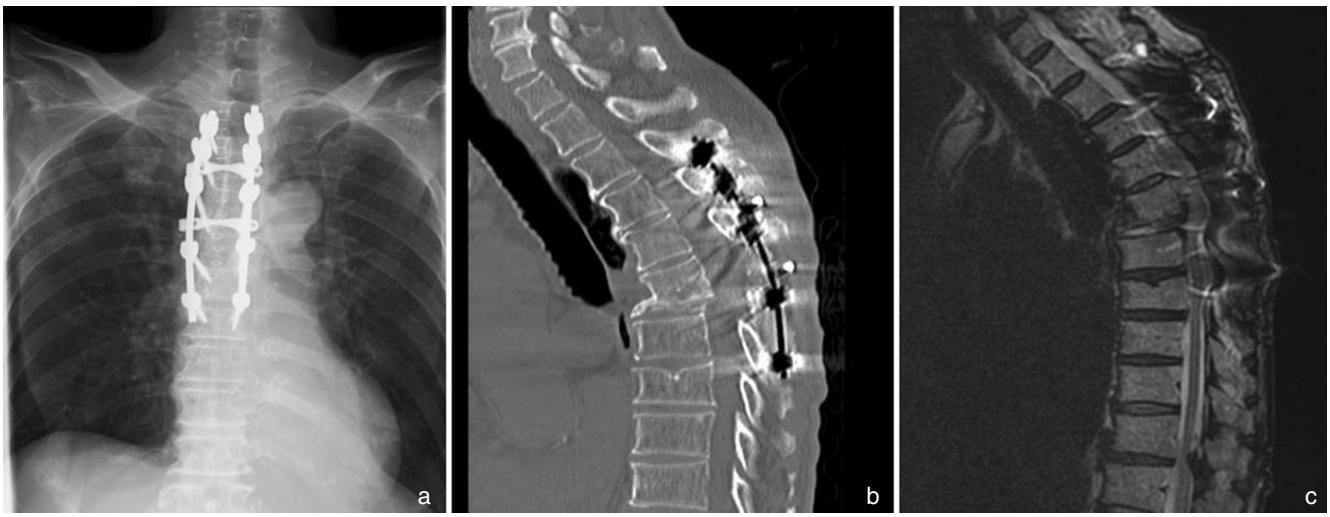

Fig. 2 Postoperative imaging. a: Postoperative antero-posterior (AP) view of chest X-ray demonstrating the pedicle screw fixation from T4 to T8 thoracic levels. b: Postoperative mid-sagittal computed tomography (CT) scan of spine at 5 months after surgery showing good fracture healing with bony fusion. c: Postoperative T_2-weighted magnetic resonance imaging (MRI) showing decompression of the spinal cord at T6 thoracic level.

are thoracic fractures, which can lead to organ damage including lacerations to lungs, heart, blood vessels, abdomen, and also pneumo- and hemo(pneumo)thorax.[2,6] Although very rare, fracture of spine has been reported as a complication in the literature but the incidence is unknown. In Krischer's autopsy series of 705 cases, cervical spine fracture was reported in 0.1% of the cases as a complication of CPR.[2] Thoracic vertebral fractures also have been infrequently reported. Two reports assumed that some degree of skeletal susceptibility such as osteoporosis, osteopenia, or kyphosis could be responsible for vertebral fractures during CPR.[3,5] Osteopenia is a well-known major risk factor for fractures of many types and dorsal kyphosis may also increase the lumbar lordosis exposing the spine to greater shearing forces during the chest compressions.[3] Thoracic vertebral fractures have also been reported after multiple transthoracic countershocks without chest compression[7] as well as after CPR without defibrillation,[4] thus this injury may be caused by either of these resuscitative measures. It has been assumed that generalized sudden muscular contraction during direct-current countershock produces a violent sudden flexion, which may result in fracture especially in osteoporotic spine. It has also been reported that device-assisted CPR, in particular the AutoPulse® (ZOLL Medical Corporation, Chelmsford, MA, USA), caused thoracolumbar vertebral fractures in about 4.5% of 88 cases.[8] In this protocol, the body is positioned on the board such that upper thoracic spine is on the flat region of the board and

the lower thoracic spine descends along the incline, thus the fracture might be attributed to the compressive force against an uneven plane.

In our case, old age fragile bone quality of the patient can be a contributory factor. Retrospectively, it may be questionable that he had some sort of occult injury in the thoracic spine during the bicycle accident, which predisposed the spine to fracture with the compressive forces during CPR. However, there was no history of pain or swelling in the thoracic spine region or any neurological deficit pointing towards the thoracic spine injury when he presented at the emergency department of the other hospital. Therefore, investigations aiming at thoracic spine injury were not performed at that initial presentation. It was only after the patient recovered by CPR that he was found to be paraplegic and had thoracic vertebral fracture with severe cord compression on investigation. So, the severe fracture was believed to be associated with the incident on the ground of his old age fragile bone as a predisposing factor. Furthermore, fracture of the sternum in this case played an important role in the severe dislocation of the thoracic column and the framework of thoracic wall was disrupted due to fracture of both the anterior and posterior elements. Although thoracic spine fracture may not occur merely due to chest compressions during CPR, there are rare chances that the compressive strong forces may cause fracture in the presence of predisposing factors like fragile bone of old age or osteoporosis.[3,5,9] The incidence of spine fracture due to CPR appears very low; however, it may increase with the increasing elderly population in Japan along with the increased utility of CPR. So, early recognition of this complication could be helpful in preventing possible spinal cord damage from an unstable fracture. Considering the rarity of the incident and the cases reported so far, future research should be required in determining the exact incidence of this complication.

Conclusion

This report illustrates a very rare case of thoracic vertebral fracture along with sternal fracture as a complication of CPR in an elderly patient with fragile bone. Although there is no alternative to CPR and adequate chest compressions must be maintained to ensure the circulation, this rare complication should be kept in mind especially in an elderly patient who might have higher propensity for this complication.

Conflicts of Interest Disclosure

The authors declare that there are no conflicts of interest regarding the publication of this article. All authors who are members of the Japan Neurosurgical Society (JNS) have registered Online Self-reported COI Disclosure Statement Forms through the website for JNS members.

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