



A timeline of cognitive functioning in glioma patients who undergo awake brain tumor surgery: a response to Mahajan et al. and their letter to the editor

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Dear Editor,

We thank Mahajan et al. [3] for responding to our manuscript “A timeline of cognitive functioning in glioma patients who undergo awake brain tumor surgery” [1]. We sincerely appreciate their valuable comments, and we are pleased to provide more information about our study by means of this scientific dialogue. In our study, cognitive functioning was measured by use of a broad cognitive screener preoperatively, days after surgery and months after surgery in patients who underwent awake brain tumor surgery with cognitive monitoring. The timeline of cognitive functioning after awake tumor surgery appeared overall stable in the early and late postoperative phases, except for inhibition, which was more difficult in the first days after awake brain tumor surgery. However, in the following months after surgery, performances on the cognitive screener returned to patient’s preoperative level.

Mahajan et al. [3] state that it would have been helpful if we could describe which eloquent areas were involved in a slower performance on the inhibition task. Although this would have been very interesting, it is unfortunately not possible within our small sample. In our study, there was a wide variety of tumor sites, which makes the subgroups too small to perform analyses on. However, research shows that performances on the Stroop test, that measures inhibition, have been associated with fronto-parietal network, including the anterior cingulate cortex, dorsolateral prefrontal cortex,

inferior frontal gyrus, inferior and superior parietal cortex, and the insula [2, 4, 5].

Moreover, we fully agree that speech deficits can influence performances on another cognitive test. However, we do presume that speech functions played no role in this specific delayed response time because we have not observed any speech or language deficits in other subtasks of the screening.

Furthermore, the relevance of the time difference of the inhibition task (*Mdn* 14.5 preoperatively and *Mdn* 16.5 postoperatively) that was found in this study is questioned. This difference was statistically significant but may have less clinical relevance. Though, since this is a group level difference, we cannot make statements about an individual patient. We would like to emphasize that this information could be interesting to inform the patient about possible cognitive deficits after awake brain surgery *in general*. In addition, Mahajan et al. [3] mention that additional information about patients developing cognitive deficits in the postoperative period and its association with the cognitive tests in our study could have been more meaningful. We fully agree with this point; we did not study the relation between, for example, the delayed response time on the inhibition task measured by our screening and performances on a more extensive neuropsychological assessment postoperatively. This would be interesting for future studies.

Finally, it is suggested that intraoperative cognitive assessment requires individualization and careful selection of an appropriate battery of neuropsychological tests, which is totally in line with our opinion. The aim of our study was to create a more detailed timeline of cognitive functioning, and as a result to gain more understanding of the development of possible postoperative cognitive deficits. To answer our research question, we used a standardized screener. However, the relatively short cognitive screener used in our study was complementary to the individual composed

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battery. Other neuropsychological tasks, adjusted to the location of the tumor and to patient's level of functioning, should always be the most important part of the cognitive monitoring. Table 2 of our original study [1] shows the variety of the neuropsychological functions that we also monitored during surgery.

To conclude, the field of awake brain tumor surgery and the accompanying cognitive monitoring is growing rapidly. An academic discussion such as this can be contributing to a more critical and nuanced interpretation of the data of new studies. We therefore thank Mahajan et al. [3] for their initiative of starting this debate.

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