

Original Article

External syringomyelia in longstanding benign foramen magnum tumors

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ABSTRACT

Background: The effect of benign foramen magnum tumours on cranial and spinal dimensions and cerebrospinal fluid (CSF) spaces is unclear. In this study, we measured alterations in cerebrospinal fluid (CSF) spaces in the spinal canal and in the posterior cranial fossa distant from the site of benign foramen magnum tumors.

Methods: Twenty-nine magnetic resonance imaging scans of patients with foramen magnum tumors (8 meningiomas and 21 C2 neurinomas) were identified for radiological morphometric analysis and compared with normal control scans. The anterior-posterior distance between the pontomedullary junction and the clivus, the spinal canal diameter, spinal cord diameter, and cord-canal ratios were measured at the C6 and T2 levels.

Results: The mean spinal canal diameter was significantly higher in tumor scans at both the C6 and T2 spinal levels than in controls (13.8 mm vs. 11.4 mm at C6; $p < 0.0001$, and 12.9 mm vs. 11.9 mm at T2; $P = 0.01$). Further, the mean cord:canal ratio was significantly lower in tumor scans at both levels (0.49 vs. 0.64 at C6; $P < 0.0001$, and 0.45 vs. 0.54 at T2; $P = 0.0009$). There was no significant difference in mean anteroposterior distance from the clivus to the pontomedullary junction (10.4 mm vs. 10.3 mm; $P = 0.91$).

Conclusion: In the presence of benign foramen magnum tumors, the spinal canal diameter and CSF volume in the spinal canal increased at the C6 and T2 levels, distant from the tumor site, a phenomenon we describe as “external syringomyelia”.

Keywords: C2-neurinoma, External syringobulbia, External syringomyelia, Foramen magnum meningioma

INTRODUCTION

In 2016, we introduced the term “external syringomyelia” and “external syringobulbia” to describe the presence of excessive cerebrospinal fluid (CSF) volume in the spinal canal outside the spinal cord substance.^[2,4,5] In this paper we analyse and correlate both entities in the context of benign foramen magnum tumors.

MATERIALS AND METHODS

We retrieved preoperative T2-weighted magnetic resonance imaging (MRI) scans of patients with C2 neurinomas and foramen magnum meningiomas that were treated from 2010 to 2017. We evaluated 29 patients (21 patients with C2 neurinoma and 8 patients with foramen magnum

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meningioma) 17 male:12 female, mean age 45.8 years, range 27 - 68 years with cervical MRI images extending to the T2 level [Figures 1 and 2]. These MR studies were then compared to 29 normal control scans (21 male:8 female, mean age 45.3 years, range 24–69 years). There were no significant differences in mean ages of patient and control groups.

Comparison of MR studies for tumor versus control patients

For both the tumor and control groups, on sagittal cervical MR studies, we measured the anteroposterior spinal canal diameter and spinal cord width at the C6 and T2 mid-vertebral body index sites. The spinal cord: canal ratio was then calculated at each level along with the maximum anteroposterior dimensions of the CSF column anterior to the pontomedullary junction and posterior to the clivus.

Statistical analysis

Statistical analysis was performed using GraphPad Prism software. The unpaired t-test results are outlined in Table 1.

RESULTS

At both the C6 and T2 levels, the spinal canal diameter in tumor scans was significantly higher, and the cord:canal ratio was significantly lower than in control scans. At the T2 level, the spinal cord girth was significantly lower in patients with benign foramen magnum tumors versus controls, but there was no significant difference at the C6 level. Further, there was no statistically significant difference in CSF width between the pontomedullary junction and the clivus between tumor patients versus controls.

DISCUSSION

Our analysis revealed that in the presence of benign tumors of the foramen magnum such as C2 neurinomas or meningiomas, the spinal canal diameter increases, and

the cord: canal ratio decreases distal to the tumor. We have described this finding as external syringomyelia in the previous papers.^[2,4,5] However, in this patient cohort, we

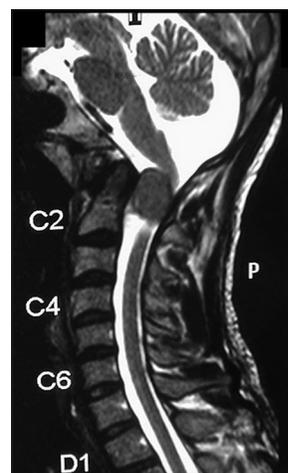


Figure 1: T2 weighted MRI scan showing a C2 neurinoma with apparent increased canal width and reduced cord:canal ratio.



Figure 2: T2 weighted MRI scan showing a foramen magnum meningioma with an apparent increased CSF space anterior to the pons.

Table 1: Spinal measurements in patient and control scans.

	Patients	Controls	Difference
Sex	17 M:12 F	21 M:8 F	N/A
Mean age	45.8 years (range 27–68 years)	45.3 years (range 24–69 years)	0.5 years ($P=0.9058$)
Mean C6 cord width (mm)	6.73	7.24	-0.51 ($P=0.0993$)
Mean C6 spinal canal width (mm)	13.83	11.35	2.48 ($P<0.0001$)**
Mean C6 cord:canal ratio	0.49	0.64	-0.15 ($P<0.0001$)**
Mean T2 cord width (mm)	5.69	6.41	-0.725 ($P=0.0259$)**
Mean T2 canal width (mm)	12.90	11.90	1.00 ($P=0.0145$)**
T2 cord:canal ratio	0.45	0.54	-0.09 ($P=0.0009$)**
Pontomedullary junction to clivus distance (mm)	10.40	10.34	0.06 ($P=0.9091$)

**Indicates statistically significant. M: Male, F: Female

observed no statistically significant increase in the CSF space anterior to the brainstem between the pontomedullary junction and the clivus, a phenomenon we previously described as “external syringobulbia”.^[2,4,5]

Low-grade or benign spinal tumors, including neurinomas and meningiomas, are generally associated with chronic local spinal changes, such as an increase in spinal canal dimensions, erosion of bones of the spinal canal, reduction of extradural fat, thinning of the dural tube, and a host of other alterations. Although spinal alterations in the vicinity of the benign spinal tumors have been previously described in the literature, alterations distant from the site of the tumor have not been elucidated.^[1,3]

Here, we described changes in the bony cervical (C6) and thoracic spinal (T2) canal width distal to the site of benign foramen magnum tumors. These changes are remarkably similar to those seen in long-standing atlantoaxial instability with odontoid process spinal cord compression at the craniovertebral junction.^[6-8] Further study into whether the extent of these local and remote neural canals and CSF space alterations can provide an estimate of the growth pattern, size, and predict the aggressiveness of these benign foramen magnum tumors is warranted.

CONCLUSION

Utilizing cervical MR studies, we documented an increase in C6 and T2 spinal canal diameter and CSF spaces remote from the site of benign foramen magnum tumors.

Declaration of patient consent

Patient’s consent not obtained as patients identity is not disclosed or compromised.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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