Role of Intraoperative Neurophysiologic Monitoring in the Resection of Thalamic Astrocytomas

Giorgio Carrabba[1], Giulio Bertani[1], Filippo Cogiamanian[2], Gianluca Ardolino[2], Barbara Zarino[1], Andrea Di Cristofori[1,3], Marco Locatelli[1], Manuela Caroli[1], Paolo Rampini[1]

■ BACKGROUND: **The thalamus is a deep-seated and crucial structure for the sensorimotor system. It has been long considered a surgically inaccessible area because of the morbidity associated with surgical resections. Astrocytomas of the thalamus are usually treated with bioptic procedures followed by adjuvant treatments. Intraoperative neurophysiologic monitoring (IONM) allows safe and satisfactory resections of lobar gliomas, but few data are available for thalamic lesions. The aim of this study was to review the outcome of a small series of patients with thalamic astrocytomas that were treated with surgical resection with the aid of IONM.**

■ METHODS: **Surgical resection with IONM was performed in 5 patients with thalamic astrocytomas (1 grade I, 1 grade II, 2 grade III, 1 grade IV). Two astrocytomas were in the dominant hemisphere. Preoperative and postoperative neuropsychological assessments were performed in 3 patients. IONM was tailored to the individual patient and consisted of transcranial motor evoked potential monitoring, cortical motor evoked potential monitoring, somatosensory evoked potential monitoring, direct electrical stimulation, electroencephalography, and electrocorticography.**

■ RESULTS: **None of the patients experienced permanent motor deficits; 2 patients had a transient hemiparesis requiring rehabilitation; 1 patient had a transient aphasia, and 1 patient had permanent aphasia. None of the patients had intraoperative seizures, but 1 patient experienced postoperative transient status epilepticus. The extent of resection on postoperative volumetric magnetic resonance imaging was >70% in all cases.**

■ CONCLUSIONS: **Surgical resection of thalamic astrocytomas appeared to be effective and relatively safe when guided by IONM. Larger series of patients are required to confirm these preliminary data.**

INTRODUCTION

The thalamus is a deep-seated and crucial anatomic structure belonging to the diencephalon, and most neurologic functions depend on its proper functioning.[1-3] In particular, the thalamus is an essential relay center for the sensorimotor system, and its involvement in higher cortical functions such as memory and language has been suggested more recently.[4-8] Consequently, injuries to the thalamus invariably result in severe neurologic deficits that can have a significant impact on a patient's quality of life. Astrocytomas are the most common malignant brain tumors.[9] Surgical resection plays a key role in their management, but it is indicated only when the risk of neurologic sequelae appears to be acceptable.[8,10] The thalamus has been classically considered a surgically inaccessible area because of the morbidity associated with surgical resections.[11-13] Thus, treatment of astrocytomas of the thalamus usually involves bioptic procedures followed by adjuvant treatments.[11]

Key words
- Brain mapping
- Gliomas
- Glioma surgery
- Neurophysiologic monitoring
- Thalamic glioma
- Thalamus

Abbreviations and Acronyms
CST: Corticospinal tract
DES: Direct electrical stimulation
DTI: Diffusion tensor imaging
ECoG: Electrocorticography
EEG: Electroencephalography
IONM: Intraoperative neurophysiologic monitoring
LGG: Low-grade glioma
MEP: Motor evoked potential
MRI: Magnetic resonance imaging
PLIC: Posterior limb of the internal capsule
SSEP: Somatosensory evoked potentials

From the Units of [1]Neurosurgery and [2]Neurophysiopathology, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico; and [3]Department of Pathophysiology and Organ Transplantation, University of Milan, Milan, Italy

To whom correspondence should be addressed: Giorgio Carrabba, M.D., Ph.D. [E-mail: giorgiocarrabba@yahoo.it]

Citation: World Neurosurg. (2016) 94:50-56.
http://dx.doi.org/10.1016/j.wneu.2016.06.049

*Journal homepage: **www.WORLDNEUROSURGERY.org***

*Available online: **www.sciencedirect.com***

The pathologic diagnosis of brain tumors is challenging and depends on the amount of tissue available; this is mainly because gliomas are histologically heterogeneous and can display different grades of malignancy in different areas.[14] Furthermore, important molecular markers with prognostic and therapeutic value have come to be included in clinical practice and require additional specimens. As a consequence, larger amounts of tissue are required to obtain a reliable pathologic diagnosis and determine the molecular profile of the tumor. Few series of patients with thalamic astrocytomas have been published in the literature, and none of them have focused on the role of intraoperative neurophysiologic monitoring (IONM) or on neuropsychological sequelae.[12,13] IONM allows safe and satisfactory resections of lobar gliomas and is currently considered standard of care for these tumors.[10] No specific recommendation exists for thalamic astrocytomas. The aim of this study was to review the outcome of a small series of patients in which thalamic astrocytomas were resected with the aid of IONM and in-depth studies of preoperative and postoperative neuropsychological testing were performed.

MATERIALS AND METHODS

This study was approved by the ethics board of our hospital. We studied 5 consecutive patients with thalamic astrocytomas who underwent surgical resection with IONM (**Figure 1**).

Preoperative Phase

Preoperative neuropsychological assessment, which is routinely performed for all patients with gliomas, could be performed in only 3 of 5 patients; 1 patient could not undergo the battery of tests for neurologic conditions (patient was unable to cooperate because of cognitive impairment), and 1 patient was a 12-year-old child with papilledema. The battery of tests included assessment of language, memory, attention, praxis, executive, and counting functions. The same tests were performed preoperatively, postoperatively, and at 3-month follow-up for 3 patients.

Preoperative neuroradiologic evaluation included 3-T magnetic resonance imaging (MRI) (Philips, Amsterdam, The Netherlands) with volumetric T1, T2, and fluid attenuated inversion recovery sequences. The same volumetric MRI sequences were performed postoperatively to establish the extent of resection using iPlan 3.0 software (Brainlab AG, Feldkirchen, Germany). In this series of patients, diffusion tensor imaging (DTI) was performed in 2 patients and allowed reconstruction of the corticospinal tract (CST) (2 patients) and of the superior longitudinal fascicle and inferior fronto-occipital fascicle (1 patient).

Anesthesia

In all patients, a total intravenous anesthesia protocol was used including propofol and remifentanil and following an asleep-asleep setting (4 of 5 patients) or an asleep-awake setting (1 of 5 patients).[15] No curare or curare-like drugs were used. Two astrocytomas were in the dominant hemisphere, and 1 patient was operated under asleep-awake anesthesia (the other patient had significant cognitive impairment).

IONM

A neurophysiologist was present throughout the operations to assess and adjust the IONM. The inomed ISIS System

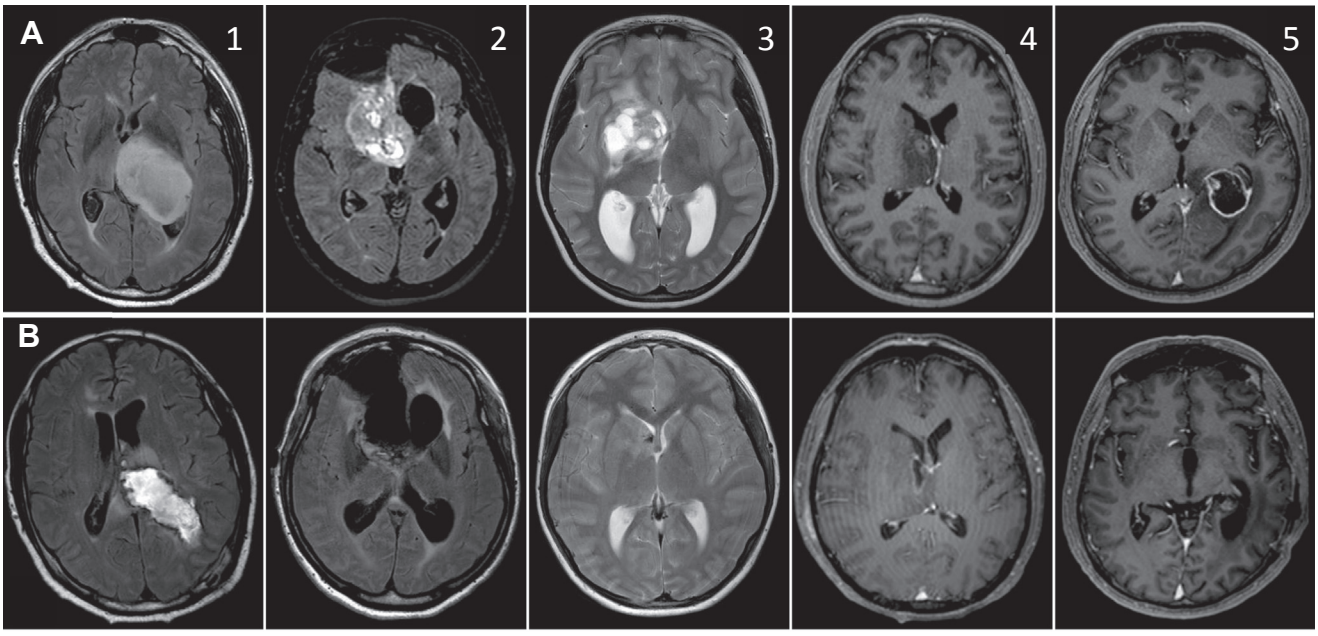

Figure 1. Preoperative (**A**) and postoperative (**B**) brain magnetic resonance imaging of the 5 patients (1–5) included in our series. A satisfactory extent of resection was achieved in all 5 cases.