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GRAND ROUNDS

Management of a major atlanto-axial instability secondary to a lytic lesion of C2

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Abstract

Introduction Management of C1–C2 instability is very challenging, especially when tumoral lesions are involved. *Case report* We present the case of a 65-year-old male, with a recently discovered small cell lung carcinoma, presenting progressive tetraparesis due to a secondary lesion involving the body of C2 with complete collapse of its anterior part and major C1–C2 instability in all planes. The patient underwent a reconstructive surgery of the upper cervical spine during two sessions. First, an emergency surgery was done by a high anterior cervical approach, where reconstruction of the body of C2 was done by an original technique using a C3 body to odontoid long screw with bone cement filling around the screw at the level of C2, and an anterior buttress plate put from C2 to C4. A posterior surgery was performed after 48 h to stabilize the spine posteriorly with C1 to C5 instrumentation. The patient recovered from his neurological symptoms, and underwent complementary adjuvant radiotherapy with chemotherapy later on.
Conclusion Literature is sparse on the treatment of major C1–C2 instability, especially when a secondary lesion is involved, the current case shows a successful treatment strategy with an original technique that was never described before in the literature. The patient was pain free at 1 year follow-up with a stable construct.

Keywords Atlanto-axial instability · C2 · Lytic lesion · Tetraparesis

Case presentation

A 65-year-old man was recently diagnosed with a small cell lung carcinoma for which a treatment by chemotherapy was done with good control of the local tumor and no need for surgery. He presented to our emergency department, 4 months after the discovery of his pulmonary lesion, with a neck pain of 1 month associated with tetraparesis. Physical examination revealed paresthesia of upper and lower limbs with global motor weakness, his left upper extremity was the most affected with a 3/5 muscle strength, the other limbs were globally evaluated at 4/5 muscle strength, pyramidal syndrome was noted (positive Babinski Sign), there was no bowel or bladder dysfunction. The patient had a CT scan and an MRI of the cervical spine that revealed destruction of the body of C2 with major atlanto-axial instability, he was put under traction with a Gardner-Wells skull Tongs (10 kg) with no reduction of the luxation

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Fig. 1 Lateral X-ray showing no reduction of the C1–C2 luxation under traction

in the emergency department (Fig. 1). Surgery was performed on an urgent basis during the same day. He first underwent an anterior high cervical approach for reduction of the luxation, tumor excision and anterior reconstruction and instrumentation from C2 to C4; he then had 48 h later, a posterior approach for a complementary instrumented stabilization from C1 to C5.

Diagnostic imaging section

CT scan reconstruction of the cervical spine revealed a lytic lesion of the body of C2, sparing the odontoid process, with complete collapse of the anterior part of the axis. It revealed also C1–C2 major instability in the three spatial planes with a complete C1–C2 luxation on the sagittal view, coronal translation to the left side and rotatory dislocation to the left side (Fig. 2a–d). MRI showed a significant compression at the atlanto-axial level due to the major instability and dislocation of the C1–C2 complex (Fig. 3).

Historical review, epidemiology, diagnosis, pathology and differential diagnosis

Cervical metastatic lesions represent one quarter of all spinal metastasis, with the most common primary tumor being breast cancer, followed by myeloma; the pulmonary tumors represent only 8 % of these primary tumors [1]. In one quarter of the patient, the cervical lesion is the first manifestation of the malignant disease [2]. The metastatic deposits predominantly affect the vertebral body with a high rate of vertebral collapse, up to 73 % [2] associated sometimes to a kyphotic deformity. Pain is usually the alarming medical symptom but neurological symptoms are very common with predominance of the radicular symptoms over the long tract symptoms with a 10 % rate of tetraparesis [2]. Plain X-rays of the cervical spine (anteroposterior, open-mouth odontoid, lateral) show an abnormal aspect of the vertebral body in case of a lytic lesion or a collapse, intervertebral instability could also be detected, but CT and MRI scans provide further information regarding the extension of the bony lesions on the CT, and the degree of spinal cord compression on the MRI. They also help in preoperative planning when surgery is indicated, and if it is the case, CT angiogram can be performed to show the course of the vertebral arteries and their diameter at C1 and C2, which is essential to determine the best operative procedure.

In case of severe neck pain with no neurological impairment, radiotherapy is the treatment of choice with a good pain relieving effect [3]. Surgery is indicated in case of neurological symptoms, major instability, severe pain with no response to classical oncological treatments, unknown primary tumor with need of a stabilization and a histopathological diagnosis.

In the case of our patient, surgery was mandatory given the tetraparetic presentation and the major C1–C2

Fig. 2 CT scan showing sagittal (**a**, **b**), coronal (**c**) and axial (**d**) dislocation of the C1C2 complex

Fig. 3 MRI showing major compression at the atlanto-axial level due to the C1–C2 dislocation

instability. The histopathological examination of the per-operative samples confirmed the diagnosis of secondary lesion from a small cell lung carcinoma.

Rationale for treatment

High cervical metastasis is very challenging when it comes to its surgical management, its approach can be either posterior or anterior or both depending on the location of the area to be reconstructed and the degree of instability.

Posterior occipito-cervical instrumentation and decompression has been advocated as a good option in metastatic lesions of the high cervical spine [4], especially in the case of total destruction of the odontoid process [2]; adding cervical pedicle screws to the construct can also increase the spinal stability and avoid an anterior column reconstruction [5]. On the other hand, several papers have advocated the use of an anterior approach, the high anterior retropharyngeal approach also called the submandibular approach has been widely described [6–9]. This is a proximal extension of the classical Smith-Robinson anterior approach, providing exposure from the atlas to the subaxial cervical spine. The use of a transoral approach in the case of secondary lesions is not a safe and satisfying option given its morbidity, infection rate [10] and the difficulty to extend the fixation down to C3 or C4. The transmandibular approach should also be avoided given its morbidity and the limited life expectancy of this category of patients [11].

Anterior reconstruction of the spine can be done by the use of a titanium mesh cage filled with bone cement, a specific C2 prosthesis [12], or by 2 screws put in the dens and the C2 body defect filled with cement as described by Sjostrom [13], the construct being always completed by an anterior plate.

In case of a major C1–C2 instability, a combined anterior reconstruction with posterior instrumentation to the occiput [14, 15] or to C1 [16] is advised, during a single session or two separate sessions.

In the case of our patient, a two-staged reconstruction and instrumentation was done, with an anterior technique similar to the Sjostrom technique but with a long screw extending from the C3 inferior endplate to the odontoid process, making the anterior support more rigid, posterior instrumentation spared the occipito-C1 joint to avoid its unnecessary fusion and give the patient a better postoperative quality of life [17].

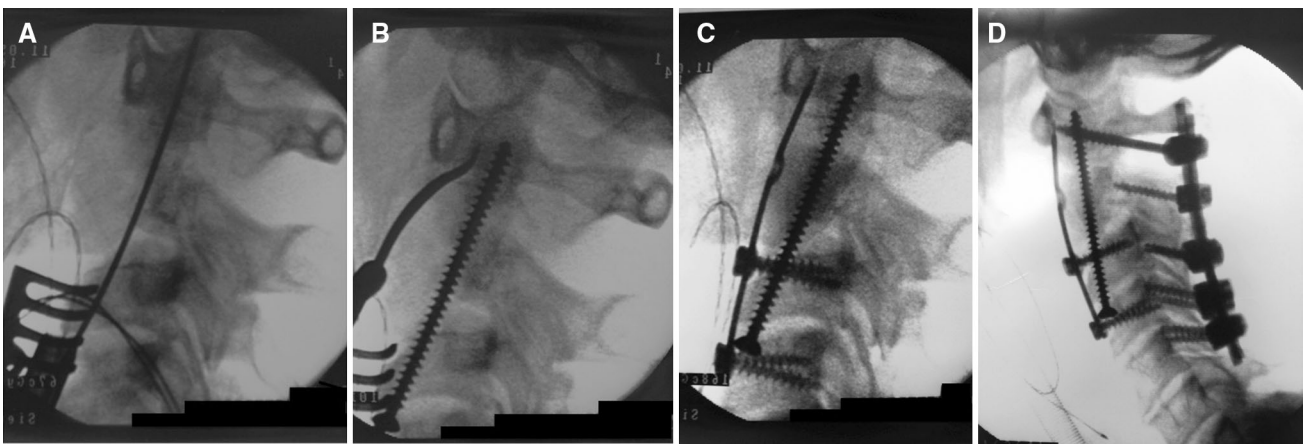

Fig. 4 Intra-operative sagittal X-rays showing the insertion of a K-wire from C3 to the odontoid process (**a**) followed by a 60mm cannulated screw (**b**), Final aspect after the anterior approach (**c**), and the posterior approach (**d**)

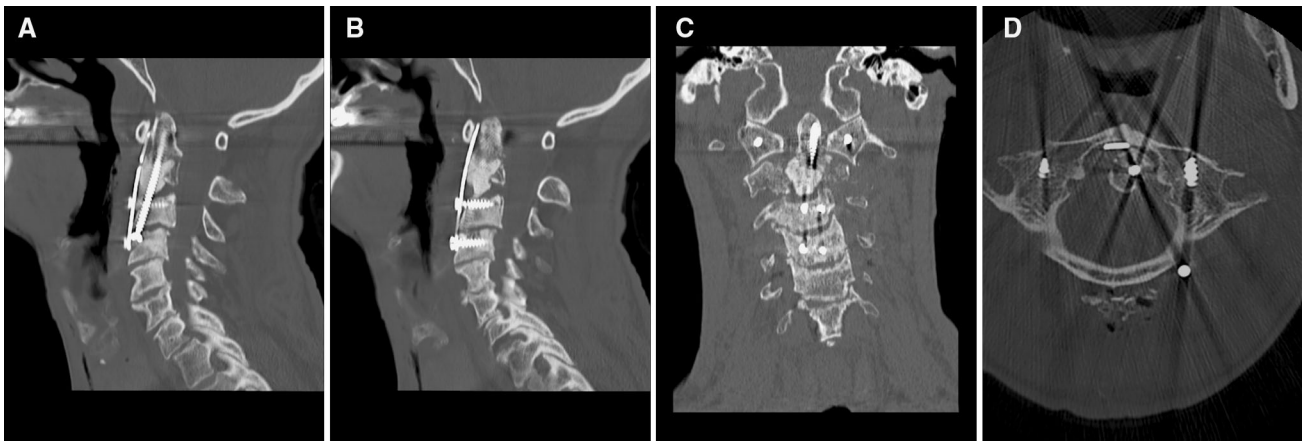

Fig. 5 Postoperative CT scan showing the final construct with reduction of the C1–C2 dislocation on the sagittal (**a**, **b**), coronal (**c**) and axial (**d**) cuts

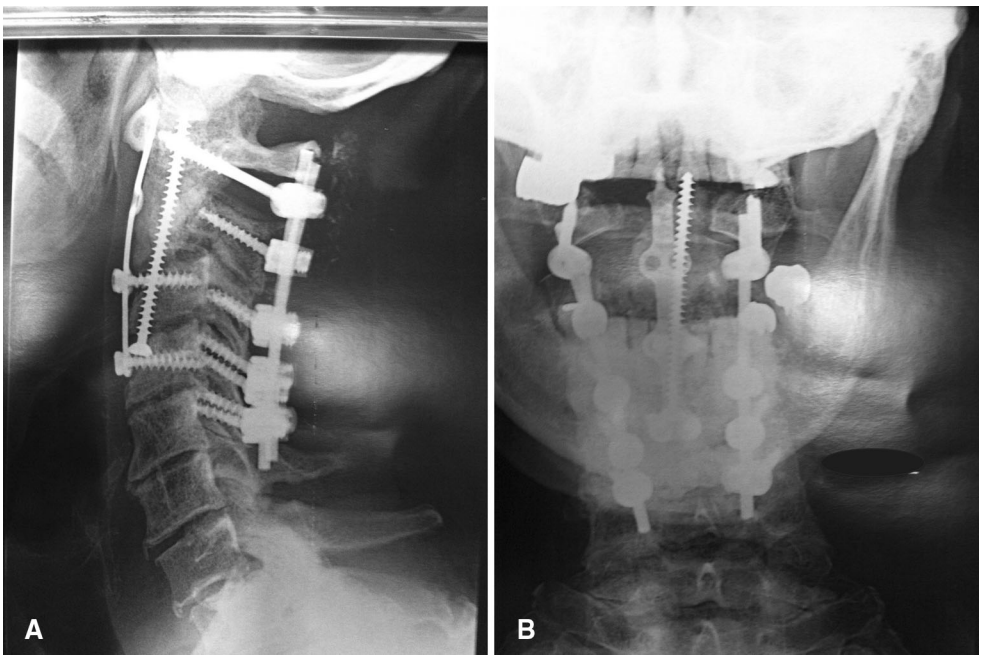

Fig. 6 Lateral X-ray showing a stable construct at 1 year

Operative procedure

The patient was taken to the operating room for emergency reduction of the C1–C2 luxation and anterior surgery. Under general anesthesia, closed manual traction maneuvers were performed using the skull tongs, which enabled reduction of the atlantoaxial luxation, confirmed on the image intensifier. This was followed by a high anterior cervical approach (submandibular approach), with access from C1 to C4. Intralesional resection of the C2 tumor was performed including the anterior part of the inferior endplate but the posterior cortex and odontoid process were spared as they were not invaded by the tumoral process. Tumoral samples were sent to the lab for histopathological examination. The inferior endplate of C3 was then prepared (with a similar technique of preparing a C2 endplate when putting an odontoid screw for a fracture) with a groove drilled into the anterior superior corner of C4 and, under image guidance and direct vision, a K-wire was drilled across C3 and the C2 empty space and docked into the cortical bone of the proximal odontoid fragment. A C3 to odontoid 4 mm/60 mm length fully threaded cannulated screw was then inserted to construct the anterior column of C2. This was completed by polymethylmethacrylate cement filling around the screw between the odontoid process and the upper endplate of C3. An anterior cervical

plate was then taken, cut at its proximal part to become narrower, and slided between the anterior arch of C1 and the odontoid proximally with two screws put in C3 and two screws put in C4 distally, the plate having an anterior buttress effect on the reconstructed C2. Suction drain was inserted and the wound was closed.

During the second session, the patient was placed in a Mayfield head holder and put in a prone position. A midline exposure was carried out from C1 to C5, instrumentation included lateral mass screws in C1, pedicle screws in C2, and lateral mass screws at the levels C3, C4 and C5. No decompression was done, and the construct was completed by two rods placed into the polyaxial screws heads and tightened.

Procedure imaging section

Intra-operative images are represented in Fig. 4a–d.

Clinical outcome

The patient was discharged on day 14, with progressive recovery of the tetraparetic symptoms. He had to wear a hard neck collar for 2 months. A postoperative CT scan was performed to verify the location of the implants and the quality of the reduction (Fig. 5a–d). He underwent complementary adjuvant radiotherapy with chemotherapy later on. He has been followed for 1 year (Fig. 6a, b), with no neck pain or no neurological deficit, and he remains free of any local recurrence.

Conflict of interest None.

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