Precentral gyrus resection case series

Since 2005, Saito et al., removed gliomas in the precentral gyrus with combined functional mapping and estimation of intraoperative voluntary movement (IVM) during awake craniotomy and transcortical motor evoked potentials (MEPs).

The purpose of a study published in 2019 was to evaluate whether intraoperative findings of combined monitoring of IVM during awake craniotomy and transcortical MEP monitoring were useful for predicting postoperative motor function of patients with gliomas in the precentral gyrus.

The current study included 30 patients who underwent resection of precentral gyrus gliomas during awake craniotomy from April 2000 to January 2018. All tumors were removed with monitoring of IVM during awake craniotomy and transcortical MEPs. Postoperative motor function was classified as stable or declined, with the extent of decline categorized as mild, moderate, or severe. We defined moderate and severe deficits were those that hindered daily life.

In 28 of 30 cases, available waveforms were obtained with transcortical MEPs. The mean extent of resection (EOR) was 93%. Relative to preoperative status, motor function 6 months after surgery was considered stable in 20 patients and was considered to show mild decline in 7, moderate decline in 2, and severe decline in 1. Motor function 6 months after surgery was significantly correlated with IVM ($p = 0.0096$), changes in transcortical MEPs (decline ≤ or > 50%) ($p = 0.0163$), EOR, and ischemic lesions on postoperative MRI. Six patients with no change in IVM showed stable motor function 6 months after surgery. Only 2 patients with a decline in IVM and a decline in MEPs ≤ 50% had a decline in motor function 6 months after surgery (18%; 2/11 patients), whereas 11 patients with a decline in IVM and a decline in MEPs > 50% had such a decline in motor function (73%; 8/11 patients) including 2 patients with moderate and 1 with severe deficits. Three patients with moderate or severe motor deficits showed the lowest MEP values (< 100 μV).

Combined judgment from monitoring of intraoperative voluntary movement (IVM) during awake craniotomy and transcortical motor evoked potentials (MEPs) is useful for predicting postoperative motor function during removal of precentral gyrus gliomas. Maximum resection was achieved with an acceptable morbidity rate. Thus, these tumors should not be considered unresectable [1].

2015

33 consecutive patients who experienced pharmacologically intractable epilepsy and underwent PGR with intraoperative cortical stimulation and mapping while under awake anesthesia. The etiological diagnoses were brain neoplasm in 26 patients (78.8%), cortical lesion in 4 (12.1%), and no lesion in 3 (9.1%). The mean follow-up period was 62.6 months (range, 12-146 months). All topographical analyses of the resected quadrant area were performed based on postoperative magnetic resonance images.

After PGR, 22 patients (66.7%) experienced neurological worsening, including 5 permanent deficits (15.2%) and 17 transient deficits (51.5%). Permanent deficits included 2 instances of weakness, 1 dysarthria, 1 dysesthesia, and 1 fine-movement disturbance of the hand. While the neurological risk for anterior lower quadrant PGR was 20.0% (1/5), the risk for posterior upper quadrant PGR was 100.0% (10/10). The anterior upper and posterior lower quadrant PGR caused neurological deteriorations in 60.0% (6/10) and 62.5% (5/8) of the patients, respectively. In a multivariate analysis,

PGR of the posterior and upper quadrant sections were significant risk factors for post-PGR neurological deteriorations (P = .022 and 0.030, respectively).

The posterior upper quadrant of the precentral gyrus was vulnerable to post-resective neurological impairment [2].

2014

Resection of glioblastoma adjacent to motor cortex or subcortical motor pathways carries a high risk of both incomplete resection and postoperative motor deficits. Although the strategy of maximal safe resection is widely accepted, the rates of complete resection of enhancing tumor (CRET) and the exact causes for motor deficits (mechanical vs vascular) are not always known. The authors report the results of their concept of combining monopolar mapping and 5-aminolevulinic acid (5-ALA)-guided surgery in patients with glioblastoma adjacent to eloquent tissue.

Schucht et al. prospectively studied 72 consecutive patients who underwent 5-ALA-guided surgery for a glioblastoma adjacent to the corticospinal tract (CST; < 10 mm) with continuous dynamic monopolar motor mapping (short-train interstimulus interval 4.0 msec, pulse duration 500 µsec) coupled to an acoustic motor evoked potential (MEP) alarm. The extent of resection was determined based on early (< 48 hours) postoperative MRI findings. Motor function was assessed 1 day after surgery, at discharge, and at 3 months.

Five patients were excluded because of nonadherence to protocol; thus, 67 patients were evaluated. The lowest motor threshold reached during individual surgery was as follows (motor threshold, number of patients): > 20 mA, n = 8; 11-20 mA, n = 13; 6-10 mA, n = 10; 4-5 mA, n = 13; and 1-3 mA, n = 23. Motor deterioration at postsurgical Day 1 and at discharge occurred in 30% (n = 20) and 10% (n = 7) of patients, respectively. At 3 months, 3 patients (4%) had a persisting postoperative motor deficit, 2 caused by vascular injury and 1 by mechanical injury. The rates of intra- and postoperative seizures were 1% and 0%, respectively. Complete resection of enhancing tumor was achieved in 73% of patients (49/67) despite proximity to the CST. Conclusions A rather high rate of CRET can be achieved in glioblastomas in motor eloquent areas via a combination of 5-ALA for tumor identification and intraoperative mapping for distinguishing between presumed and actual motor eloquent tissues. Continuous dynamic mapping was found to be a very ergonomic technique that localizes the motor tissue early and reliably [3]

Schucht et al. analyzed 8 consecutive pediatric patients in whom they performed 9 resections for lesions within or close (≤ 10 mm) to M1.

Monopolar high-frequency motor mapping with train-of-five stimuli (pulse duration 500 µsec, interstimulus interval 4.0 msec, frequency 250 Hz) was used. The motor threshold was defined as the minimal stimulation intensity that elicited motor evoked potentials (MEPs) from target muscles (amplitude > 30 µV). Resection was performed toward M1 at sites negative to 1- to 3-mA high-frequency train-of-five stimulation.

The M1 was identified through high-frequency train-of-five via application of varying low intensities. The lowest motor thresholds after final resection ranged from 1 to 9 mA in 8 cases and up to 18 mA in

1 case, indicating proximity to motor neurons. Intraoperative electroencephalography documented an absence of seizures during all surgeries. Two transient neurological deficits were observed, but there were no permanent deficits. Postoperative imaging revealed complete resection in 8 patients and a very small remnant (< 0.175 cm3) in 1 patient.

Low-threshold motor mapping might help to expand the area for safe resection in pediatric patients with lesions located within the precentral gyrus, and may be regarded as a functional navigational tool [4].

2013

During a 2-year period from 2010 to 2012, 17 consecutive patients harboring a cerebral metastasis within the precentral gyrus underwent microsurgical resection. All patients were discussed at a multi-disciplinary tumor board. The prerequisite for neurosurgical treatment was stable systemic disease and life expectancy greater than 6 months as determined by the patient's oncologist. Patients also were required to harbor a symptomatic lesion within the motor cortex, defined as the precentral gyrus.

Surgery was uneventful and without any severe perioperative complications in all 17 patients. At 3 month follow up, symptoms had improved or been stabilized in 94.1% of patients and were worsened in 5.9%.

This results have shown that surgery for cerebral metastases in the precentral gyrus can be done safely and improve or stabilize the neurological function of most patients. Microsurgical resection of precentral gyrus metastases should be a treatment option for patients with single or multiple lesions who present a focal neurologic deficit. This can be performed safely and without intraoperative cortical mapping [5].

1)
Saito T, Muragaki Y, Tamura M, Maruyama T, Nitta M, Tsuzuki S, Fukuchi S, Ohashi M, Kawamata T. Awake craniotomy with transcortical motor evoked potential monitoring for resection of gliomas in the precentral gyrus: utility for predicting motor function. J Neurosurg. 2019 Mar 15:1-11. doi: 10.3171/2018.11.JNS182609. [Epub ahead of print] PubMed PMID: 30875689.
2)
Kim YH, Kim CH, Kim JS, Lee SK, Han JH, Kim CY, Chung CK. Topographical Risk Factor Analysis of New Neurological Deficits Following Precentral Gyrus Resection. Neurosurgery. 2015 Mar 2. [Epub ahead of print] PubMed PMID: 25734322.
3)
Schucht P, Seidel K, Beck J, Murek M, Jilch A, Wiest R, Fung C, Raabe A. Intraoperative monopolar mapping during 5-ALA-guided resections of glioblastomas adjacent to motor eloquent areas: evaluation of resection rates and neurological outcome. Neurosurg Focus. 2014 Dec;37(6):E16. doi: 10.3171/2014.10.FOCUS14524. PubMed PMID: 25434385.
4)
Schucht P, Seidel K, Murek M, Stieglitz LH, Urwyler N, Wiest R, Steinlin M, Leibundgut K, Raabe A, Beck J. Low-threshold monopolar motor mapping for resection of lesions in motor eloquent areas in children and adolescents. J Neurosurg Pediatr. 2014 Mar 17. [Epub ahead of print] PubMed PMID: 24635135.
5)
Kellogg RG, Munoz LF. Selective excision of cerebral metastases from the precentral gyrus. Surg Neurol Int. 2013 May 17;4:66. doi: 10.4103/2152-7806.112189. Print 2013. PubMed PMID: 23776752; PubMed Central PMCID: PMC3683173.