International Journal of Medical Science and Clinical Research Studies

ISSN(print): 2767-8326, ISSN(online): 2767-8342

Volume 03 Issue 09 September 2023

Page No: 1945-1948

DOI: https://doi.org/10.47191/ijmscrs/v3-i9-25, Impact Factor: 6.597

Atlantoaxial Subluxation with Atlas and Hangman's Fractures: A Case Report

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ABSTRACT

Combined dislocation and fracture of the upper cervical spine in adults is a rare condition that may result in devastating consequences. With the increase in road traffic accidents and the improvement in prehospital emergency care, serious injuries of the upper cervical spine are more frequently diagnosed at tertiary care centers. We report a case of a 19-year-old adolescent with dislocation-fracture of the upper cervical spine following a moderate-energy trauma. With early diagnosis and treatment, the patient showed good progress without major complications and 24-month follow-up.

KEYWORDS: C1 fracture, C2 fracture, Hangman's fracture, Atlantoaxial subluxation, halo vest.

ARTICLE DETAILS

Published On:
16 September 2023

Available on:
https://ijmscr.org/

INTRODUCTION

Combined fractures of the atlas and axis represent 3 to 4% of cervical spine injuries, are caused by high-energy trauma in young patients with good bone stock and are usually associated with variable degrees of neurological injury ranging from 12 to 34%. (1, 2) The combination of atlantoaxial dislocation and odontoid fracture has been previously reported, however, there are very few reported cases of atlantoaxial dislocations associated with fracture of the pars interarticularis of cervical vertebra 2 (C2) or "hangman's fracture".

CASE REPORT

A 19-year-old male, from Montevideo, unemployed, with no previous pathological history, rammed into a parked bus with his bicycle while wearing no helmet. He presented with transient loss of consciousness as a result of head trauma, without any other neurological deficit or alteration at the initial assessment. He receives medical care by an emergency response unit at the site of the accident and is discharge home. The patient presented 24 hours later in a third-level hospital with persistent neck pain, mild discomfort when swallowing, and neck crepitus during movement. On physical examination, the patient was alert with a Glasgow Coma Scale of 15 and was hemodynamically stable. He presented moderate pain (5/10) on the visual analogue scale (VAS), which increased during manual palpation of the posterior upper cervical spine. The rest of the neurological evaluation was normal, with no signs of myelopathy or radiculopathy.

Computed tomography (CT) scan of the cervical spine (Fig. 1 A-B) revealed a type I C1-C2 rotary subluxation of the Fielding-Hawkins classification, type B and A3 fracture of the posterior arch of C1 of Levine and Jefferson classification, respectively, as well as type I and II traumatic spondylolisthesis of C2 of Effendi and Levine-Edwards classification, also known as a "hangman's fracture". The rest of the subaxial cervical spine showed no significant abnormality. Magnetic resonance imaging (MRI) revealed an intact transverse ligament, no evidence of nerve or spinal cord compression, and no disruption of the C2-C3 intervertebral disc (Fig.1 C-E).

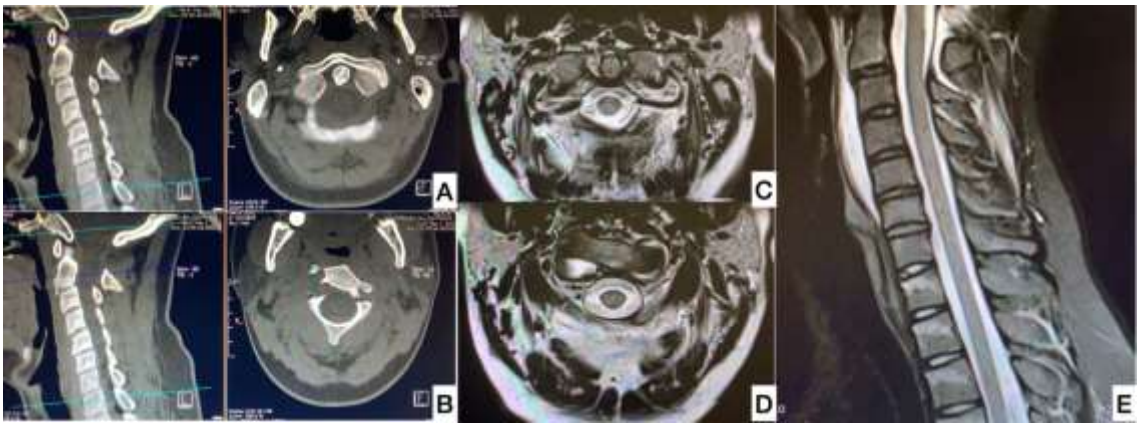

Fig. 1. A: CT C1-C2 rotary subluxation, **B:** CT Hangman's fracture, **C**: MRI intact transverse ligament, **D:** MRI C1-C2 rotary subluxation, **E:** MRI Intact intervertebral discs and absence of spinal cord compression.
Source: self-made.

TREATMENT

Following the diagnosis of this rare, combined injury, the patient was immobilized with a Philadelphia rigid cervical collar. After a team meeting at the traumatology department, it was decided to place the halo vest in the surgical block, performing a closed reduction under general anesthesia with the halo in place. Traction and rotation manoeuvres were performed to correct the C1-C2 rotary subluxation, followed by mild extension to reduce the C2 fracture, accurately guided under image intensifier. Strict clinical and radiological follow up was carried out during the first 4 weeks, as well as monthly CT scans during the first 3 months. The treatment was well tolerated by the patient and was extended for 3 months. However, due to a local skin infectious complication produced by the vest on the posterior left hemithorax, treatment was withdrawn, and the infection resolved with antibiotic therapy at home. After removing the halo vest, a cervical collar was placed for 1 month, evidencing persistent reduction and consolidation of the fractures (Fig. 2). To date, the patient showed an excellent progress at 2-year follow-up, with no neck pain or alterations in neck mobility, doing sports and back to work on logistics tasks (Fig 3 A-B).

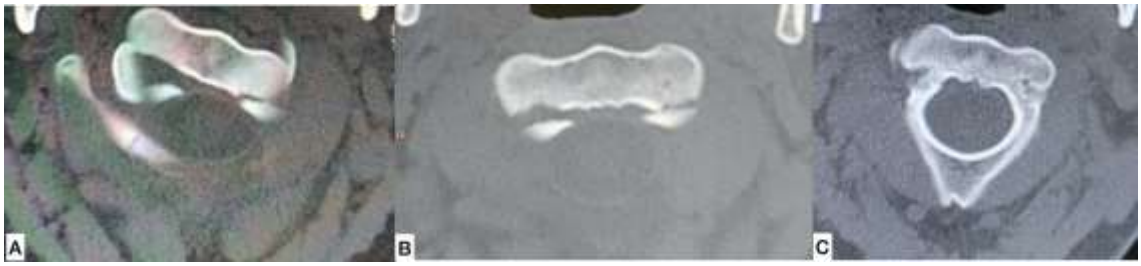

Figure 2. C2 fracture. A: Preoperative image, B: Postoperative reduction, C: Consolidation at 6 months.
Source: self-made.

Fig. 3. A: Cervical mobility at 2-year follow-up, B: Static X-rays, C: Dynamics at 2-year follow-up.
Source: self-made

DISCUSSION

The atlantoaxial joint is the most mobile joint in the body. It is responsible for a large part of the vertebral column mobility, representing more than half of head rotation movements. This extensively mobile region within the cervical spine, makes the atlantoaxial joint most prone to instability and dislocations. (3, 4) Atlantoaxial dislocations or subluxations appear to be an infrequent entity with a reported incidence of 2.7%, often resulting from extreme rotation and distraction trauma of the cervical spine. (5)

C1 fractures usually occur at the weakest transition zones between the lateral masses and the anterior and/or posterior arches, accounting for 2 to 15% of all cervical spine fractures. (6, 7) They are rarely seen in isolation. (3) Stable atlas fractures commonly compromise the posterior or anterior arch and are usually associated with intact transverse ligaments. These fractures usually result from a combination of axial compression and flexion-extension forces applied to the spine. They present high fusion rates with conservative treatments such as immobilization with a halo vest or rigid cervical collar. (6, 8) However, when disruption of the transverse ligament occurs, atlantoaxial instability presents, requiring fixation of the C1-C2 segment and hence resulting in a significant loss of mobility of the cervical spine. (3)

Traumatic spondylolisthesis of C2 occurs in the pars interarticularis of the neural arch and is caused by a sudden hyperextension of the neck. It can be seen in children as well as in adults, representing 17 to 25% of cervical spine fractures. (7, 9-12) This type of fracture is not usually associated with neurological injury due to the tendency of the medullary canal to expand. (5) The recommended treatment for this type of fracture varies depending on the type and severity of the instability. Effendi types I and II and Levine-Edwards types I and II are suitable for conservative treatment with a rigid cervical collar or halo vest, while patients presenting with Effendi type III or Levine-Edwards type IIa or III fractures should be treated surgically with instrumentation. (8, 9, 11)

Historically, treatment strategies were based on the characteristics of the C2 fracture, however, recent studies suggest that certain combination of injuries are unstable and should be treated with surgery. It is also worth noting the existence of multiple patient-related factors when choosing an specific treatment, such as age, level of activity and presence of comorbidities. (2, 8) The variability in terms of neurological injury is determined by the integrity of the transverse ligament and the degree of compression of the medullary canal, both intact in our patient. (5)

Conservative treatment of the upper cervical spine varies from collocation of a Philadelphia cervical collar, a halo vest, or even a halo cast. These fixation methods can be useful for stable fractures, with low morbidity rate and few relative contraindications. (13) The halo vest was created in 1959 by Perry and Nickel, for the treatment of cervical instability or paralysis secondary to poliomyelitis. (7) Relative contraindications include elderly patients, patients with skull fractures, bone pathologies or sepsis. The most common complications are patient discomfort, pin-site loosening or infection, brain abscess, breakage of the pins, and skin ulcerations secondary to the vest. (7, 10, 13) The halo vest seems to be beneficial not only to preserve the ability to move, but also to avoid late consequences of surgery. (9) Ideally, reduction by traction manoeuvres should be performed within the first 24 hours; after this period general anesthesia and placement of a halo are needed, due to the muscle contracture that makes reduction difficult. (4)

Surgical treatment of the upper cervical spine is usually reserved for unstable injuries, with the aim of providing mechanical stability and allowing bone fusion. Multiple options for treatment exist both for posterior and anterior approach, depending on the type of injury. However, this can lead to a significant variety of complications such as: vertebral artery injury, Dural tears, CSF fistulas, spinal cord injury, surgical infections, nerve root injury, esophageal or pharyngeal lesions, airway obstruction, instrumentation failure and pseudoarthrosis. (7, 10, 13) Additionally, surgical treatment is associated with greater probability of secondary deformities and limitation in residual cervical mobility. (3, 9) Currently, there is no consensus whether the anterior approach is better than the posterior approach, or in regards to which type of instrumentation to perform, leaving the treating surgeon to choose based on his experience and comfort with each technique. (2)

Formal indication for surgery in combined C1 and C2 fractures include: failure of conservative treatment, atlanto-odontodieal interval > 5mm, C2-C3 angulation > 11°, C1 lateral mass displacement > 7mm, evidence of transverse ligament injury in the MRI, Levine-Edwards type IIa and III fractures. (2, 8)

In the literature, there are four case reports that show this injury association; one case describes a closed reduction with traction and halo vest placement at 3 weeks, reduction and subsequent stabilization of C1-C3, another case performs a double reduction and stabilization of C1-C4 , and the other case that also associates an unstable odontoid fracture had to be managed surgically. (4, 5, 14, 15) We believe that our case contributes to the literature on this rare injury association. Prompt diagnosis and treatment allowed us to manage the patient with a valid conservative option, avoiding surgical treatment of the upper cervical spine.

CONCLUSION

We believe that the clinical reasoning of our patient's injury association, including early diagnosis, accurate classification and individualization of each lesion, gave us better understanding of the injury stability. This allowed a more conservative approach in a young patient with excellent clinical, functional, and imaging results. Therefore, we believe that conservative management may be a reasonable option for this injury association.

KEY POINTS

- Infrequent injury association.
- Integrity of the transverse ligament to define management of atlas fractures.
- Individualization of injuries for decision-making.

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