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Case Report

Pontomedullary Laceration, a Fatal Consequence of Skull Base Ring Fracture

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Due to improvements in emergency resuscitation provided by rescue teams, more trauma victims who could have died due to sudden heart failure at the scene are brought to the hospital following resuscitation. Most of these patients present with major organ injuries and hypovolemic shock at the time of trauma. However, head trauma associated with sudden heart arrest is rare. Here, we report a case of ring fracture with pontomedullary laceration that led to sudden heart arrest.

Key Words : Trauma · Resuscitation · Heart arrest · Fracture.

INTRODUCTION

For severe trauma patients, pre-admission mortality continues to be the most important reason for clinical trauma deaths[9]. The most common cause of death from trauma at the scene is acute hemorrhagic shock[5]. However, advances in emergency resuscitation and rescue teams have been credited with significantly improved outcomes among such patients. In particular, trauma victims who would have died due to sudden heart arrest at the scene are now brought to the hospital following resuscitation. Most of these patients present with major organ injuries and hypovolemic shock at the time of trauma. However, head trauma-related sudden heart arrest is rare. Here, we report a case of ring fracture with pontomedullary laceration that led to sudden heart arrest.

CASE REPORT

A 43-year-old man involved in a pedestrian accident was admitted from a local hospital to our institution and was comatose during resuscitation. At the scene, he was noted to have a Glasgow coma score of 3 with nonreactive pupils 5 mm in diameter. On arrival, he was ventilated and achieved a hemodynamically stable condition. Full medical examination revealed only bilateral otorrhea and rhinorrhea, involving some bruising in his face and jaw and right side of the scalp. Computed tomography of the head showed diffuse brain injury with severe cerebral swelling, particularly right-side acute subdural hemorrhage. Skull base CT revealed a 'ring' fracture around the foramen magnum that involved the clivus, both petrous temporal bones and the posterior part of the foramen magnum. There were no signs of atlanto-occipital dislocation, and the remainder of the cervical spine was intact (Fig. 1). The patient was immediately admitted to the neurosurgical intensive care unit (NICU). There were no subsequent neurological changes, and brain death was suspected. In review of his medical history, he was healthy before the accident. On arrival to the NICU, the patient was in a coma, with a Glasgow coma scale score of 3, and showed fixed, nonreactive pupils 6 mm in diameter. There were no signs of brain stem activity, although his vital signs were stable. At 27 days after admission, magnetic resonance imaging revealed swelling of the brain stem and cerebellum combined with transtentorial and foraminal herniation (Fig. 2). These findings indicated the presence of pontomedullary laceration. The patient remained fully comatose for 34 days after injury and then died of pneumonia with sepsis.

DISCUSSION

Specific types of skull base fracture, including ring (complete or incomplete) and hinge fractures, can be accompanied by brain stem injury[7]. Ring fractures that occur at the skull base involve separation of the rim of the foramen magnum from the rest of the skull, accompanied by the fracture of one petrous temporal

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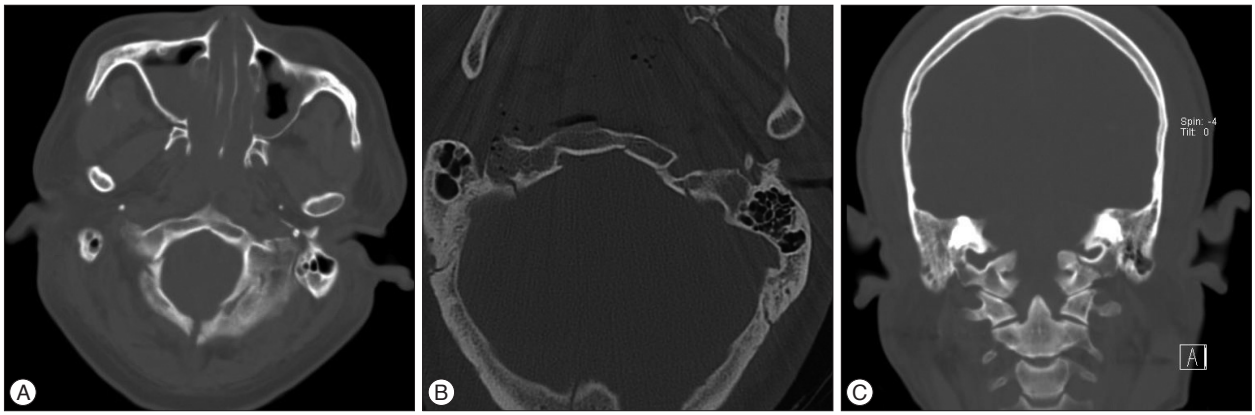

Fig. 1. A and B : Skull base computed tomography, with bone windows, reveals a ring fracture involving the clivus, both petrous temporal bones and the posterior part of the foramen magnum. C : Skull base 3-D reconstruction computed tomography reveals no signs of atlanto-occipital dislocation, and the remainder of the cervical spine is intact.

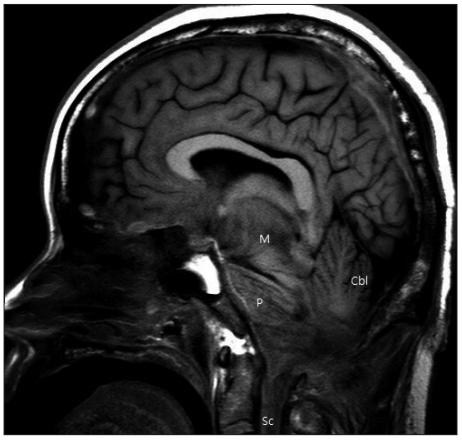

Fig. 2. Brain magnetic resonance imaging, after 27 days of admission, shows swelling of the brain stem and cerebellum combined with transtentorial and foraminal herniation. There are also signal changes on the lower part of the pons and cerebellum, and pontomedullar continuity is not observed. M : midbrain, P : pons, Cbl : cerebellum, Sc : spinal cord.

bone to the other across the midline and then posteriorly around the foramen magnum through the occiput. These fractures cause traumatic brainstem injury, and the pontomedullary junction is the most frequently injured site[6]. These lacerations may be either partial or complete and are associated with hinge or ring fractures or fracture of the cervical spine[3]. The potential mechanisms responsible for ring fracture including the pushing of the spine against the skull base and an extraction force owing to hyperextension of the neck[12]. The mechanisms are often similar to those responsible for pontomedullar laceration[4,11]. In particular, ring fractures result from traction of the head caused by hyperextension or hyperflexion, a shearing effect, rotatory torsion or wedge compression against the frontal bone and the invasion of the vertebral column into the base of the skull. The causes of death in cases of ring fracture include dislocation of the atlantooccipital junction, pontine hemorrhage, brainstem injury and vascular injuries[2]. Although sudden heart arrest caused by brain stem injury represents a leading cause of death in the field[1,8], this condition remained unfamiliar to forensic doctors until recently.

Hyperextension without neck joint dislocation can produce brain stem injuries such as pontomedullary avulsion. Unexpectedly, victims of ring fracture show neither neck joint dislocation nor basal skull fracture. In such cases, soft tissue injuries to the chin area and hemorrhage can be observed in the neck muscles, indicating hyperextension or hyperflexion of the neck[12]. However, mandible fractures reduce energy transfer to the temporomandibular joints and protect the skull base and the brain[10]. In cases of chin impact, the presence of a mandible fracture reduces the incidence of the pontomedullar laceration by 2.3-fold compared to the absence of such a fracture[12]. In addition, ring fractures can also be accompanied by cerebrospinal fluid rhinorrhea and/or otorrhea[1].

With improvements in emergency resuscitation and rescue team efforts, more ring fracture patients who would have died due to sudden heart arrest at the scene are brought to the hospital following resuscitation. Despite the presence of significant internal injuries, victims of immediate post-traumatic heart arrest may have surprisingly few external manifestations of trauma, although most of these patients suffered from combined injury at the time of trauma. Ring fractures associated with pontomedullar laceration are the primary reason for head trauma-related sudden heart arrest. Thus, primary emergency doctors must keep in mind that patients resuscitated immediately after trauma and showing cerebrospinal fluid rhinorrhea and/or otorrhea without combined injury may have suffered ring fracture and brain stem injury.

CONCLUSION

Ring fracture of the skull base is a commonly fatal injury detected in victims of head trauma. Ring fracture can cause pontomedullary laceration and give rise to sudden cardiac arrest at the time of fracture. As a result, this condition was previously unfamiliar to forensic doctors. However, with improvements in emergency care, more patients with ring fractures survive to reach the hospital, and the diagnosis of ring fracture has become the job of

neurosurgeons. Accurate diagnosis and medical information improve the early evaluation of ring fracture and pontomedullar laceration. Thus, for the greater number of patients who survive this type of injury, we should aim to provide an early diagnosis and precise medical information for patients and their families.

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