Foramen magnum meningioma: transoral resection with a bone baffle to prevent CSF leakage

Case report


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A case of meningioma situated at the anterior rim of the foramen magnum with successful removal via a transoral approach is reported. A new technique of preventing cerebrospinal fluid leakage is described utilizing fascia lata and a bone baffle without any attempt to close the dura, either by primary suture or tissue sealants.

KEY WORDS • foramen magnum • meningioma • transoral surgery • operative technique • bone graft • cerebrospinal fluid leakage

The transoral approach for lesions in the region of the anterior rim of the foramen magnum has, over the last two decades, assumed an increasing role in the neurosurgical armamentarium. Progressive technical refinements have broadened the range of pathology which can be successfully managed by this operative technique. For some time the problem of wound breakdown and intractable postoperative cerebrospinal fluid (CSF) leakage has hampered application of the approach to intradural lesions, specifically to aneurysms and tumors. The introduction of biological tissue sealants has provided a new stimulus to the utilization of transoral surgery for intradural pathology. While the sealants have demonstrated an improvement in primary healing, they are blood-derived products and despite presumed stringent checks on their safety there is, in the current climate, some residual concern about long-term safety as regards viral and other infective complications.

We report a case of successful transoral removal of a foramen magnum meningioma in which simple autograft material provided an effective seal against postoperative CSF leakage, despite lack of primary dural suture. Baffling of CSF pulsation is suggested as the potential mechanism whereby this new technique is successful.

Case Report

This 49-year-old woman came to neurological attention with a 2-year history of severe headaches, initially radiating up the right side of the occiput but becoming bilateral. She developed associated hyperpathic sensations of the occiput and also evolved sensory symptoms radiating down the right side of the body. The right leg and foot became "raw and hot" with reduced temperature sensation of the entire lower limb. The occipital and skull base pains had rendered the patient virtually bedridden. She also developed diplopia on upward gaze and progressive unsteadiness.

Examination. The patient demonstrated no cranial nerve deficit save nystagmus on right lateral gaze. She had a mild degree of truncal ataxia with an unsteady gait. There was a hyperesthetic response to pinprick of the entire right side with diminished sensation to light touch down the right leg. There was no objective motor deficit.

A computerized tomography (CT) scan of the head obtained 1 year previously had been unremarkable, but had not included views of the foramen magnum and skull base. A cervical myelogram with instillation of Omnipaque at C1-2 and subsequent CT scanning were reported as showing some abnormal relationship
between the dens, C-1, and the spinal cord, but concentra-
tion of contrast material was suboptimal in the fora-
men magnum region and further views were sug-
gested. Analysis of CSF removed at this examination
was positive for oligoclonal banding, although subse-
quent visual evoked responses and brain-stem auditory
evoked potentials were normal. Computerized tomog-
raphy scanning with a higher concentration of intrathe-
cal contrast material showed a number of "ossicles"
above the dens, and the medulla and cord were dis-
placed posteriorly, with a soft tissue gap between "os-
sicles" and lower medulla. Further CT scanning with
intravenous contrast medium showed an enhancing
hemispherical soft tissue mass, 3 cm in diameter, cen-
tered on the previously demonstrated calcified nodule
(Fig. 1). Vertebral angiography showed both vertebral
arteries to be displaced laterally around the mass as
they passed forward at the foramen magnum. The pre-
operative diagnosis was of a foramen magnum menin-
gioma.

Operation. Following preliminary tracheostomy
and insertion of a lumbar subarachnoid drain, a mid-
line approach to the foramen magnum and atlantoaxial
region was performed through the posterior pharyngeal
wall, using a transoral approach and splitting the soft
palate vertically. The tumor was entered by drilling
away and removing the lower clivus, anterior arch of
the atlas and dens, and associated ligaments. The tumor
was debulked centrally by removal of the calcified
"ossicles," and resected until arachnoid was identified
posteriorly. The tumor had been split centrally and the
two lateral plaques of residual tumor could be rotated
into the field and cut away from their dural attachment.
The medulla and cord could be identified through the
residual dural defect and there was no possibility of
closing the dura by primary suture.

A 4 \times 1\text{cm} graft of fascia lata was placed intradural
and a single suture was passed across the middle of the
dural defect to prevent the fascia from prolapsing into
the wound. A rectangle of corticocancellous bone, mea-
suring 4 \times 1\text{cm}, was harvested from the inner iliac
cortex and placed in the defect over the fascia. The
upper and lower ends of the graft were thinned to leave
cortex only and were wedged, above and below, behind
the clivus and body of C-2, after an extradural pocket
had been fashioned behind the clivus and a lower pocket
between the posterior longitudinal ligament and the
body of C-2 (Fig. 2).

Postoperative Course. The patient's postoperative
recovery was unremarkable. The lumbar drain was left
to drain continuously for 48 hours then removed. The
tracheostomy was removed after 7 days. The patient
received a week's course of prophylactic antibiotics. At

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**Fig. 1.** Computerized tomography reconstruction, sagittal projection, showing the foramen magnum tumor.

**Fig. 2.** Schematic representation of the bone graft as visualized in the sagittal (left) and coronal (right) plane.
Prevention of CSF leakage in transoral meningioma resection

no stage were there any problems with leakage or bulging of the pharyngeal wound and the patient was mobilized with no apparent complications. Subsequent follow-up findings have remained unremarkable. She has made a full recovery of neurological function save some slight residual sensory symptoms in the right leg. Subsequent tomograms of the foramen magnum performed 1 month postoperatively showed the bone graft to be in a satisfactory position (Fig. 3). Subsequent CT scanning and review at 12 months have revealed no evidence of tumor recurrence. Histological examination of the excised specimen revealed it to be a transitional meningioma.

Discussion

This case illustrates the clinical and radiological difficulties encountered in the diagnosis of lesions of the foramen magnum region. Magnetic resonance imaging would undoubtedly have been diagnostic but was not locally available.

The absence of a postoperative CSF leak, despite the lack of dural sealing by either tissue sealant or primary dural closure might be chance or partly helped by CSF drainage; however, due to the almost invariable difficulties previously reported, we suggest that the fascial graft and bone baffle had a significant role to play. Cerebrospinal fluid drainage is recommended routinely in these procedures but has been reported as failing to prevent breakdown even when instituted on a prolonged basis. It has even been recommended that permanent CSF diversion by lumbo-peritoneal drainage is the only technique to reduce pressure for a suitable length of time to allow sealing of the area to occur.

We propose that the primary mechanism for the wound breakdown that has frequently been reported even in the face of high-quality primary closure is related to pulsatile effects of the CSF, both regular transmitted vascular pulsation and intermittent higher displacement pulses associated with Valsalva maneuvers and the like. Waves are a mechanism for transmitting energy, and each CSF pulsation results in the transmission of energy to the surrounding membrane. This is absorbed as potential energy, which can then be dissipated back to the CSF during diastolic pressure troughs if the membrane is elastic; or will be utilized internally as kinetic energy in the case of an inelastic membrane such as dura. Normally, dura has little requirement for elastic recoil since it is largely backed by a layer of bone which is well able to reflect the energy of cerebral pulsations. However, if dura loses this bone backing then it poorly tolerates distortion and movement, and the progressive absorption of strain energy can result in stretching of the connective tissue junctions of the dura with a propensity to dehiscence. If there is a dural incision, the suture junction is even less tolerant of repetitive strains and, with a dural defect, an onlay fascia graft will have almost no capacity to repair under strain. When a lesion has been removed by the anterior approach, there is a resultant cavity in the bone, a rectangular dead space over 1 cm deep, into which the energy of CSF pulsations will push the dura or any other soft-tissue graft irrespective of the primary repair (Fig. 4). Furthermore, the muscular layer anterior to this bone space also has poor tensile characteristics and will not prevent progressive anterior propulsion of the pseudomeningocele which may eventually dehisce and rupture the mucosa. Even if the mucosa does hold then, there may still remain a residual retropharyngeal CSF meningocele; this complication has also been reported.

The ideal repair therefore provides a hard bed flush with the posterior face of the bone excision against which the CSF can pulsate and, by preventing any anterior movement into the defect, allows spontaneous membrane healing to seal any CSF leak. In this case, the bone graft was thinned down to provide a plug approximately 5 mm thick, but sufficiently thin to avoid interfering with movement. The patient's neck

![Fig. 3. Postoperative midline tomogram, sagittal projection, illustrating cortical bone lying across the defect between the clivus and the posterior body of C-2.](image)

![Fig. 4. Schematic representation showing the pressure of cerebrospinal fluid pulsations (direction of arrows) after removal of a lesion by the anterior approach.](image)
movements have recovered fully. We would presume that this bone graft will, over a long period of time, either resorb or form a local pseudoarthrosis which should not interfere with function of the craniocervical articulations. There have been previous reports of bone grafts through the region,

but these appear to have largely consisted of onlaying or packing cancellous bone into the defect to try to achieve bone union and stability. We would suggest that this technique of a thin, wedged, or locked inlay graft to baffle CSF pulsations is an alternative to tissue sealants and long-term CSF drainage in the achievement of water-tight closure for intradural lesions in this area.

References

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