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Quantification of glioma removal by intraoperative high-field magnetic resonance imaging - an update.

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Abstract

BACKGROUND: The beneficial role of the extent of resection (EOR) in glioma surgery in correlation to increased survival remains controversial. However, common literature favors maximum EOR with preservation of neurological function, which is shown to be associated with a significantly improved outcome.

OBJECTIVE: In order to obtain a maximum EOR, it was examined whether intraoperative high-field magnetic resonance imaging (iMRI) combined with multimodal navigation contributes to a significantly improved EOR in glioma surgery.

METHODS: 293 glioma patients underwent craniotomy and tumor resection with the aid of intraoperative 1.5 T MRI and integrated multimodal navigation. In cases of remnant tumor, an update of navigation was performed with intraoperative images. Tumor volume was quantified pre- and intraoperatively by segmentation of T2-abnormality in low-grade and contrast enhancement in high-grade gliomas.

RESULTS: In 25.9% of all cases examined, additional tumor mass was removed as a result of intraoperative MRI. This led to complete tumor resection in 20 cases, increasing the rate of gross-total removal from 31.7% to 38.6%. In 56 patients, additional but incomplete resection was performed due to close location to eloquent brain areas. Volumetric analysis showed a significantly ($p < 0.01$) reduced mean percentage of tumor volume following additional further resection after iMRI from $33.5\% \pm 25.1\%$ to $14.7\% \pm 23.3\%$ (world health organization (WHO) grade I: $32.8\% \pm 21.9\%$ to $6.1\% \pm 18.8\%$, WHO grade II: $24.4\% \pm 25.1\%$ to $10.8\% \pm 11.0\%$, WHO grade III: $35.1\% \pm 27.3\%$ to $24.8\% \pm 26.3\%$, WHO grade IV: $34.2\% \pm 23.7\%$ to $1.2\% \pm 16.2\%$).

CONCLUSION: Intraoperative high-field MRI in conjunction with multimodal navigation and intraoperative updating-procedure enlarges tumor volume reduction in glioma surgery significantly without higher postoperative morbidity.

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