Dural Tail Sign in the Resection of Ventral Foramen Magnum Meningiomas via a Far Lateral Approach: Surgical Implications

Bo Wu[1], Shang-Hang Shen[2,3], Long-Yi Chen[1], Wei-Dong Liu[1]

OBJECTIVE: **To investigate the implications of dural tail sign (DTS) in the tailored far lateral approach for resection of ventral foramen magnum meningiomas (FMMs).**

METHODS: **Clinical data for 16 patients treated surgically for ventral FMMs over 5 years were reviewed retrospectively.**

RESULTS: **The DTS was positive in 11 cases (68.8%) and negative in 5 cases (31.2%). The most frequent form was a single cranial tail (7 of 11), followed by multiple tails consisting of a cranial tail and a caudal tail (3 of 11), and multiple tails composed of a cranial tail and a contralateral tail (1 of 11). The retrocondylar approach was carried out in 5 cases without DTS characterized by a narrow dural attachment and a partial transcondylar approach in 11 cases with DTS featuring a broad and hypervascular dural attachment. Drilling ranged from approximately one fifth to one third of the condyle with reference to the DTS form and tumor size. Total tumor removal was achieved in 16 patients. Postoperative complications were encountered in 25% of patients, predominantly associated with cranial nerve impairment. Follow-up ranging from 8 to 56 months (mean 24.4 months) showed no tumor recurrence.**

CONCLUSIONS: **In addition to tumor dural attachment and tumor size, we propose that DTS should be considered as another factor in planning the surgical approach for ventral FMMs. Differentiation between a positive and negative DTS plays a role in the neurosurgical planning of ventral FMMs. Bone removal is warranted in tumors with DTS, particularly the multiple form with contralateral tails, to facilitate the surgical procedure and achieve a more radical resection.**

INTRODUCTION

Foramen magnum meningiomas (FMMs) have been defined as tumors arising anteriorly from the inferior third of the clivus to the superior edge of the C2 body, laterally from the jugular tubercle to the C2 laminae, and posteriorly from the anterior border of the occipital squama to the spinal process of C2 (2, 4, 7, 8, 17). Despite the development of microsurgery and skull base techniques, FMMs located in such an accessible and eloquent area of the brain remain a technical challenge for neurosurgeons. The far lateral approach has been widely considered as the first choice for removal of intradural ventral and ventral-lateral FMMs (7, 8, 13). Nevertheless, debate still exists regarding what amount of the lateral wall of the foramen magnum (FM) should be removed for ventral FMMs (1, 2, 4, 14, 17).

The resection of dura invaded by tumor is essential for complete removal of a meningioma. Many investigators attribute meningioma recurrence to the fact that the extent of resection, especially for the tumor-associated dura, is not sufficient (5, 11, 12, 15, 18). The pathological changes in the dura around the tumor can be interpreted by evaluating the dural tail sign (DTS) on magnetic resonance imaging (MRI) studies, which appears as linear meningeal thickening adjacent to an intracranial pathology or a spinal lesion on contrast-enhanced T1-weighted MRI. The prevalence of a dural tail in meningiomas ranges from 52% to 78% (9, 10, 16). However, there is still no consensus available on the precise histopathological characteristics of DTS. Tumor invasion, connective tissue expansion, angiogenesis, dilated vessels, and

Key words
- Dural tail
- Foramen magnum
- Meningioma
- Microsurgery
- Far lateral approach

Abbreviations and Acronyms
FMM: Foramen magnum meningioma

From the [1]Department of Neurosurgery, Sichuan Provincial People's Hospital, Chengdu, Sichuan Province; [2]Department of Neurosurgery, The First Affiliated Hospital of Xiamen University; and [3]The Medical College, Xiamen University, Xiamen, Fujian Province, PRC

To whom correspondence should be addressed: Bo Wu, M.D., Ph.D. [E-mail: wuboscph@sina.com]

Bo Wu and Shang-Hang Shen have equally contributed to the article and are considered as co-first authors.

Citation: World Neurosurg. (2015) 84, 5:1402-1411.
http://dx.doi.org/10.1016/j.wneu.2015.06.062

Journal homepage: www.WORLDNEUROSURGERY.org

Available online: www.sciencedirect.com

Table 1. Demographic Data of the Present Patient Series with Ventral Foramen Magnum Meningiomas

Number	Sex/Age (years)	Symptom	Tumor Type	Maximum Diameter (cm)	Dural Tail Sign	Bone Removal	Removal Extension	Postoperative New Deficits	Follow-Up
1	F/47	Neck pain; no deficits	Menin	2.0	No	No	Total	No	52 months; no recurrence
2	F/58	Neck pain; no deficits	Menin	2.7	Single: cranial	Yes, approximately medial fifth	Total	No	16 months; no recurrence
3	F/60	Neck pain; no deficits	Menin	2.8	Multiple: cranial and caudal	Yes, approximately medial fifth	Total	No	15 months; no recurrence
4	F/66	No	Menin	1.5	Multiple: cranial and caudal	Yes, extensive but no more than one third	Total	No	14 months; no recurrence
5	F/62	Neck pain; no deficits	Menin	2.5	No	No	Total	No	18 months; no recurrence
6	F/53	Neck pain; hemiparesis, dysesthesia IX, X cranial nerve deficits	Menin	4.2	Single cranial	Yes, approximately medial fifth	Total	Transient worsening of IX, X cranial nerve deficits	42 months; no recurrence
7	F/54	Neck pain; hemiparesis, dysesthesia	Fibr	3.0	Single: cranial	Yes, approximately medial fifth	Total	Transient XI cranial nerve deficits	30 months; no recurrence
8	F/47	Neck pain; hemiparesis, dysesthesia XII cranial nerve deficits	Fibr	4.0	No	No	Total	No	20 months; no recurrence
9	F/64	Neck pain; XII cranial nerve deficits	Fibr	3.8	Multiple: cranial and caudal	Yes, approximately medial fifth	Total	No	10 months; no recurrence
10	F/62	Hemiparesis, dysesthesia	Fibr	2.5	Single: cranial	Yes, approximately medial fifth	Total	No	8 months; no recurrence
11	M/62	Neck pain; no deficits	Trans	3.0	Multiple: cranial and contralateral	Yes, extensive but no more than one third	Total	Partial XII cranial nerve deficit	10 months; no recurrence
12	F/42	Neck pain; no deficits	Trans	2.6	No	No	Total	No	56 months; no recurrence
13	F/46	Neck pain; hemiparesis, dysesthesia	Psam	3.2	Single cranial	Yes, approximately medial fifth	Total	No	15 months; no recurrence
14	F/65	Neck pain; no deficits	Psam	2.5	Single cranial	Yes, approximately medial fifth	Total	No	20 months; no recurrence
15	M/57	Neck pain; no deficits	Psam	2.6	No	No	Total	No	28 months; no recurrence
16	M/67	Neck pain; no deficits	Psam	3.0	Single: cranial	Yes, approximately medial fifth	Total	Transient XI cranial nerve deficits	36 months; no recurrence

F, female; Menin, meningothelial; Fibr, fibroblastic; M, male; Trans, transitional; Psam, psammomatous.