Endoscopic excision of C2 Osteoid Osteoma: a technical case report

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Abstract

Purpose The Authors illustrate the feasibility of an open biopsy and complete excision of Osteoid Osteoma involving the C2 vertebral body performed via endoscopic anterior cervical approach.

Methods A 23-year-old male patient with history of delayed diagnosis of cervical Osteoid Osteoma underwent evaluation and surgical treatment: the minimally invasive procedure and techniques were described. The clinical features, the radiological findings and the outcome were assessed. Complications and local recurrences were also recorded.

Results There were no intra- or post-operative complications. Immediately after surgery the typical Osteoid Osteoma related pain disappeared. At three years follow-up the patient was asymptomatic and considered disease-free: CT-scan and x-Ray showed no local recurrence and C2-C3 interbody fusion with cervical plate in site.

Conclusions The endoscopic transcervical surgery represents an interesting option for the treatment of these diseases in difficult areas of the upper cervical spine, also minimizing soft tissue trauma and collateral damage allows patients a faster and complete return to normal function. To our knowledge this is the first report of cervical spine tumor removal using this minimally invasive approach.

Keywords Osteoid osteoma · Cervical vertebrae · Anterior approach · Endoscopy · Video-Assisted Surgery

Introduction

Osteoid osteoma (OO) is a small benign bone tumor, usually very painful. Ten percent of the lesions occur in the spine, rarely within the vertebral body [1]. C2 is an extremely rare site for a lesion of OO [2].

Mini-invasive surgery is emerging as an alternative and reliable method of treatment in a variety of spinal disorders. This can be extremely interesting in the management of spinal tumors, particularly in case of benign lesions in which surgeons should consider to minimize morbidity caused by traditional approaches, provided that the oncological criteria are satisfied.

In recent years, minimally invasive techniques have been introduced in the management of OO, such as percutaneous radiofrequency ablation [3], percutaneous lead tunnel surgery [4].

Anterior approach to the cervical spine using tubular sequential dilator retractors has been previously described in non-cancer cases [5–7]. In the report, this minimally invasive approach option was applied in the treatment of OO located in C2 vertebral body.

Case report

A 23-year-old young man presented with left occipito-cervical permanent pain since 24 weeks, more severe at night and temporarily relieved by NSAIDs.

Physical examination revealed a limitation of range of motions exacerbated the pain, but otherwise the results of

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Fig. 1 CT-scans showed the typical feature of Osteoid Osteoma. **a** Axial view. **b** Sagittal view

the neurologic examination were normal. Laboratory data fall within the reference ranges.

No abnormalities could be found on standard X-ray. Tc-99m MDP bone scintigraphy showed increased up-take at the lower C2 endplate. CT-scan showing the typical feature was considered conclusive for the diagnosis of OO that was located superior to the dorsal aspect of the inferior end plate of C2 (Fig. 1).

This lesion was classified pre-operatively according to the Enneking oncological staging (S2) and WBB surgical staging system (sectors 5-6, layers B-C).

Endoscopic biopsy and excision was accepted by the patient, who received careful informations on alternative techniques.

Surgical technique

The patient underwent surgery under general anesthesia in a supine position on a Mayfield frame. The approach was made on the right side for a right-handed surgeon, and contralateral to the lesion according to the trajectory pre-operatively planned.

Fluoroscopy was used preoperatively to locate the exact point for introduction of the tubular sequential dilator retractors. The anterior neck was then prepared and draped in an aseptic technique.

A 2 cm longitudinal skin incision was performed just below the hyoid bone, medial to the anterior border of sternocleidomastoid muscle. The underlying subcutaneous tissue was incised with the Bovie cautery; the platysma muscle and the superficial cervical fascia were then divided across its fibers in a transverse way to expose the anterior border of the sternocleidomastoid muscle.

Using blunt dissection, the paratracheal fascia was opened and, in an antero-inferior to postero-superior oblique direction towards the C2 body, the visceral structures were swept medially and the neurovascular laterally under the anteromedial margin of the sternocleidomastoid muscle. The dissection described was inferior to the superior thyroid artery. At no time during the dissections were the superior laryngeal and hypoglossal nerves exposed or visualized.

The subsequent procedures were performed under fluoroscopic guidance. A initial dilator was inserted into the incision to palpate the bony anatomy and to identify by fluoroscopy the proper dilator positioning (Fig. 2a). A K-wire guided by initial dilator was inserted through the C2-C3 intervertebral disc directed to the target located in the left posterior half part of the inferior endplate of C2 (Fig. 2b).

The dilators were sequentially placed over each other up to 22mm along the K-wire with slightly rotating movements and finally the Mast QuadrantTM retractor (Medtronic Sofamar Danek) was inserted over the last dilator and locked in place with the flexible arm to the operating table side rail.

The dilators were then removed establishing a tubular operative corridor (Fig. 2c) with light source and endoscopic optic (45° angle) to perform resection under illumination and magnification (Fig. 3).

The tubular dilator afforded protection of the soft tissue in the neck along the entire length of the tunnel: it retract the superior thyroid vessels cranially without the need to ligate and divide itself, thus eliminating the risk of accidental injury to the associated superior laryngeal nerve.

Fixation of the retractor to the operating table maintained the correct working trajectory preventing movement out of the surgical field during the whole procedure,

Fig. 2 Positioning of the retractors. **a** Initial dilator into the incision. **b** K-wire directed to the target (lateral fluoroscopic view). **c** Minimally invasive anterior approach by retractor

Fig. 3 Intraoperative endoscopic view before curettage

without excessive tension on surrounding soft tissue often associated with manual retraction. The surgical instruments were inserted through the tubular retractor.

The prevertebral fascia was opened and longus colli muscle dissected using an insulated long-tip Bovie electrocautery to expose the anterior aspect of the vertebral bodies and the C2-C3 intervertebral space.

A complete C2-C3 discectomy was performed and a long-handled high-speed drill with a diamond burr was used to remove the anterior wall of the lesion (Fig. 4a). After the lesion had been exposed, the nidus was curetted thoroughly (Figs. 4b, 5) and the wall of the lesion was burred around. (Fig. 4c).

The excised nidus was sent for histological examination.

Through the same expandable and movable tubular retractor, a plate and an autologous graft (Fig. 6), harvested

Fig. 4 Biopsy and tumor excision procedure (lateral fluoroscopic view). **a** Anterior wall of the lesion removed by high-speed burr. **b** Nidus curetted. **c** Wall of the lesion burred around

Fig. 5 Endoscopic view during nidus curettage

Fig. 6 Autologous graft introduced between two cervical vertebral bodies (lateral fluoroscopic view)

from the iliac bone were introduced for C2-C3 fusion. A wound drainage was used postoperatively.

Results

The operation time was 3 hours. No surgery-related complications (neurological, hardware, infections, high blood loss) were observed. There was no intra- or post-operative measurable blood loss.

Fig. 7 Postoperative X-ray

Immediately after surgery the typical OO related pain disappeared. The patient only complained mild surgical pain managed with oral analgesic agents. The wound drainage was removed two days after surgery.

Postoperative plain radiographs showed good positioning of the bone graft and the implant (Fig. 7); CT scan demonstrated complete excision of OO.

Histologic analysis of the biopsy specimens confirmed the diagnosis of OO: osteoid lined with plump osteoblasts and vascularized connective tissue were found.

The patient had a short post-operative recovery time (4 days) compared to our series of benign cervical tumor treated by open surgery that were discharged 5 to 7 days post-operatively depending on pain control.

Follow-up radiograph and CT examinations were performed after 1, 3, 6, 12, 24 months and then yearly.

No early and late post-operative complications were recorded.

At the time of the latest follow-up, three years after surgery: at clinical examination the patient was asymptomatic, without ROM limitation of cervical spine and he was permitted to return to full activities; X-rays of the cervical spine showed normal alignment and bone graft/cervical plate in site; CT-scans demonstrated complete resection of the nidus and C2-C3 interbody fusion (Fig. 8). Thirty-six months postoperatively the patient was considered disease-free.

Fig. 8 CT-scans 3 years after surgery

Discussion

The goal of surgery was to remove the nidus entirely without causing pathologic fracture, instability [8] or disrupting the surrounding uninvolved tissues.

In our case, radiofrequency ablation was impossible to apply because the lesion is in direct proximity to the spinal cord. Open techniques are still necessary in those circumstances.

Although diagnosis of OO is usually possible by clinical and imaging techniques, sometimes it is very difficult to distinguish between stress fracture or Brodie's abscess and Osteoid Osteoma [4]. In these situations, a positive histological diagnosis can be helpful in confirmation of treatment method [9]; surgery has remained to be the standard treatment in cases where the nature of lesion is in doubt [10].

In our patient the surgical procedure would be complicated by the inaccessibility of the lesion (near posterior wall of the body) and by require of extensive dissection and wide section of C2 body to expose the lesion at the base for definitive control.

In that case, the anterior open approach to the upper cervical spine (C1 and C2) was necessary and could be either transoral–transpharyngeal [11–13], transmandibular with median labiomandibuloglossotomy (if added exposure is required) [14, 15] or lateral retropharyngeal [16–19], depending on the experience and the needs of the surgeon.

These approaches should be used with care and only in appropriate circumstances because can be debilitating and associated with high risk of significant complications, due to iatrogenic injury to visceral, vascular or neurological structures [11–19].

Furthermore, the surgical open exposure can disrupt muscle, ligamentous tissues and bony elements important to stability [8].

Particularly in case of benign tumors, the surgeon should consider to minimize morbidity, provided that the oncological criteria are satisfied.

New miniminvasive surgery techniques allow surgeons to perform complete intralesional excision (extracapsular) minimizing the collateral damage caused by surgical exposure. This can be extremely interesting in case of OO located in difficult areas like C2.

In this report we present minimally invasive surgical management of OO of C2 through an anterior tubular retractor approach that allowed a full intralesional excision of the tumor by partial corporectomy, an interbody fusion and stabilization by graft and plate, with much less trauma than traditional open surgery. It also provides the material for tissue diagnosis.

This approach has been previously described by Saringer [5] for decompressive foraminotomies in the subaxial spine, by Wolinsky [6] for treatment of basilar invagination and recently in a large series of patients by Yao [7] for discectomy and interbody fusion (ACDF).

This spinal approach potentially places the superior laryngeal nerve at risk of a stretch injury, but is the same as in an conventional open approach: it is possible to inadvertently injure this nerve by a loop suture ligation or electrocautery of the superior thyroid artery during the open approach to better retract the carotid sheath laterally [20]. We are agree with the hypothesis of Fong and DuPlessis [21]: as the superior laryngeal nerve loops downward as it descends medially toward the thyrohyoid membrane, any inferior retraction coming downward from above the nerve may stretch it further; on the contrary, this downward curve can allow for superior retraction going upward from below the nerve without causing any undue tension.

Furthermore, bleeding is significantly lower than in open approaches, because this technique permits caudal extension of the dissection without involvement from vessels traversing the operative field (facial, lingual, and superior thyroid) and along the entire length of the tunnel soft tissue of the neck are protected from surgical instruments.

The retractor fixed to the operating table maintained the correct working trajectory during the whole procedure, minimizing tension on surrounding soft tissue often associated with manual retraction during open spine surgery. Consequently, pain and wound healing problems that can develop after soft tissue retraction are spared to the patients. In addition it avoids the need for an assistant to perform procedure and enables the surgeon to use both hands freely and simultaneously.

Although this is not the strongest argument for microsurgical techniques, the favorable cosmetic result due to smaller skin incisions should be considered.

These approaches also decrease the risk of significant complications related to traversing the oropharynx:

bacterial contamination, prolonged intubation or tracheostomy, postoperative enteral tube feeding, huge postoperative pain.

Minimally invasive procedures directly results in shorter hospitalization, shorter rehabilitation periods and decreased overall costs.

In our opinion there are no true disadvantages of the application of these techniques in cervical spine surgery, except for the long “learning curve” that is associated with endoscopic surgeries: a deep working distance, limited operative space that reduces the mobility of the surgical instruments.

Moreover, these techniques requires deep and careful knowledge of anatomy and of surgical steps in order to prevent severe complications; a meticulous preoperative planning is the key to success.

In conclusion, despite our limited experience, the achieved result is encouraging and the endoscopic transcervical excision of C2 Osteoid Osteoma provides a useful technique for treating this pathology in the upper cervical spine.

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