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Case Report

The Value of Intraoperative Ultrasonography in Basal Ganglia Mass Resection: Illustrative Case

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Abstract

Background: The lifetime risk of developing a primary brain or spinal cord malignancy is approximately 1%, with basal ganglia tumors representing a particularly challenging subset due to their deep anatomical location and proximity to critical neurovascular structures. We present a case highlighting the utility of intraoperative ultrasonography in the safe resection of a basal ganglia mass.

Observations: A 68-year-old male presented with progressive neurological decline and imaging findings consistent with a large left basal ganglia mass. Intraoperative ultrasound was used to delineate tumor margins and guide resection. Postoperative recovery was uneventful, and histology confirmed high-grade B-cell non-Hodgkin lymphoma.

Lessons: Intraoperative ultrasonography serves as an effective and accessible adjunct for real-time tumor localization and resection in deep-seated lesions, particularly in resource-limited settings, while offering significant educational value in neurosurgical training.

Keywords: Basal Ganglia Mass; Brain; MRI

Introduction

Basal ganglia lesions, though uncommon, pose significant surgical challenges due to their location and proximity to vital structures. The basal ganglia include the caudate nucleus, putamen, globus pallidus, subthalamic nucleus, and substantia nigra, and are deeply embedded within the cerebral hemispheres. Lesions in this region may cause motor deficits such as rigidity, tremors, or bradykinesia—symptoms often mimicking extrapyramidal disorders like Parkinson's disease.

Traditional surgical approaches to these lesions are limited by the risk of iatrogenic injury. Advanced intraoperative imaging modalities such as MRI can aid in safe resection, but access is often limited in developing nations. In contrast, intraoperative ultrasound is relatively inexpensive, accessible, and increasingly recognized for its real-time imaging capabilities. This case illustrates how intraoperative ultrasonography can enhance surgical safety, precision and understanding in the management of deep-seated basal ganglia lesions

Illustrative case

A 68-year-old male with a history of intracranial hemorrhage presented with a one-day history of bilious emesis, worsening confusion, and decreased responsiveness. His symptoms followed a two-week progression of bilateral lower limb weakness and ataxia, unresponsive to oral dexamethasone.

Examination

- **GCS:** 8/15 ($E_3M_4V_1$)
- **Motor strength:** Grade 3 in the right side and left lower limb; Grade 2 in left upper limb; Grade 4 grip strength bilaterally.

Imaging

MRI (Jan 27, 2023) demonstrated a large enhancing left basal ganglia mass (32 × 45 × 40 mm), with marked perilesional edema, 16 mm midline shift, uncal herniation, and hydrocephalus (Figure 1).

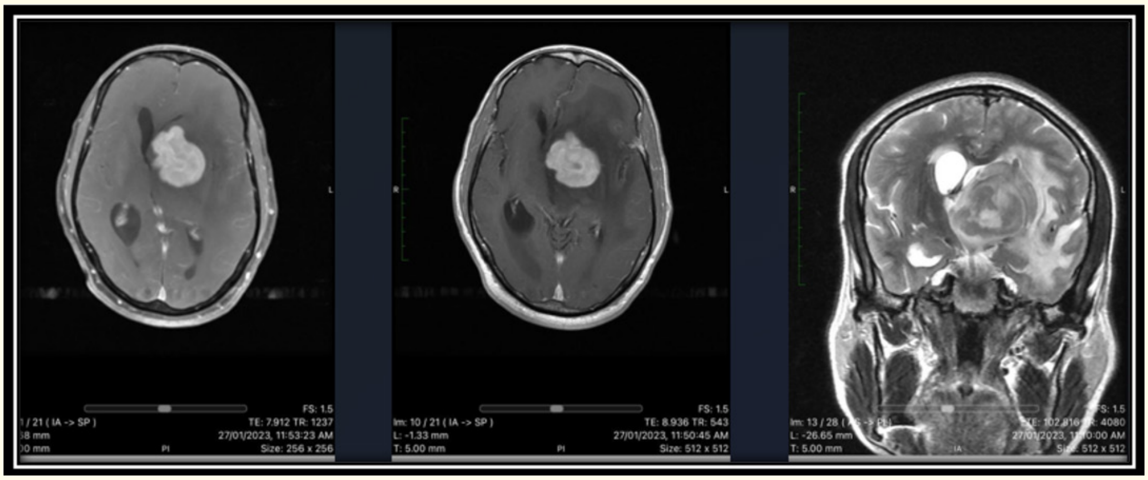

Figure 1: MRI Images representing left basal ganglia mass with evidence of edema and hydrocephalus.

CT brain (Feb 2, 2023) corroborated findings with notable third ventricular compression and right ventricular distension.

Management and surgery

Following stabilization with mannitol, dexamethasone, and fluid correction, the patient's GCS improved to 13/15. After family counselling and consent, he underwent open biopsy and resection of the tumour on February 23, 2023. A modified left pterional craniotomy was performed with Mayfield head fixation.

Intraoperatively, ultrasound was used to localize and delineate tumor margins. A middle frontal gyrus corticectomy was performed, and the tumor was resected using bipolar cautery and the Cavitron Ultrasonic Surgical Aspirator (CUSA), with ultrasound confirmation of resection margins (Figure 2, 3). Dura and scalp were closed in standard fashion.

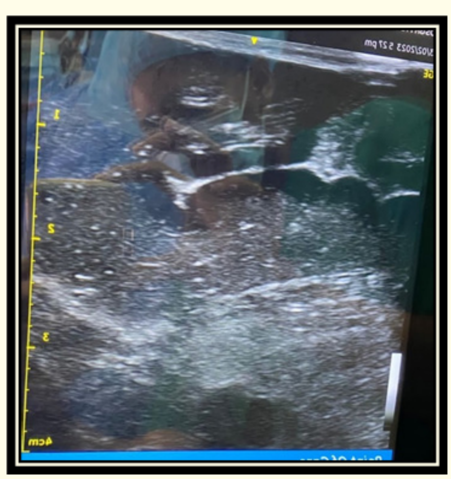

Figure 2: Pre resection of Basal Ganglia Mass.

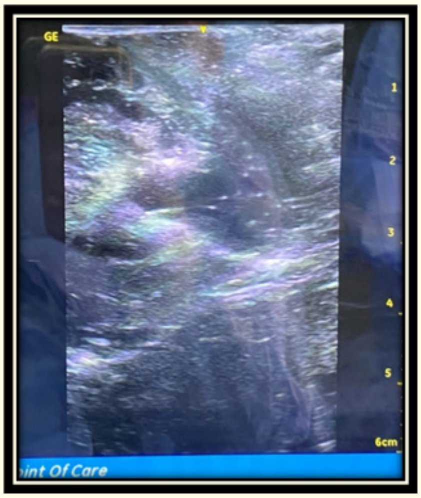

Figure 3: Post-Resection of Basal Ganglia Mass.

Postoperative course

The patient was monitored in the ICU and developed transient cerebral salt-wasting syndrome, which resolved with supportive care. He was discharged two weeks postoperatively with improved motor strength and full consciousness (GCS 15/15).

Histopathology

High-grade non-Hodgkin B-cell lymphoma. Cells were diffusely CD20-positive; CD3 highlighted background T cells; AE3 was negative.

Discussion

Surgical access to deep-seated lesions like those of the basal ganglia carries inherent risks. Intraoperative image guidance is often essential to optimize tumor removal while preserving eloquent brain structures. Although intraoperative MRI is widely considered the gold standard for real-time imaging, its high cost and resource demands make it impractical in many settings. Intraoperative ultrasonography presents a viable alternative [1-8].

In our case, ultrasonography allowed for:

- Clear demarcation of tumor margins
- Real-time confirmation of gross-total resection
- Avoidance of excessive brain retraction or injury

The echogenic differences between tumor and healthy parenchyma facilitated safe dissection. Newer ultrasound technologies have improved resolution and reduced artifact, addressing earlier limitations. The CUSA device further enabled precision tissue removal, minimizing thermal injury and preserving surrounding structures.

Given our experience, we opt to support adjunct ultrasonography for routine consideration in the setting of resection of basal ganglia lesions. Beyond its established clinical utility, intraoperative ultrasonography offers distinct value as teaching tool in neurosurgery. For residents and early-career surgeons, this adjunct offers a unique bridge between preoperative neuroimaging and the operative anatomy encountered under the microscope. Its capacity for real-time imaging enhances spatial understanding of deep-seated structures, such as those within the basal ganglia where direct visualization can be limited and neuro-navigation can sometimes be imprecise due to brain shift.

Thus, the use of intraoperative ultrasonography provides dynamic visualization of the lesion's margins, depth and relationship to eloquent structures, allowing trainees to appreciate complex three-dimensional relationships as they evolve during the procedure. Unlike static imaging, intraoperative ultrasonography can be repeated in a staged manner – before corticectomy, after partial resection, and upon completion to confirm trajectory, accuracy, and to evaluate for residual lesion and guide safe dissection planes.

From an educational perspective, this concept fosters active and experiential learning. Trainees can independently perform scans under supervision, interpret findings, and immediately correlate them with the surgical field, strengthening both cognitive and technical skills. It encourages hands-on engagement, improves confidence in intraoperative localization and provides an accessible introduction to image-guided neurosurgery.

While intraoperative ultrasound is not yet standardized in basal ganglia surgery, growing evidence—including this case—supports its expanded role. Particularly in low-resource environments, intraoperative ultrasonography represents a cost-effective, reproducible and highly instructive alternative that maintains high educational and operative value. By underscoring its dual clinical and pedagogical benefits, this case broadens its educational impact and reinforces the importance of intraoperative ultrasonography in modern neurosurgical training.

Lessons

This case reinforces the utility of intraoperative ultrasonography in deep-seated tumor resections. In our experience, it provided accurate real-time imaging, guided safe resection, and enhanced operative confidence. Wider adoption and protocol standardization may improve outcomes for patients with complex intracranial lesions.

Patient Informed Consent

Written informed consent was obtained from the patient for the publication of this case report, including the use of images and clinical details. Identifying information has been withheld to ensure patient anonymity.

Conflicts of Interest

The authors report no conflicts of interest concerning the materials or methods used in this study or the findings specified in this paper.

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