Use of intraoperative monitoring in children

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The holy grail of intraoperative monitoring is accurate correlation of electrophysiological changes and postoperative neurological changes. Ideally, feedback provided to the surgeon in real time would allow for an alteration in technique and thus the opportunity to prevent or reverse neurological deficits. While intraoperative neuro-monitoring modalities continue to evolve, the perfect predictive value of this tool remains elusive.

Intraoperative spinal cord monitoring is essentially the standard of care for adults harboring intramedullary tumors. Less information is available in the pediatric population, perhaps given the rarity of these lesions. Cheng et al. report on their experience using both transcranial motor evoked potentials (TcMEPs) and somatosensory evoked potentials (SSEPs) in a retrospective series of 12 patients. Overall, they found that intraoperative electrical changes predicted postoperative neurological outcomes. They correlated changes in TcMEP and SSEP monitoring with specific intraoperative maneuvers, including traction on the spinal cord and tumor resection via the cavitation ultrasonic surgical aspirator. They also used dorsal column mapping to accurately predict where to perform a midline myelotomy, novel information in the pediatric population.

Several patients in the series had intraoperative changes in their monitoring, which correlated with new postoperative deficits. Not all of these deficits resolved, and the correlation between intraoperative changes and postoperative dysfunction was not perfect.

While the use of intraoperative monitoring in children undergoing intramedullary spinal cord tumor resection appears to be useful, the results of this study must be interpreted with some caution. The study is retrospective in nature with only 12 patients, 5 of whom did not undergo dorsal column mapping. Data were collected over a period of 8 years, and the last patient in the series underwent surgery a decade ago. Moreover, D-wave monitoring, a more recent advance in the intraoperative assessment of motor function, was not utilized.

Nevertheless, the data contribute to our understanding of spinal cord tumor resection in the pediatric population. The authors noted that raising the blood pressure above normal was not helpful in reversing SSEP changes and that releasing traction proved the most reliable maneuver for correcting the first SSEP change. Finally, the provided data offer some guidance in the intraoperative balancing act faced by every surgeon regarding how aggressive the tumor resection should be to avoid tumor recurrence, while doing no harm in preserving neurological function.

Disclosure

Dr. Arnold is a consultant for Medtronic, LifeSpine, Integra Life, SpineWave, Stryker Spine, MIEMS, and AOSpine North America and has direct stock ownership in Z-plasty.

References

Response

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We greatly appreciate the comments put forth by Dr. Arnold in his editorial regarding our experience with intraoperative neuromonitoring for intramedullary spinal cord tumor resections in children. As he points out, the task of resecting these lesions can be a daunting one. In our study we attempted to shed some light on how monitoring can help to navigate the potentially treacherous path of tumor resection in such a delicate structure.

Our experience in the adult population has shown that intraoperative changes in TcMEPs predicted postoperative deficits. 1 Naturally, our attention then turned to our younger patients. We were pleased to see this pattern carry over into the pediatric population. The trend of predicted deficits relating to intraoperative waveform changes, though not statistically significant, is compelling. It is also in keeping with our study of adults undergoing the same procedure. Also worth mentioning is the pediatric patient who had 0/5 strength immediately postoperatively and recovered to 66% of their preoperative strength, as compared with our adult patients who recovered, on average, 48% of their preoperative motor strength with a score of 0/5 on the immediate postoperative examination, a finding that will require more rigorous analysis as data become available.

We are pleased to advocate the use of dorsal column stimulation, a mapping technique routinely used in older patients, to accurately delineate the spinal cord midline in children. Mapping the midline in our patients may have anecdotally contributed to later onset of SSEP changes during tumor resection, but future experience will tell us if this trend holds true. Regardless, this technique takes minutes but sets the stage for the entire resection: it affords the surgeon confidence in optimizing the myelotomy while lowering the likelihood of causing inadvertent harm to the dorsal columns either upon entry or during resection.

The pattern of SSEP changes we experienced revealed the surprising finding of the “3 strikes” phenomenon. Every surgeon has faced the scenario in which an operative maneuver causes neuromonitoring changes. To our relief, many changes are transient and resolve but still leave us wondering, “How many more times could I possibly get away with that before abandoning ship?” The data suggest at most twice and then no more. To be clear, our findings do not argue for overly aggressive resection or repeated attempts in the face of SSEP changes. Every surgeon must use his or her own sound judgment and careful thought before proceeding. Nevertheless, this pattern of SSEP changes may help to “strike” a balance between our fears and our determination when faced with these situations.

In complete honesty, we share Dr. Arnold’s concerns regarding our sample size and the distribution of study subjects over such an extended period of time. These were genuine preoccupations as we interpreted our own data. We also believe that the addition of newer techniques, such as D-wave recording, will probably enhance our ability to protect motor and sensory pathways during surgery. Nonetheless, we feel confident that our results tell a story of both the utility of neurophysiological data in pediatric neurosurgery and, perhaps more importantly, the resilience of the developing spinal cord.

Reference


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