Decompressive craniectomy

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The accompanying article by Bor-Seng-Shu et al. attempts to address a rather straightforward question: Does decompressive craniectomy reduce intracranial pressure (ICP) and increase cerebral perfusion pressure (CPP) in the setting of traumatic brain injury? While conventional wisdom would hold this as a foregone conclusion, studies that have included this information have not been entirely conclusive. Moreover, most studies on the topic have been rather small and have not had sufficient power to arrive at a conclusion. The authors of this pooled analysis attempt to address the issue of statistical power by pooling available studies.

The outcomes examined by Bor-Seng-Shu are rather straightforward, but the method does illustrate some of the limitations of doing a meta-analysis of widely heterogeneous studies. As the authors themselves indicate, there is wide variability in almost every aspect of the studies utilized in the meta-analysis—from patient inclusion criteria, to ICP measurement techniques, to medical treatment intensity, to surgical timing, to surgical technique. In fact, in a true meta-analysis, such important sources of variability are typically incorporated in the inclusion/exclusion criteria. While the authors of this meta-analysis excluded some analyses (such as case reports, reviews, nonhuman studies, non-English studies, and so forth), very important sources of variability remain in the included studies. We should always exercise caution when interpreting the results of this type of pooled analysis. The assumption that pooling patient data from multiple studies will result in a valid pooled comparison is not always a reliable one. Disparity in patient numbers between studies with confounding variables will not infrequently lead to a contradictory conclusion (Yule-Simpson effect). Given that there is wide variation in patient accrual in the present pooled analysis (4–100 patients in the included studies) as well as a number of likely confounders, the possibility of a Simpson paradox should not be discounted.

Because of the study heterogeneity in this pooled analysis, it is difficult to have much confidence in the degree of ICP reduction or CPP elevation afforded by decompressive craniectomy. However, the conclusion of the analysis—that cranial decompression reduces ICP and increases CPP—is believable. It remains to be seen whether the degree of ICP reduction and its durability hold up as more studies on the topic are published.

Disclosure

The author reports no conflict of interest.

Reference


Response

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In his thoughtful editorial, Dr. Sagher raises some important questions about the reliability of meta-analysis when the studies present a lack of uniformity. We agree that our systematic review included a number of small studies that were not uniform in terms of patient inclusion criteria, ICP measurement techniques, intensity of medical treatment, surgical technique, and timing, among other factors. Indeed, it was precisely the huge disparity and inconclusiveness of the existing literature on decompressive craniectomy that prompted us to perform a systematic review to call attention to this controversial issue. Had there been a greater number of more uniform, relevant randomized clinical trials with adequate statistical power, it is likely that more conclusive evidence would have been available, making our review and concurrent meta-analysis less urgent. Meta-analyses are most useful when they can bring in new evidence, obviously subject to
the caveats raised by Dr. Sagher. We strongly believe this to be the case for our review. As shown in Figs. 1–4 of our paper, all primary studies with pre- and postsurgical ICP (and CPP) data indicated directional changes toward a reduction in ICP and an increase in CPP. For this reason, highly significant values of weighted mean differences were obtained. We agree with Dr. Sagher’s assertion that estimates of the expected changes in ICP are less reliable given the heterogeneity of the pooled studies. However, it is difficult to see how a Yule-Simpson paradox could have distorted our results. First of all, we did not assess the effect of decompressive craniectomy comparing a target group (surgical group) against a control group (nonsurgical group)—in our meta-analysis we evaluated the changes in ICP and CPP by using each patient as his or her own control. Second, postoperative ICP was comparable with preoperative ICP for each patient in each study given that the ICP measurement technique and the neurosurgical team were the same prior to and following surgical decompression (the type of ICP monitoring systems applied and the surgical technique used). Finally, the results of our meta-analysis are in line with the results from biomechanical modeling studies, pathophysiological studies, and randomized controlled trials regarding the effects of decompressive craniectomy. Nevertheless, the most important question raised by Dr. Sagher remains: If ICP is expected to be reduced by decompressive craniectomy, how much can we expect it to drop? The results of our review provide an initial estimate based on the best scientific evidence available to date. Given the nonuniformity of the literature, it is likely that under different conditions better or worse results will be obtained, and therefore considerably more work is needed, including randomized clinical trials designed to identify optimal surgical protocols.

References


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