

## INTRAOPERATIVE ULTRASONOGRAPHY IN BRAIN TUMOR SURGERY

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**Introduction** Intraoperative ultrasonography (IOUS) is an accessible imaging modality that provides real-time surgical guidance with minimal risk or additional operative time. There is a strong correlation between IOUS and postoperative CT findings when evaluating the extent of tumor resection, suggesting that IOUS can have significant clinical implications.

**Keywords** neurosurgery, intraoperative ultrasonography, tumor resection

**Purpose** The objective of this study was to provide more evidence on the usage of IOUS in the determination of gross-total resection (GTR) in adult patients with brain tumors.

Table 1. Pathological diagnosis in 85 patients undergoing surgery with ultrasound guidance

Pathological diagnosis	N
<b>Neuro-ectodermal tumours</b>	60
<b>High grade gliomas</b>	51
Glioblastomas	42
Anaplastic oligodendrogliomas	5
Anaplastic astrocytoma	4
<b>Low grade gliomas</b>	9
Astrocytoma	6
Oligodendroglioma	3
<b>Cerebral metastasis</b>	14
<b>Other tumours</b>	11
(Ependymoma, Pineocytoma, Meduloblastoma)	

**Material and methods** This study consisted of a retrospective review of adult neurosurgical patients who were treated at Institute of Neurology and Neurosurgery between 2015 and 2020 for a tumor of the brain. All patients were treated with IOUS and then underwent postoperative CT with or without contrast within first 3 days after surgery.

**Results** A total of 85 patients met inclusion criteria for the study. IOUS results showed a strong association with postoperative CT results. IOUS was able to accurately identify residual tumor in 100% of subtotal resection cases where resection was stopped due to invasion of tumor into eloquent locations. Cases involving gliomas had a 75% intended GTR rate. Cases involving metastatic tumors had an 87% intended GTR rate. The sensitivity and specificity were reported for IOUS in all included tumor pathologies, glioma cases, and metastatic tumor cases, respectively.

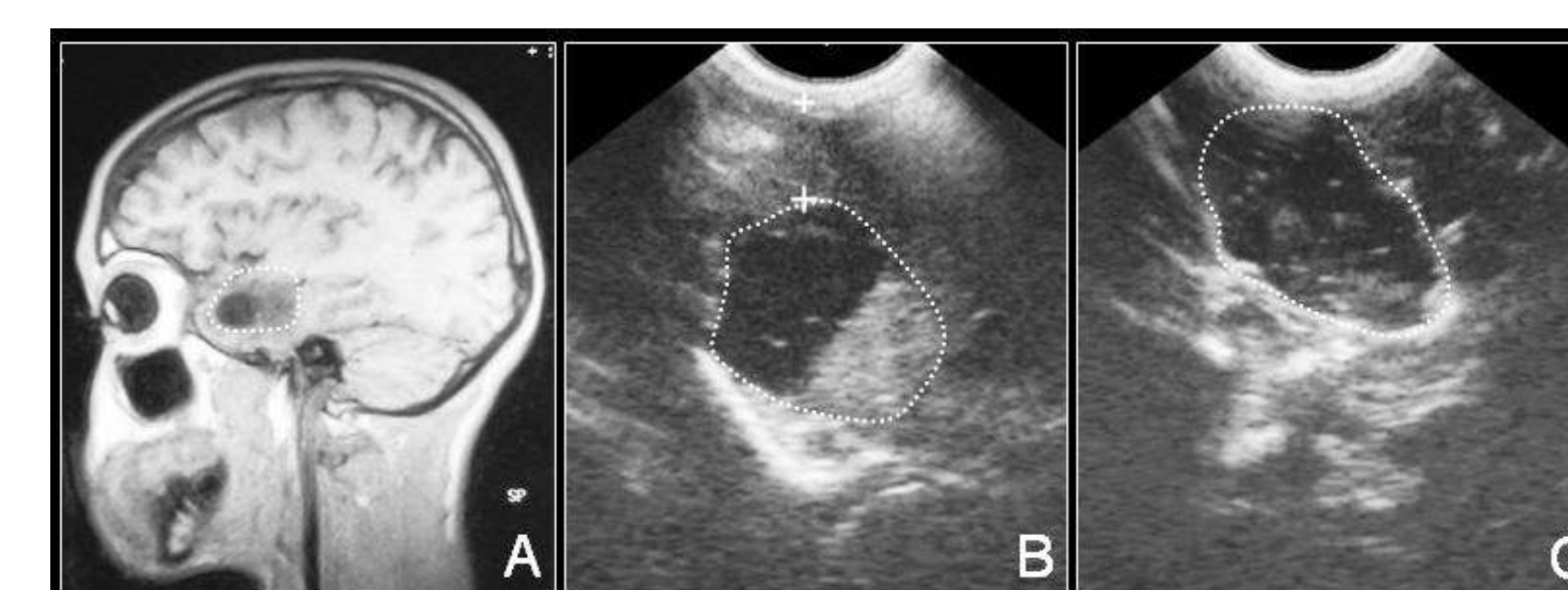


Fig. 1. (A) The sagittal MRI scan of a low grade glioma, showing a uniformly hypointense mass with a cyst in the temporal lobe with well defined margins. (B) The axial IOUS done soon after opening the dura. Note the hyperechoic tumour with well-defined margins. (C) IOUS after complete removal of tumor.

		preOP CT		
		Well defined	Poorly defined	
intraOP	Well defined	56	4	60
	Poorly defined	16	9	25
		72	13	

Table 2. A comparison between computed tomography and intra-operative ultrasonography in defining the margins of 85 parenchymal brain tumors

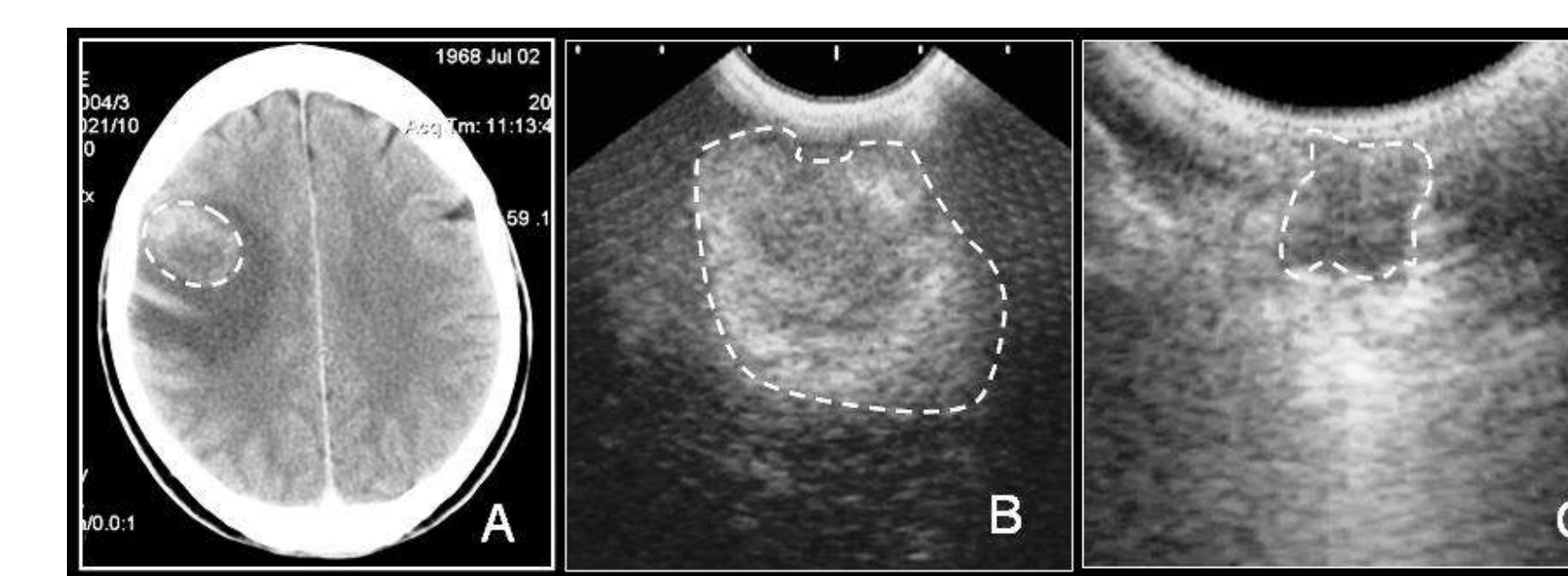


Fig. 2. (A) An axial CT scan of a high grade glioma showing a peripherally enhancing mass in the posterior frontal region with central necrosis and marked peripheral oedema. (B) The axial IOUS done soon after opening the dura. The mass is hyperechoic with a central hypo-echoic area corresponding to the central necrosis seen on the CT scan. The margins are well defined. (C) IOUS after complete removal of tumor.

		postop CT		
		Residual tumour	No tumour	
intraOP	Residual tumor	37	4	41
	No tumor	6	38	44
		43	42	

Table 3. The postoperative CT findings correlated with the corresponding intra-operative ultrasound findings in 85 patients with intraparenchymal tumors

**Conclusions** The use of IOUS may allow for a reliable imaging modality to achieve a more successful GTR of brain tumors in adult neurosurgical patients. When attempting GTR, it was demonstrated an 81% GTR rate. IOUS can be used in CNS tumor surgery to improve surgical outcomes.