Clinical case

Metastatic odontoid fracture management by anterior screw fixation and kyphoplasty

Fracture pathologique de l’odontoïde : prise en charge mini-invasive par visage antérieur et cyphoplastie

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\textbf{A R T I C L E   I N F O}

Article history:
Received 12 February 2013
Accepted 28 April 2013

Keywords:
Cervical spine
Kyphoplasty
Spinal metastasis
Odontoid screw

\textbf{A B S T R A C T}

We report the case of a patient diagnosed with a pathological fracture of the odontoid dens related to a renal carcinoma metastasis and treated by an original technique. In order to achieve correct stabilization of the fracture and to preserve rotational neck mobility, an anterior approach combining an odontoid screw fixation and a balloon kyphoplasty was performed. This minimal invasive strategy provided satisfactory clinical and radiological results for this unstable lesion. To our knowledge, this technique has not been previously reported and could be a valuable alternative approach in the management of craniovertebral metastatic lesions for these fragile patients.

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\textbf{RÉSUMÉ}

Les auteurs rapportent le cas d’un patient présentant une fracture pathologique de l’odontoïde secondaire à un carcinome rénal, traitée selon une technique originale. Afin d’obtenir une stabilisation optimale de la fracture et de préserver la mobilité en rotation du rachis cervical, une procédure chirurgicale associant cyphoplastie par ballonnet et vissage antérieur de l’odontoïde fut réalisée. Les résultats cliniques et radiographiques obtenus par cette approche mini-invasive d’une lésion instable étaient satisfaisants. À notre connaissance, cette procédure n’a jamais été décrite précédemment et peut constituer une alternative intéressante dans la prise en charge des lésions métastatiques du rachis cervical haut chez des patients souvent fragiles.

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\textbf{1. Introduction}

The spine is the third most frequent site for metastasis after the lung and liver and nearly 3\% of patients diagnosed with a malignant process eventually develop a secondary spinal localization. In this population, metastases involving the craniovertebral junction are more uncommon, representing 0.5\% of cases.

The global prognosis of these patients with spinal metastasis is poor, with an average life expectancy below one year. Outcomes are even worse when the craniovertebral junction is involved, with an average life expectancy of 6 months. Management of these lesions must therefore meet two objectives [1]: assure a spinal stabilization in order to avoid a potentially fatal neurological complication and maintain the satisfactory function of the cervical spine in order to preserve quality of life as long as possible for these patients.

To date, few clinical series have been reported in the literature concerning the management of axis metastasis. Depending on the stability of the lesion, different therapeutic options are available from abstention to surgery combined with radiotherapy. Traditional surgical procedures for axis metastasis have primarily involved C1–C2 intervertebral fusion with additional occipital bone involvement if required. In the past few years, minimally invasive procedures gained in popularity such as cement injection (vertebroplasty and kyphoplasty) in the vertebral body for bone reinforcement [2–4].

We report the case of a patient diagnosed with an axis metastasis managed by a minimally invasive technique combining, via a unique anterior access, a direct osteosynthesis [5,6] and a balloon

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http://dx.doi.org/10.1016/j.neuchi.2013.04.010
kyphoplasty. This procedure was developed in order to assure satisfactory pain relief by stabilization of the fracture while preserving rotational mobility.

2. Case report

2.1. Clinical history and examination

A 58-year-old patient was monitored in our institution’s oncology department for a renal carcinoma. He previously underwent 5 years of medical treatment before a partial right nephrectomy, with a local recurrence 2 years later that justified a total nephrectomy. During the follow-up period, hepatic and left suprarenal gland secondary lesions were diagnosed one year after the initial recurrence. A specific antiangiogenic therapy was then introduced and the patient stabilized for one year before he was referred to the surgical department for acute cervical pain requiring high dose grade III analgesics. Initial neurological examination of the patient was grossly normal.

Radiological evaluation included a cervical CT-scan and magnetic resonance imaging (MRI). Based on these examinations, the patient was diagnosed with a lytic lesion of the odontoid process of axis responsible for a pathologic dens fracture with no significant displacement (Fig. 1). On MRI, no metastatic spinal cord compression was visible (Fig. 2).

2.2. Surgical procedure

In the context of uncontrolled renal carcinoma with intense cervical pain related to the dens fracture, we decided to perform a minimally invasive surgical procedure. In order to achieve pain relief and spinal stabilization, a single anterior approach was proposed combining a balloon kyphoplasty of the distal part of the dens followed by a direct screw fixation of the axis fracture. The procedure was performed under general anaesthesia with a 2 kg cervical traction, in a supine position on a radiolucent table. Throughout the surgery, anteroposterior and lateral fluoroscopic guidance was used.

A classical 3 cm right cervicotomy was performed and the C2–C3 disc was fully exposed before insertion of a flexible k-wire through the dens fracture, under double fluoroscopic guidance. The balloon kyphoplasty was then performed using the introducer cannula over the wire followed by inflation/deflation of a 10 mm balloon (Fig. 3) in order to create a cavity for low pressure cement injection. High-viscosity polymethylmethacrylate (PMMA) bone cement was injected in the dens for a total of 1.5 mL under alternative anteroposterior and lateral X-ray control. A small cement leakage in direction of the transverse ligament was observed during the procedure and was used as the limit of cement injection. Before cement crystallization, the kyphoplasty cannula was removed and a cannulated screw was inserted in the axis, bridging the dens fracture with its distal extremity into the cement. A classical wound closure was then performed. During the postoperative course, no cervical collar or orthesis was prescribed.

2.3. Postoperative course

The surgical procedure was well tolerated and the postoperative course was uneventful. Almost immediate pain relief was observed and the patient was discharged from hospital two days after surgery without opioid analgesics but with grade II treatment in order to manage pain related to other secondary localizations.

A cervical CT-scan was performed on day one after surgery and six months after the procedure and they both showed satisfactory positioning of the screw and cement (Fig. 4). No clinical

Fig. 1. Preoperative coronal (a) and sagittal (b) CT-scan reconstructions showing the lytic lesion of C2 dens, with no significant displacement. Reconstructions tomodensitométriques coronale (a) et sagittale (b) mettant en évidence la lésion ostéolytique de l’odontoïde sans déplacement significatif.

Fig. 2. No metastatic spinal cord compression was visible on the initial MRI (T1-weighted sagittal reconstruction). Reconstruction sagittale IRM préopératoire (séquence pondérée en T1) ne mettant en évidence aucune compression neurologique.
Fig. 3. Peroperative alternative anteroposterior (a) and lateral (b) fluoroscopic guidance during balloon kyphoplasty procedure. 
Contrôle peropératoire de face (a) et de profil (b) lors de la réalisation de la cyphoplastie par ballonnets.

Fig. 4. Six months postoperative sagittal reconstruction CT-scan showing good positioning of the implant, and healing of the fracture. A minimal posterior cement leakage is also visible. 
Reconstruction tomodensitométrique sagittal à 6 mois postopératoires montrant le bon positionnement des implants et la consolidation de la fracture. Une fuite postérieure minime de ciment est également visible.

significance of the leakage was observed on postoperative neurological examination and rotational mobility.

Complementary radiotherapy on the metastatic vertebra was started 7 days after the surgery for a total irradiation of 30 Gy in 10 sessions.

At last follow-up, 12 months after the procedure, the patient is still alive with complete stand-alone capacity, under grade II analgesics and second line chemotherapy.

3. Discussion

Cervical spinal metastasis can be responsible for incapacitating pain. Most of the time, medical management of these lesions with analgesics, cervical immobilization and radiotherapy is sufficient for pain relief. Surgical procedures are proposed in the case of spinal destabilization with a neurological risk or in case of spinal cord compression due to a pathological fracture or epidural invasion.

This strategy is not modified if the secondary localization is located at the craniocervical junction. However, due to the short life expectancy of these patients, it is necessary to perform a minimal invasive surgical procedure with the best functional outcomes. To our knowledge, only limited literature data exists on the minimally invasive management of axis metastasis.

For many years, the gold standard for these lesions was intervertebral fusion with occipitocervical fixation in most of the cases [7]. It should be noted that inclusion of the craniocervical junction in the construct is necessary when spinal instability is associated with spinal cord compression, but this posterior approach remains a complex surgery in terms of functional outcomes and complications in these very fragile patients.

Vertebroplasty is mainly used for the thoracic and lumbar spine in order to assure reinforcement and stabilize the vertebral body when a pathological fracture occurs [2]. It also provides a high potential of pain relief for patients with spinal metastasis. Balloon kyphoplasty is based on the same indications but allows the possibility to reduce spinal deformity by balloon inflation and to decrease the risk of cement leakage by creating a cavity in the vertebral body that allows a low pressure injection of the PMMA cement.

In each case, the percutaneous procedure must be integrated into a multidisciplinary approach and most of the time is associated with a specific oncological treatment (radio and/or chemotherapy). Over the past few years, several authors [7–15] have proposed various indications for balloon kyphoplasty, especially for axis lesions in order to reinforce the vertebral body while preserving rotational mobility. The classical indication for these procedures is a lytic lesion of C2 without spine instability. The largest series available was reported by Mont’Alverne et al. [11] based on 12 cases. In their results, they showed satisfactory cervical pain relief but with a high risk of cement leakage evaluated at 58.3%, although it was symptomatic in only two cases.

Due to this risk, several authors have therefore proposed using balloon kyphoplasty in order to treat axis lytic lesions without instability. This technique has been reported in different case reports [8,9,16] and although vertebroplasty is difficult, to date no complications related to the technique have been reported. Surgical approaches vary for axis treatment; some authors have described percutaneous procedures [9,11,14] via an anterolateral access [15] or using a transoral approach [10,12]. The transoral route is the most direct but also leads to more infection complications [17,18] and cement leakage in the prevertebral tissues. In contrast, using
an anterolateral percutaneous approach decreases risk of infection but can lead to a higher risk of vascular and nervous lesions due to the absence of direct control of these structures. We argue that using a surgical anterolateral classical approach is safer for these patients with comorbidities even if it requires general anaesthesia. Whatever the approach chosen by the surgeon, it is mandatory prior to these procedures to verify the stability of the axis lesions and to use biplanar fluoroscopic guidance to insure proper implementation of the technique. The last point may be a disadvantage of this strategy as both patient and surgeon are exposed to additional radiation as in other percutaneous or minimal invasive procedures [19,20].

The technique, which combines balloon kyphoplasty and anterior osteosynthesis of a potentially unstable lesion of the cranio cervical junction, requires a learning curve in order to avoid complications but can be a valuable alternative to conventional posterior fixation due to its less invasive characteristics and preservation of rotational mobility.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References