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TECHNICAL NOTE - NEUROSURGICAL TECHNIQUES

Evolving instrumentation for endoscopic tumour removal of CNS tumours

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Abstract
Background Open surgical approaches to intraventricular tumours are complex and challenging. Neuro-endoscopy, however, has enabled us to biopsy and resect small intraventricular tumours with potentially reduced morbidity. Nevertheless, suitable methods/ instrumentation for resection have limited the use of the endoscope. The authors report the utilisation of endoscopic ultrasonic aspirator in the resection of an intraventricular tumour. This technique was compared to another case that utilised conventional endoscopic techniques for removal of an intraventricular tumour.
Methods Using an endoscope, the third ventricle was entered and visualised, with the tumours clearly seen. Tumours were then either debulked via conventional or novel technique.
Results Using the conventional technique, tumour was removed with rongeurs via the flexible scope. Irrigation was needed to improve vision due to bleeding. Postoperative magnetic resonance imaging (MRI) confirmed good excision. Histology was reported as anaplastic ependymoma World Health Organization (WHO) Grade III. Utilising the novel technique, the tumour was also debulked uneventfully. Histology confirmed Grade 1 glioneuronal tumour. Postoperative MRI revealed a small residuum.
Conclusions To date, endoscopic resection of tumours has been limited by suitable tools. The advent of an ultrasonic aspirator that can be used down an endoscope increases the possibilities for such resections. This is the first reported case of endoscopic resection of an intraventricular tumour using this technique.

Keywords Aqueduct of Sylvius tumour · Endoscopic ultrasonic aspirator · Neuroendoscopy

The use of endoscopy has increased dramatically over the last two decades—particularly for the treatment of hydrocephalus. In addition, endoscopes have been used to perform biopsies and to remove small intraventricular lesions, with the greatest number of reports being related to the removal of colloid cysts of the third ventricle. However, resection of solid lesions has been compromised by the lack of instruments available to remove such lesions and problems with visibility secondary to bleeding. The authors report a novel technique that can be utilised in the resection of small intraventricular tumours. To the best of our knowledge from searching the literature, intraventricular tumour resection using an ultrasonic aspirator via an endoscopic channel has never been reported. This technique is compared to conventional resection of tumour utilising neuro-endoscopy.

Operative technique

Case 1

A 27-year-old patient presented with triventricular hydrocephalus secondary to an enchancing third ventricular tumour (Fig. 1). The tumour was located in the left posterior aspect of the third ventricle, in close proximity to the superior aspect of the cerebral aqueduct. A burr hole was fashioned on the right Kocher's point. The ventricle was cannulated and the flexible scope was inserted through the foramen of Monro into the third ventricle. Third ventriculostomy was then performed.

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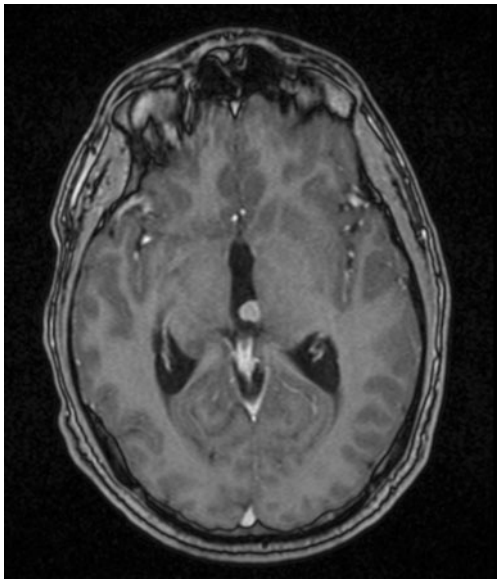

Fig. 1 Axial T1-weighted MRI demonstrating a intraventricular lesion in the posterior aspect of the third ventricle

Scope was then turned back to visualise tumour. Tumour appeared pedunculated with an exophytic component protruding into the ventricle. The ependymal tumour edge was diathermied and the tumour was removed in piecemeal with rongeurs. Irrigation was employed between bites in order to improve visualisation. At the end of the procedure, the tumour bed was diathermied. The final histology was a grade III anaplastic ependymoma.

Patient's postoperative course was complicated by ventriculitis, necessitating insertion of an external ventricular drain and treatment with intrathecal antibiotics. Postoperative magnetic resonance imaging (MRI) revealed a small amount of residual enchancement at the resection site (Fig. 2). Patient was followed up with annual scans. At 3 years follow-up, patient developed distant recurrence in the fourth ventricle and also in the spinal canal. His disease at the original tumour site remained stable. Patient went on to craniospinal radiation. His post-radiation scan revealed no further progression of the lesions at both sites to date.

Case 2

A 31-yearold patient presented with 6 months history of headaches and blurring of vision, and examination revealed papilloedema and decreased upward gaze. Her MRI scans revealed triventricular obstructive hydrocephalus, but no obvious cause for this was identified on standard MR imaging (T1 +/−GAD and T2). Endoscopic third ventriculostomy was performed. Postoperatively, due to persisting headaches, MRI constructive interference in steady state (CISS) sequence was done to assess patency of the ventriculostomy, and it was only on this sequence that an intraventricular tumour of the inferior

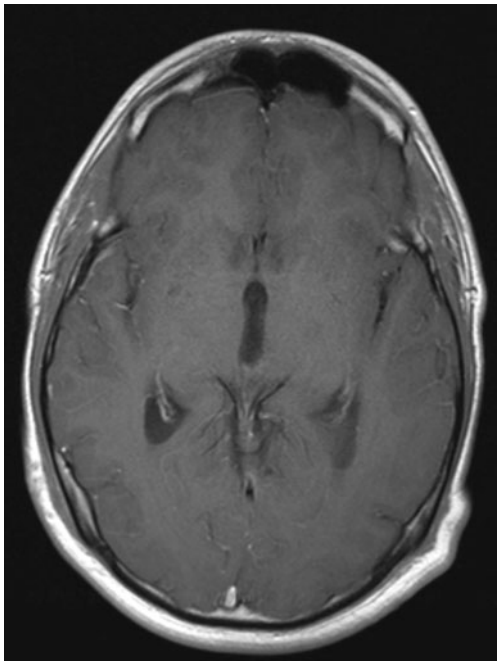

Fig. 2 Postoperative axial T1-weighted MRI demonstrating good resection of the intraventricular lesion with evidence of small amount of enchancement at resection site

half of the aqueduct of Sylvius was revealed (Fig. 3). Biopsy of the aqueductal tumour was then performed, and the histology was initially reported as Grade 1 Ependymoma. A third operation was then performed to debulk the tumour using the endoscopic ultrasonic aspirator.

Following BrainLab registration, the rigid endoscope was first registered. Using the navigation system, a new burr

Fig. 3 Sagittal T2-weighted MRI with CISS sequence, demonstrating a intraventricular lesion in the Aqueduct of Sylvius

hole was planned and fashioned in the mid-pupillary line, approximately 1 cm anterior to the Kocher's point. After navigating through the lateral and third ventricle, the aqueduct was visualised, and the tumour clearly seen (Fig. 4). The tumour was soft, friable and not vascular. Using a 3mm Micro ENP Ultrasonic Hand Piece (Scoring GmbH, Medizintechnik, Germany), the tumour was uneventfully debulked via the endoscope port(Fig. 5). The initial histology was revised, and final histology of the tumour was a benign glioneuronal tumour (WHO Grade 1).

Post-surgical MRI scans confirmed small residuum on the undersurface of the tectum (Fig. 6). The patient was discharged home the day after surgery, but with a partial right-sided fourth nerve palsy, which improved after 3 months. Follow-up scan a year later revealed a stable appearance of the residuum.

Fig. 5 Intraoperative endoscopic view of the Aqueduct of Sylvius following resection using the endoscopic ultrasonic aspirator

Discussion

Neuro-endoscopy is an established technique for the treatment of hydrocephalus, intracranial cysts and for intraventricular tumour biopsy. There are many case series and reports of endoscopic resection of intraventricular tumours [1]. Tumour resection via an endoscope often includes a combination of coagulation, suction and the use of biopsy forceps, as in the first case above. Endotracheal suction catheter used in a pulsed manner has also been reported to have been utilised [3]. The aforementioned techniques are useful for small lesions; however, open trans-cortical approach remains the mainstay treatment, especially for large supratentorial intraventricular tumours.

The utilisation of an endoscopic ultrasonic aspirator in surgery is not a novel proposition. The ultrasonic aspirator has been used in the resection of thoracic oesophageal carcinoma in laparoscopic transhiatal resection of oesophageal cancers [5]. In gynaecology, endoscopic ultrasonic aspirators have been used in performing hysterectomies and pre-sacral neurectomies [2]. There has only been one published report of using the above technique in neurosurgery. In this report, the device was used in the evacuation of intraventricular haematoma to treat hydrocephalus [4].

As in the above case, conventional tumour resection via the endoscope can be complicated by bleeding from the tumour bed and regular irrigation would be needed to achieve a better view. However, such bleeding is more likely to be dependent on the tumour than on its method of resection. Despite increased bleeding in Case 1 utilising the

Fig. 4 Intraoperative endoscopic view of the Aqueduct of Sylvius demonstrating the tumour

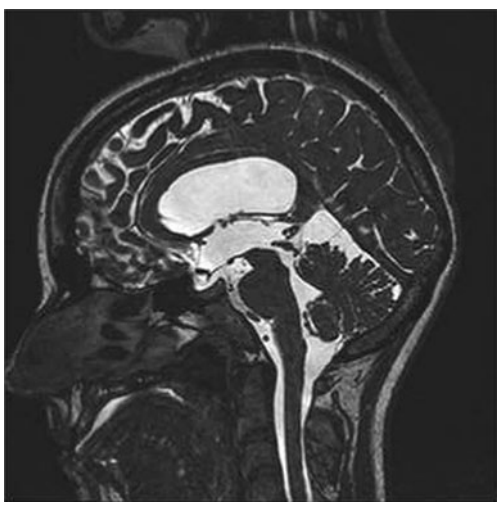

Fig. 6 Postoperative sagittal MRI with CISS sequence showing tumour being adequately resected from the Aqueduct of Sylvius

conventional technique, a good resection margin was achieved.

The main limitation in achieving a complete resection in Case 2 was the angle of introduction the ultrasonic aspirator within the aqueduct—making it impossible to resect tumour on the right side of the wall of the aqueduct. If the histology had proven to be an ependymoma, and hence increased the need to attempt a gross total excision, then it would have been possible to insert the scope into the left ventricle and attempt a more complete resection. It should also be noted that we explored Case 2 on the basis of the initial histology (ependymoma). If we had known the tumour was a grade I tumour, we would have pursued an expectant policy with a tumour in this site. Case 2 also raised interesting issues with regards to the imaging required to delineate the tumour in the aqueduct, with no tumour being seen on standard imaging, but only being clearly defined by a CISS protocol.

We found that we temporarily lost vision during the procedure, due to an air bubble caused by the ultrasonic aspirator. This is an important disadvantage of the technique. It was during this period that the aqueduct was contused—possibly causing the temporary IV nerve palsy. Formation of these bubbles is secondary to cavitation effect due to rapid motion of the ultrasonic aspirator tip, and also secondary to transmission of ultrasonic energy to the surrounding fluid medium. There are certainly devices available on the market to reduce bubble formation; however, they are not yet available to be utilised with endoscopic ultrasonic aspirators. Lastly, as with all new instruments, it is important for the surgeon to become familiar with the settings of the endoscopic ultrasonic aspirator before using it—and this is particularly so for the aspiration settings.

Conclusions

The above case highlights the novel use of an endoscopic ultrasonic aspirator in neurosurgery. It can be a useful surgical technique in the resection of small intraventricular tumours, avoiding the need for a large craniotomy. In comparison to conventional neuro-endoscopy and open procedure, this technique may offer better visualisation, shorter operative time and potentially reduced operative morbidity; but a larger series of patients treated with this technique is required to better define its advantages and limitations.

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Conflicts of interest None.

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