

ORIGINAL REPORT

Intraoperative 3 tesla magnetic resonance imaging: Our experience in tumors[☆]



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KEYWORDS

Magnetic resonance;
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Abstract

Objective: To report our experience in the use of 3 T intraoperative magnetic resonance imaging (MRI) in neurosurgical procedures for tumors, and to evaluate the criteria for increasing the extension of resection.

Material and methods: This retrospective study included all consecutive intraoperative MRI studies done for neuro-oncologic disease in the first 13 months after the implementation of the technique. We registered possible immediate complications, the presence of tumor remnants, and whether the results of the intraoperative MRI study changed the surgical management. We recorded the duration of surgery in all cases.

Results: The most common tumor was recurrent glioblastoma, followed by primary glioblastoma and metastases. Complete resection was achieved in 28%, and tumor remnants remained in 72%. Intraoperative MRI enabled neurosurgeons to improve the extent of the resection in 85% of cases. The mean duration of surgery was 390 ± 122 min.

Conclusion: Intraoperative MRI using a strong magnetic field (3 T) is a valid new technique that enables precise study of the tumor resection to determine whether the resection can be extended without damaging eloquent zones. Although the use of MRI increases the duration of surgery, the time required decreases as the team becomes more familiar with the technique.

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PALABRAS CLAVE

Resonancia magnética;
Neoplasias cerebrales;
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Resonancia magnética intraoperatoria de 3 teslas: Nuestra experiencia en patología tumoral**Resumen**

Objetivo: Describir nuestra experiencia con la resonancia magnética intraoperatoria (RMio) de 3 teslas en procedimientos neuroquirúrgicos en patología tumoral y evaluar los criterios que condicionaron la ampliación quirúrgica.

Material y métodos: Estudio retrospectivo en el que se incluyeron todas las RMio consecutivas realizadas por patología neurooncológica en los primeros 13 meses tras su instalación. Se registraron las posibles complicaciones inmediatas, la presencia de restos tumorales y la modificación de la actitud quirúrgica por los resultados de la RMio. Se midió el tiempo quirúrgico en todos los casos.

Resultados: El mayor porcentaje de lesiones resecaadas correspondió a glioblastomas recidivados, seguido de glioblastomas primarios y metástasis. Se evidenció una resección completa en un 28% y restos tumorales en un 72%. La RMio permitió a los neurocirujanos mejorar la extensión de la resección en un 85%. La media del tiempo quirúrgico fue de 390 ± 122 minutos.

Conclusión: La RMio con equipos de alto campo (3 teslas) es una técnica novedosa y válida, que permite estudiar la resección tumoral de forma precisa y evaluar si se puede continuar la resección sin dañar zonas elocuentes. Aunque su empleo conlleva una prolongación del tiempo quirúrgico, este mejora con la curva de aprendizaje del personal.

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Introduction

The main goal of neurosurgery is the surgical resection of intracranial lesions without damage to the normo-functioning parenchyma while preserving essential neurologic functions.¹ The MRI has proven the ideal imaging modality to establish what the situation of the tumor really is and analyze the best way to approach it. During the last few years, systems of intraoperative MRI (iMRI) have been developed in order to assess the resection of intracranial lesions during the surgical act. Although initially the iMRI has been used in the resection of glial tumors, today, it is also used in other procedures.²⁻¹⁴

The development of 3 T MRIs allows us to acquire images with shorter scan times, higher resolution, and better performance than other studies conducted using lower field MRI machines.¹⁵⁻¹⁹

In the usual protocols, one postoperative control MRI is conducted to assess whether the resection of the target lesion has been complete. This postoperative MRI is conducted during the first 24–36 h. Although these postoperative studies are accurate, the problem is that if the tumor resection has not been satisfactory, a second intervention is required in order to complete it, with the corresponding risks and associated costs.

Ever since it was first introduced to the surgical practice, the iMRI systems have become important tools for the surgery of brain tumors in many centers. Several studies have confirmed that by using iMRIs we can achieve wider and more accurate tumor resections, which, in turn, associates higher survival rates.^{8,11,16,18} Also, the existence of immediate complications (hemorrhages, infarctions, ...) can be assessed too. All this allows us to analyze whether the goal of

the surgery has been achieved in order to make the decision of ending or continuing the surgery (Fig. 1).

The main advantages of the iMRI are: get to know the degree of "real time" resection, the preservation of healthy structures, and brain-shift compensation. Brain-shift is defined as a distortion of intracranial structures as a consequence of one craniectomy procedure; this displacement involves a lack of correlation with preoperative studies, in which intracranial pressures have not been modified.

In Spain, several centers already have iMRI machines, although most of them are low-field MRI machines. The goal of this paper is to describe our own experience with the implementation of 3 T iMRI machines in neurosurgical procedures for the management of tumor pathology and establish the criteria conditioning margin-widening surgeries.

Material and methods

Retrospective study conducted between January 2016 and March 2017 where all the iMRIs conducted and evaluated at our center by neuro-oncological pathology were recorded.

Ninety-three (93) patients were included, whose age, sex, and imaging diagnosis were recorded in preoperative studies.

We did not feel it was necessary to ask for the approval from the hospital ethics committee given the descriptive retrospective nature of the study and use of anonymized data.

In all cases, and with the presence of an experienced neuro-radiologist, the operative results were evaluated and briefed personally to the neurosurgical team. The following topics were discussed: all possible immediate complications,

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