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IM - PHYSICAL EXAMINATION

An unusual cause of cardiopulmonary arrest

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Case presentation

A 43-year-old man arrived at our emergency department (ED) entrance in a private vehicle. The patient's family members summoned help, reporting that the patient had suddenly lost consciousness and become cyanotic. The patient's sister expressed concern that the patient may have used intravenous heroin. There was no preceding trauma. The patient's medical history was significant for type II diabetes mellitus and intravenous drug abuse.

The primary survey revealed an apneic patient without palpable pulses. Cardiopulmonary resuscitation was immediately initiated, and the patient was moved to the ED critical care area. Return of spontaneous circulation was rapidly achieved. Intravenous access was established and 4 mg of intravenous naloxone was administered without response. The patient was orotracheally intubated without the need for sedation or paralysis.

Upon secondary survey, the patient's eyes were open, and he was clenching his teeth on the endotracheal tube. However, he had no movement of his extremities in response to commands or noxious stimuli (GCS 6T). There were track marks on his arms consistent with IVDU. The remainder of his examination was unremarkable. Initial laboratory studies were unrevealing. The ECG showed a sinus tachycardia. Central venous access was obtained, and post-cardiac arrest cooling was initiated. He was given ketamine and vecuronium just prior to being transferred to the medical intensive care unit (MICU).

Immediately following admission to the MICU, sedatives and paralytics were briefly held to facilitate re-examination. Upon re-examination, the patient was noted to be tracking the examiner with his eyes. He responded to questions with blinking, and he had full extra ocular movements but no other motor movement to command. His reflexes were brisk throughout, and he exhibited weak triple flexion of his bilateral lower extremities.

Based upon his examination, a cervical collar was immediately placed, and neurosurgery was emergently consulted as the patient was transported for radiographic imaging of his cervical spine (c-spine). Computed tomography (CT) of the patient's c-spine revealed a comminuted odontoid fracture with complete atlantoaxial (C1-C2) dislocation as well as vertebral erosions, severe ligamentous injury, and paravertebral fluid collections (Fig. 1). The differential included infectious, other inflammatory, and traumatic etiologies.

A halo traction device was placed for stabilization, and the patient was started on ceftriaxone and vancomycin empirically. Bacterial cultures from transoral aspiration of the fluid collections grew methicillin-resistant *Staphylococcus aureus* (MRSA). The patient subsequently underwent occiput-to-C4 fusion, and completed a course of long-term IV antibiotic therapy. On follow-up examinations, his executive function remained intact, but his motor examination remained poor with complete quadriplegia and ventilator dependence.

Cardiopulmonary arrest resulting from cervical spinal cord injury occurs due to paralysis of the respiratory muscles or disruption of the autonomic nervous system resulting in cardiovascular collapse (i.e. neurogenic shock

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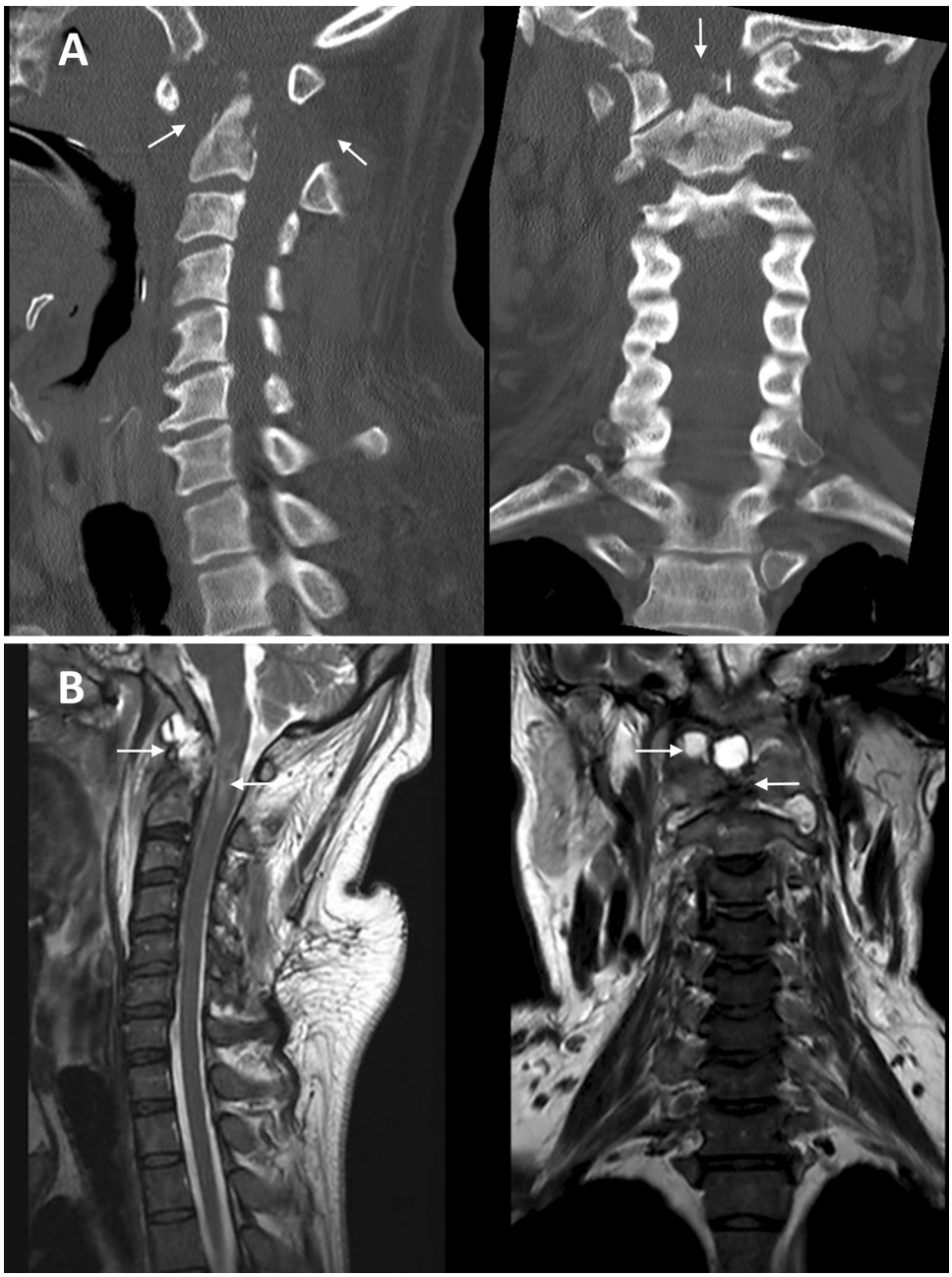

Fig. 1 **a** Sagittal and coronal CT images. These CT images show a comminuted, type II odontoid fracture and osteolysis of the dens process resulting in severe atlantoaxial (C1–C2) dislocation. Associated paravertebral fluid collections are also visualized. **b** Sagittal and coronal T2-weighted MRI images post-halo stabilization. Multiple fluid collections are visualized surrounding the occipitoatlantal (C0–C1) joint, the atlantoaxial (C1–C2) joint, the dens process, and anterior to the upper cervical vertebral bodies. There is also abnormal signal within the spinal cord

or dysrhythmia). The patient described above sustained cardiopulmonary arrest due to non-traumatic atlantoaxial dislocation, which resulted from infectious osteolysis of the dens process as well as surrounding structures.

Atlantoaxial subluxation is a serious condition resulting from loss of ligamentous stability between the atlas (C1) and axis (C2). The majority of cases are preceded by traumatic injury. Grisel's syndrome is non-traumatic atlantoaxial subluxation secondary to an inflammatory process in the upper neck [1]. It occurs almost exclusively in children, often with susceptible conditions such as Down syndrome, rheumatoid arthritis, and ankylosing spondylitis [2]. Infectious causes of Grisel's syndrome are exceedingly rare in adults, with only seven confirmed adult cases reported in the literature since 1830 [3]. Upper respiratory tract and intraoral infections as well as otolaryngologic procedures have been cited as possible causes of Grisel's syndrome [3, 4].

Destruction of the dens due to inflammatory processes is also quite uncommon. There are a handful of case reports of infectious destruction of the dens ranging from osteitis to near complete osteolysis [5]. Predominant organisms are *S. aureus*, *Mycobacterium tuberculosis*, and mixed flora. Illicit substance abuse, chronic alcohol use, and diabetes mellitus are common comorbid conditions [6].

The course of c-spine infections can be quite protracted. Fever is the most common associated symptom, while Grisel's syndrome often presents with torticollis as well [1, 5]. These facts, combined with limited awareness amongst physicians, can delay the diagnosis for several months. Early identification followed by initiation of antibiotic therapy and stabilization of the c-spine is vital to prevent serious outcomes such as hemiplegia, tetraplegia, and cardiopulmonary arrest [3, 7].

Overall, this case highlights the importance of thorough physical examination in the setting of cardiopulmonary arrest. In the case above, astute neurological examination identified c-spine disruption as the cause of the patient's cardiopulmonary arrest. This may have prevented a multiple-day delay in diagnosis, thereby precluding dissemination of infection or additional damage to cervical structures. Although accurate early neuroprognostication is not possible in the setting of resuscitated cardiopulmonary arrest, thorough neurologic examination remains essential.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Statement of human and animal rights This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent Informed consent was obtained prior to publication of this Case Report.

References

1. Osiro S, Tiwari KJ, Matusz P, Gielecki J, Tubbs RS, Loukas M (2012) Grisel's syndrome: a comprehensive review with focus on pathogenesis, natural history, and current treatment options. Childs Nerv Syst 28:821–825
2. Karkos PD, Benton J, Leong SC, Mushi E, Sifaji N, Assimakopoulos DA (2007) Grisel's syndrome in otolaryngology: a systematic review. Int J Pediatr Otorhinolaryngol 71:1823–1827
3. Kerolus M, Jeans EB, Fontes RBV, Deutsch H, Traynelis VC (2015) Atlantoaxial instability of inflammatory origin in adults: case reports, literature review, and rationale for early surgical intervention. Neurosurgery 76:E226–E232
4. Gormley W, Rock J (1994) Spontaneous atlantoaxial osteomyelitis: no longer a rare case? Neurosurgery 35:133–136
5. Busche M, Bastian L, Riedemann NC, Brachvogel P, Rosenthal H, Krettek C (2006) Complete osteolysis of the dens with atlantoaxial luxation caused by infection with *Staphylococcus aureus*. Spine 30:E369–E374
6. Goes E, Zeller V, Chicheportiche V, Tristan A, Desplaces N, Ziza J-M (2013) Staphylococcus aureus osteitis of the dens: a rare location. Joint Bone Spine 80:531–533
7. Shunmugam M, Poonnoose S (2015) Spontaneous atlantoaxial subluxation associated with tonsillitis. Asian J Neurosurg 10:139–141