Evaluation of 31-P-MR-Spectroscopy in malignant glioma correlated with histopathological results and intraoperative fluorescence

C.F. Freyschlag
J. Kerschbaumer, R. Steiger, D. Pinggera, E.R. Gizewski, C. Thomé

Department of Neurosurgery
Medical University of Innsbruck
No conflicts of interest.
INTRODUCTION

• Gliomas are characterized by diffuse infiltration
• Surgical resection with necessity for utmost radicality
• Fluorescence techniques enhanced resection
• Surgical aim for supratotal resection

Objective:

Does advanced MRI with inclusion of 31-Phosphorus – MR – spectroscopy (31P-MRS) depict glioma infiltration into peritumoral tissue that appeared non-pathological upon MRI?
**METHODS**

- **Prospective trial**, approved by IRB

- Patients who underwent surgery for malignant glioma in non-eloquent areas (n=16)

- preoperative **standard MRI**, with additional **whole brain 31P-MRS**.

- Planning of biopsy trajectory: one voxel within the **contrast-enhancing tumor** (CE+), one voxel at the **border** (including CE+ areas and surrounding T2-hyperintensive (T2+)) and one distant voxel, **purely including T2+ areas** (amenable for supratotal resection)

- Absolute values of 31P-MRS were **compared with contralateral hemisphere** (healthy control)

- standardized application of **5-ALA**, image guided craniotomy and **frameless stereotactic biopsy** were performed, **followed by microsurgical resection**.

- The 31P-MRS-metabolites **correlated to the contralateral control, histopathology** and **fluorescence behavior**.
• Biopsies showed tumor cells and fluorescence in all but one tumor (93%)
• tumor cells were encountered within the infiltration zone in 81% of biopsies with one positive sample without fluorescence
• The surrounding tissue included tumor cells in 7 patients, 4 of which were fluorescence negative.
RESULTS

- **31P-MRS absolute values:**
  - Resynthesis: \((CE+/\text{border/T2+}: 1,050\pm0,300/1,029\pm0,290/1,104\pm0,277)\)
  - Hydrolysis: \((0,295\pm0,241/0,294\pm0,259/0,332\pm0,298)\)
  - Energy demand: \((5,207\pm13,569/3,938\pm3,383/3,716\pm2,004)\)
  - Membrane turnover: \((1,367\pm1,277/1,267\pm1,092/1,122\pm0,649)\)

Membrane-turnover was significantly higher in CE+, border zone and also in the T2+ areas, when compared to the healthy control (\(p>0,001; \ p>0,002\)).
CONCLUSION

• 31PMRS in malignant gliomas provided information on metabolic changes tumor and surrounding edema.

• There was a evidence of infiltration by tumor cells in biopsies regardless of intraoperative fluorescence.