Posterior subtemporal transtentorial approach to intraparenchymal lesions of the anteromedial region of the superior cerebellum

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Object. To overcome the limitations associated with surgical approaches that have been described for accessing intraparenchymal lesions of the anteromedial region of the superior cerebellum, the authors used a posterior subtemporal transtentorial approach to remove tumors in this region. In this paper they describe the surgical technique that they used as well as the operative findings and clinical outcomes observed in patients who underwent resection of tumors in the anteromedial superior cerebellum.

Methods. The consecutive patients with anteromedial superior cerebellar tumors who underwent resection performed using the posterior subtemporal transtentorial approach at the National Institutes of Health were included in this study. Clinical, neuroimaging, and operative results were analyzed.

Three patients (two men and one woman) with anteromedial superior cerebellar tumors (two hemangioblastomas and one pilocytic astrocytoma) underwent resection via this approach. All the tumors were larger than 3 cm in diameter (range 3.1–3.5 cm). This approach provided excellent surgical access and permitted complete tumor resection in each case. The patients remained neurologically unchanged compared with preoperative baseline findings at the last follow-up examination (conducted at 4, 18, and 42 months postoperatively). One patient displayed a mild transient confusion immediately after surgery, but it resolved within 6 days.

Conclusions. The posterior subtemporal transtentorial approach provides excellent access to the anteromedial superior cerebellar region. This approach permits resection of large lesions in this location, while avoiding many of the limitations associated with other approaches to this site.

KEY WORDS • tumor • cerebellum • subtemporal approach • surgical technique • transtentorial approach

Tumors of the anteromedial region of the superior cerebellum are rare and technically challenging to remove because of their anatomical location. Although several surgical approaches that provide access to this area have been described, they are frequently limited by the need for significant cerebellar retraction along a narrow working corridor, the need for resection of a portion of the cerebellum to provide adequate exposure of large lesions, and the long working distances often necessary to reach the pathological entity. To overcome the limitations associated with previously described surgical methods used to access the anteromedial superior cerebellum, we developed a posterior subtemporal transtentorial approach for removal of selected tumors in this location. We describe the surgical technique that we used as well as the operative findings and clinical outcomes observed in patients who underwent resection of tumors of the anteromedial superior cerebellum via this approach.

Clinical Material and Methods

Patient Population

Three patients with anteromedial superior cerebellar tumors, who were examined and underwent tumor resection via the posterior subtemporal transtentorial approach at the National Institutes of Health, were included in this study.

Patient Examinations

Clinical Examination. Neurological examinations were conducted before and after surgery. Findings from inpatient charts, clinic notes, and operative reports were reviewed and recorded.

Neuroimaging Studies. Patients were examined before and after surgery by performing serial high-resolution, T1-weighted (unenhanced and contrast-enhanced), T2-weighted, fluid-attenuated inversion-recovery, and spoiled gradient MR imaging. The largest diameter of the tumor measured on contrast-enhanced T1-weighted MR images was recorded. Preoperative MR venograms and cerebral venous-phase

Abbreviations used in this paper: CSF = cerebrospinal fluid; MR = magnetic resonance.

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angiograms were obtained to confirm the location and caliber of the vein of Labbé and to determine the site of its insertion into the transverse sinus.

Surgical Technique

Positioning. The patient is positioned supine on the operating table and a small gel roll is placed beneath the shoulder on the same side as the surgical approach (Fig. 1). The head is placed in three-point pin fixation and turned 80˚ away from the vertical plane, leaning toward the contralateral side, and the vertex is tilted 10 to 15˚ toward the floor (inset).

Skin Incision and Craniotomy. A horseshoe-shaped incision is made over the parietotemporal region (Fig. 2). The incision begins anteriorly at the level of the zygoma (5 mm anterior to the tragus) and extends superiorly to the temporal line, where it is directed posteriorly approximately 6 to 8 cm and turned inferiorly, ending 10 mm posterior to the mastoid notch (Fig. 2). Hemostatic clips are applied to the skin edges and the mycuteaneous flap is elevated, exposing the temporal region. A temporal craniotomy is made, with the inferior margin flush to the floor of the middle fossa.

Mastoid air cells encountered during the craniotomy are occluded with bone wax.

Tumor Resection. The dura mater is opened in a U-shaped fashion, with the base of the U on the floor of the middle fossa, to expose the posterior portion of the temporal lobe (Fig. 2). The vein of Labbé is identified by tracing its course into the transverse sinus and preserved. A self-retaining retractor system is affixed to the headholder or operating table, and the operating microscope is brought into the operative field. To aid with the subtemporal dissection and temporal lobe retraction, mild hyperventilation, diuresis, and CSF removal are used, in addition to gentle elevation of the temporal lobe provided by gravity as a result of the head position.

Using a pair of malleable brain retractors (3/8 and 1/2 in), the temporal lobe is gently elevated away from the floor of the temporal fossa. The retractors are advanced deeper (medially) in stages until the tentorial edge is visualized. Infratemporal veins encountered during dissection are coagulated and sharply divided. Once the medial tentorial margin has been exposed, the trochlear nerve is identified as it passes over the lateral aspect of the brainstem before it is inserted anteriorly into the tentorial edge (Figs. 3 and 4).

The tentorium over the cerebellum is incised in a lateral-to-medial direction. The initial opening is made using a dia-
Posterior subtemporal approach

Fig. 2. Schematic diagram depicting the skin incision (dotted line) and location of burr holes for the parietotemporal craniotomy (inset). The dura mater is opened over the posterior temporal lobe, exposing the vein of Labbé.

mond knife to expose the arachnoid overlying the superior surface of the cerebellar hemisphere. The incision is then extended medially with the aid of microscissors or the diamond knife. The anterior flap of the tentorium is tacked anterolaterally by using a 4-0 suture, whereas the posterior tentorial flap is either tacked laterally by using a 4-0 suture or placed beneath the posterior retractor blade (Fig. 3). If the tumor extends to the pial surface the cerebellar surface and superior pole of the tumor are visible at this stage. The tumor–arachnoid interface is identified and incised sharply to create a surgical plane around the tumor edge at its interface with the cerebellum. A deeper circumferential tumor dissection is performed in stages (Fig. 3) to free the tumor from the cerebellum. To enhance the ease of resection of large lesions, ultrasonic aspiration of the center of the tumor can be performed.

Closure. After the tumor has been resected (Fig. 3), the brain retractors are removed and the dura mater is closed with a running suture. The bone flap is affixed to the skull and the scalp is closed in layers.

Results

Patients and Tumors

Two men (ages 42 and 32 years) and one woman (50 years of age) underwent resection of anteromedial superior cerebellar tumors via this approach. The follow-up times in these cases were 4, 18, and 42 months. Two of the tumors were hemangioblastomas (one of which was 3.1 cm in diameter and the other 3.2 cm; Fig. 5) and one was a pilocytic astrocytoma (3.5 cm in diameter). Two of the tumors were located on the right side and one tumor was on the left side.
Fig. 3. Schematic drawings illustrating a left-sided posterior subtemporal transtentorial exposure and removal of a tumor. A: Following temporal lobe retraction, the free edge of the tentorium is visualized with the tumor extending just beyond the posterior edge. The trochlear nerve can be seen entering the tentorial edge immediately anteriorly. B: The tentorial edge has been divided and retracted to expose the proximal portion of the trochlear nerve and the tumor in the anteromedial region of the superior cerebellum. C: The tumor–arachnoid interface is incised, and the plane between the tumor and cerebellum is precisely created. D: After this circumferential dissection has been completed, the tumor is removed from its bed.

Fig. 4. Intraoperative photograph of a left subtemporal exposure demonstrating the anatomical relationships among the tentorium (arrowheads), trochlear nerve (arrow), and anteromedial superior cerebellar hemangioblastoma (asterisk).
Posterior subtemporal approach

Fig. 5. Preoperative contrast-enhanced T1-weighted MR images of the brain in the coronal (left) and axial (right) planes revealing an enhancing hemangioblastoma arising in the anteromedial superior cerebellum.

of the paramedian region of the anterior superior cerebellum. The surgical approach was made from the side of the cerebellum in which the tumor arose. Venous imaging confirmed that the insertion of the vein of Labbé was at least 1 cm posterior to the junction of the sigmoid and transverse sinuses on the side of the surgical approach in each case.

Operative Findings

In each case, the posterior subtemporal transtentorial approach provided excellent visualization of the tumor and adjacent neurovascular structures. The short working distance and ample working corridor to the tumor allowed unencumbered removal of the lesions. Because of the direct visualization of the superior tumor surface permitted by this approach (Fig. 4), tumor removal was possible without resection of surrounding cerebellar tissue. Ultrasonic aspiration of the center of the tumors was performed to debulk the tumors and augment the ease of removal.

Outcomes of Surgery

Patients remained neurologically unchanged (compared with preoperative baseline findings) at the last follow-up examination. In one patient a mild transient confusion developed immediately after surgery, but it resolved within days. Computerized tomography scans obtained on postoperative Day 1 in this patient revealed edema of the temporal lobe at the retractor sites. Complete tumor resection was achieved in all cases (Fig. 6), and there was no evidence of recurrence in any patient on follow-up images.

Discussion

Other Surgical Approaches

Lesions of the anteromedial region of the superior cerebellum are uncommon. Surgical routes to access this region include lateral suboccipital, infratentorial supracerebellar, occipital transtentorial, and transpetrosal approaches.14,15,21 Variations of the lateral suboccipital and infratentorial supracerebellar approaches have been used to remove lesions in the regions of the anterior cerebellum and posterior brainstem.5,20 These approaches have been limited by a narrow surgical corridor that frequently requires significant cerebellar tissue retraction or resection to reach and expose the surface of medially located lesions, particularly if they are large.3,17,21 Alternatively, some surgeons approach tumors of the anterior and superior cerebellum via an occipital transtentorial approach.10 Approaching these lesions by this route places the inferior pole of the tumor at a considerable working distance from the cranial opening, however, and requires significant retraction of the occipital lobe as the working distance deepens. Transpetrosal approaches have been advocated by some surgeons to access the region of the posterolateral brainstem.1,5,21 Although transpetrosal approaches provide a direct surgical corridor, they risk causing hearing loss, CSF leakage, and facial nerve paresis, and they require dissection and bone removal that is unnecessary for the treatment of lesions in the superomedial cerebellum.2

Posterior Subtemporal Transtentorial Approach

The subtemporal approach to deep intracranial lesions was initially popularized by Drake4 as a technique for accessing the anterior region of the brainstem to treat basilar artery aneurysms. Subsequent modifications of the anterior subtemporal approach have been used to reach lesions of the lateral and posterolateral brainstem, as well as lesions of the tentorial notch.1,4,12,13,19 We describe the surgical technique that we used, the intraoperative findings, and the outcomes of surgery in patients with tumors of the anteromedial superior cerebellum in whom resection was performed using a posterior subtemporal approach combined with splitting of the tentorium.

The approach provided excellent visualization of the tumor and adjacent neurovascular structures. The short working distance, ample working corridor, and ultrasonic aspiration of the center of the tumor enhanced its removal. Because of the direct visualization of the tumor surface permitted by the approach in these cases, tumor removal was possible without resection of surrounding cerebellar tissue.

Certain features of the tumors in this small series made them particularly amenable to resection via a posterior subtemporal transtentorial approach. First, in each tumor the superior pole presented at the cerebellar surface. The approach provided excellent direct access along a short surgical corridor to the exposed tumor surface. Second, in each patient there was a steep angulation of the tentorium. This enhanced the ease of dissection around the lateral and inferior poles of the tumors. Finally, the site of insertion of the vein of Labbé was at least 1 cm posterior to the transverse–sigmoid sinus junction on the side of the surgical approach. This permitted adequate elevation and retraction of the temporal lobe during tumor resection without placing undue tension on the vein of Labbé.

Potential complications associated with the approach include retraction-related temporal lobe edema and injury to the vein of Labbé. By using routine brain-relaxation maneu-
vers during surgery, which include optimal head positioning, mild hyperventilation, diuresis, and CSF removal, the risk of temporal lobe retraction edema should be reduced. Postoperative difficulties related to retraction edema, which occurred in one patient in this series, tend to be mild and resolve within a few days.  

Although not required in this series of patients, techniques devised to minimize tension on the vein of Labbé during temporal lobe retraction can reduce the risk of injury to that vein. If the site of the vein of Labbé’s insertion is the anterior portion of the transverse sinus, it could make subtemporal retraction more difficult, and specific techniques designed to reduce tension on the vein during retraction of the temporal lobe may be required.  

Sugita and colleagues have described detaching the vein from the cortex or the tentorium, which functionally increases the length of the vessel, allowing additional exposure without creating an additional stretch at the site of the vein’s insertion into the sinus. Others have also described dissecting the vein of Labbé from the site of its insertion into the dura mater. This dissection shifts the fixation point in the dura, permits greater mobilization of the vein, and reduces tension during retraction.  

Other techniques described to preserve the vein of Labbé include resection of the inferior temporal gyrus and vessel reconstruction with a short saphenous vein graft.  

Conclusions  

The posterior subtemporal transtentorial approach provides excellent access to cerebellar tumors in the anteromedial region of the superior cerebellum. The approach permits resection of large, intraparenchymal lesions in this location, while avoiding many of the limitations associated with other approaches to this anatomical site.

References  


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