Surgical Technique in the Removal of C2 Schwannoma with Maximal Preservation of the Surrounding Supportive Tissue : A Case Report

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Abstract

A high incidence of cervical spine instability after resection of dumbbell type cervical neurinoma with laminectomy has been reported. Intraoperative disruption of the muscles and ligaments attached to the C2 process is relevant to the significant loss in the range of movement (ROM) and the malalignment that manifest late postoperatively. A case of C2 neurinoma in a 48-year-old female that was successfully managed with maximal preservation of the surrounding supportive tissue is presented. She was admitted with a six-month history of progressive tetraparesis, bilateral paresthesia of the limbs, bowel and bladder dysfunction. Imaging studies revealed a large extradural dumbbell shaped tumor at C1/2, extending postero-laterally, that was severely compressing the spinal cord. The vertebral artery was displaced antero-laterally, the C1-C2 intervertebral space extended, and the C2 lamina partially eroded. The tumor appeared to be enclosed by the rectus capitis posterior major and inferior oblique muscle. Thus, a midline posterior approach without laminectomy was adopted and the tumor extirpated without detaching the surrounding muscle and ligament from their insertion. Neither nuchal pain nor loss of ROM developed postoperatively. During a 6-month follow-up period, no sign of the surrounding muscle atrophy was detected on the follow-up MRI, and the cervical alignment was well preserved as confirmed on a plain X-radiography. The preservation of the surrounding supportive tissue during the surgical intervention of the cervical spine is important to avoid instability. Our technical adaptation of the posterior approach to the C2 neurinomas is discussed and the literature regarding the approaches to C2 dumbbell tumors is reviewed.

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Key words

cervical, neurinoma, schwannoma, posterior approach, laminectomy

Introduction

The posterior and postero-lateral approaches are common surgical routes for the management of C2 neurinoma¹⁻³⁾. However, the issue on postoperative instability due to intraoperative disruption of the soft tissues and bony structures around C2 is yet to be settled⁴⁾. We presented a case of C2 neurinoma successfully managed via the posterior approach with maximal preservation of the surrounding supportive tissue. Using a linear straight skin incision, extirpation of the tumor was performed

without laminectomy, or detachment of any muscles and ligaments from the C2 spinous process. The technical adaptation and the rationale of our approach are discussed.

Case report

1 History and examination

A 48-year-old right-handed Japanese woman was referred to the neurosurgery department of the Kansai Rosai Hospital for progressive tetraparesis. She had a 5-year history of neck pain and occasional paresthesia of the

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Fig. 1

Preoperative MRI and CT angiography. Axial image of the Gd-enhanced T1-weighted MRI (a) showed a heterogeneously enhanced extramedullary lesion in the intervertebral space of C1 and C2. The dura is indicated by the dark lining (white arrow) demonstrated on the axial image of the T2-weighted MRI (b) and the white lining (white arrow) shown on the axial image of the CISS MRI (c). The left side of the axis and atlas lamina was eroded and the vertebral artery was displaced anteriorly by the tumor as demonstrated on the CT angiography (d).

hands. Six-months prior to admission, she started to notice bilateral numbness and worsening weakness of both the upper and lower limbs, followed by urinary retention and constipation. She had difficulty in using chopsticks, writing, and walking. There was no history of neurofibromatosis either from the patient or her family. On admission, there were no cutaneous stigmata of neurofibromatosis, and no systemic abnormalities were detected. Neurological assessment revealed anesthesia of the left C2 dermatome, bilateral glove-and-stocking hypoesthesia, bilateral hyperesthesia of the dermatomes distal to C5, and motor weakness of both the upper and lower extremities (MMT4-/5). Bilateral hyperreflexia of the elbow, knee and ankle, and bilateral positive Hoffmann and Babinski reflexes were also detected. There was a reduced ROM of the neck, especially head turning to the left. The JOA score was 7/17.

Plain X-radiography showed erosion on the left side of the axis and atlas lamina. Magnetic resonance imaging demonstrated a heterogeneous enhancing dumbbell-shaped mass at C1/2, causing severe extradural compression of the cord intraspinally, and extending postero-lat-

eral extraspinally. The tumor appeared to be enclosed by the rectus capitis posterior major and inferior oblique muscle. The left vertebral artery was displaced anteriorly as confirmed on the CT angiography (Fig. 1).

2 Operation and postoperative course

The preoperative diagnosis was a neurinoma originating from the left root of C2 and a midline posterior approach without laminectomy was employed.

Under general anesthesia, the patient was placed in the prone position with her body rotated 45° to the contralateral side, resembling a lateral decubitus position. Using a linear straight-line skin incision extending from the C1 vertebral level, continuing inferiorly down to the C4 vertebral level, a midline posterior approach was performed (Fig. 2). The ipsilateral cervical superficial extensor musculature were detached at the midline and retracted laterally with the skin to expose the cervical deep extensor musculature. The ipsilateral rectus capitis posterior major was retracted latero-caudally without detaching it from the C2 spinous process to expose the C1/2 intervertebral space. With this exposure, the lesion was found to be buried within the posterior arc of the C1, C2, rectus capitis

a | b

Fig. 2

Operative photograph (a) and illustration (b) demonstrated the tumor surrounded by the posterior arc of the C1, C2, rectus capitis posterior major and minor.

Fig. 3

Postoperative MRI (a) and coronal CT (b) demonstrated the well preserved musculature around the C2. The alignment and stability was well maintained as shown in the X-radiography. The skin incision was demonstrated by the skin staplers on the postoperative CT (d).

posterior major and minor. Without laminectomy, the intraspinal component of the tumor was enucleated to reduce the compression on the cord. Furthermore, the excision of the paraspinal component was facilitated with the space obtained after the resection of the intraspinal component. The lesion originating from the left C2 root

was totally removed and the shape of the invaginated dura sac resumed. The tumor was totally extradural and thus intradural exploration was not furthered. The course of the VA was confirmed and traced with a microdoppler device throughout the procedure and no adhesion was found between the VA and the lesion.

The postoperative course was uneventful. The patient had a prompt recovery and was discharged on the third postoperative day. Postoperatively, the patient experienced spontaneous symptomatic and neurological improvement. Her neck pain resolved and neck ROM increased. At the sixth month follow-up examination, no neurological deficits were found except a mild hypoesthesia in the left C2 dermatome, and no disability in daily life was reported. Her JOA score was 16/17. On the follow-up MRI, neither sign of residue nor recurrence was detected. The surrounding supportive tissue was well preserved, and no atrophy of the cervical extensor musculature was noted. The alignment of the cervical vertebrae was maintained normally on the follow-up X-radiography (Fig. 3).

■ Discussion

1 The importance of preserving the surrounding supportive tissue

A high incidence of cervical spine instability after resection of dumbbell type cervical neurinoma with laminectomy has been reported⁵⁾. Intraoperative disruptions especially of the muscles and ligaments attached to the C2 spinous process are related to the significant loss of ROM and the malalignment that manifests late postoperatively. The axis plays a principal role in the extension and stabilization of the head and neck. There are five extensor muscles attached to the large C2 spinous process and all of them act as a dynamic stabilizer for the cervical spine⁶⁾. It is well recognized that postoperative instability generally leads to a loss of lordosis and even the development of kyphosis. These subsequently resulted in postoperative neck pain and neurological deterioration. Several authors^{4,6~8)} have emphasized the importance of cervical extensor musculature preservation in cervical spine surgery. Reconstruction of the cervical extensor musculature has even been suggested for preventing postoperative cervical malalignment^{4,9)}.

In our approach, the cervical extensor musculature is maximally preserved. This appeared to be the ideal method in preventing postoperative cervical deformity.

2 The unique anatomical features of C1/2 intervertebral space and the characteristic of C2 neurinoma

The misinterpretation of the dumbbell shape of a C2 neurinoma, like in our case, as an intradural-extradural lesion could lead to unnecessary lateral expansion of the approach. Most neurinomas in the high cervical region, especially C1 and C2, are extradural. This can always be predicted from a careful assessment of the preoperative Constructive Interference Steady State (CISS) or T2-weighted MRI (Fig. 1). Jinnai¹⁰⁾ reported that the percentage of extradural tumors and tumors with an extraforaminal component decreases from the high cervical region to the sacral region. George and Lot¹⁾ reported that only 17% of C1 or C2 neuromas were strictly intradural. This observation is logical as more caudal nerve roots run a longer distance to reach the intervertebral foramina as postulated elsewhere before¹⁰⁾.

Anatomically, there is no intervertebral foramen between the atlas and axis. The intervertebral space between them is much wider than the others even in normal condition, and further enlarged with the presence of a tumor. The concentric enlargement of a neurinoma results in both intraspinal and paraspinal extension. Therefore, neurinomas of the C2 nerve root can be totally extradural even if they are dumbbell-shaped. During the resection of a C2 neurinoma, the enlargement of the C1/2 intravertebral space can be facilitated for the management of the intraspinal and paraspinal component. Usually, neither laminectomy nor facetectomy is necessary for the management of these tumors.

3 Consideration for the vertebral artery

McCormick³⁾ reported that if the dissection is limited to the tumor surface, the tumor can be easily dissected from the vertebral artery. The artery is neither encased nor invaded by these benign tumors but is separated from the tumor capsule by a thin layer of periosteum and perivertebral veins. Therefore, the consideration to control or mobilize the artery intraoperatively is not mandatory.

■ Conclusion

Our approach, a midline posterior approach, without lateral expansion or laminectomy, provides adequate expo-

sure for the management of most C2 neurinomas. The cervical supportive tissue including the extensor musculature and the bony structure is maximally preserved and postoperative cervical deformity can be prevented with this technique. This is a useful and effective approach for the management of C2 neurinomas.

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