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Does the Variability in the Volume of Lumbosacral Cerebrospinal Fluid Affect Sensory Block Extent of Spinal Anesthesia?

To the Editor:—We read with great interest the study of Carpenter and colleagues[1] who used magnetic resonance images to assess the volume of lumbosacral cerebrospinal fluid (CSF). The authors were able to demonstrate that volumes of lumbosacral CSF correlated with peak sensory block height and duration of surgical anesthesia in 10 volunteers. Accordingly, Carpenter and colleagues[1] concluded that variability in lumbosacral CSF is the most important factor identified to date that contributes to the variability in the spread of spinal sensory anesthesia. Unfortunately, their conclusion depends on the inclusion of one volunteer (patient 9). Excluding this subject from the statistical analysis alters the statistical significance of the correlation between CSF volume and tolerance to transcutaneous electrical stimulation from borderline ($P = 0.049$) to clearly insignificant ($P > 0.1$). Moreover, the correlation coefficient of the CSF volume and peak sensory block level relation decreases from -0.91 to -0.67, indicating that the variability in lumbosacral CSF volume explains only approximately 45% of the variability in sensory block extent. Accordingly, the previously significant correlation ($P = 0.02$) becomes insignificant ($P = 0.066$, as determined by the Kendall rank correlation). Therefore, excluding one particular subject from statistical analysis yields a completely different picture, in that no significant correlation of any characteristic of spinal anesthesia with lumbosacral CSF volume can be found.

What makes volunteer 9 so special? Figure 2 (page 27) illustrates this volunteer as remarkable for two reasons. First, he has by far the highest CSF volume (81.1 ml). The mean CSF volume of the remaining nine volunteers is 50.7 ml with a standard deviation of 7.7 ml. Thus, the CSF volume of subject 9 is 3.9 standard deviations more than the mean of the other volunteers. Moreover, he has by far the lowest peak sensory block height (L3). A peak sensory block height of L3 is usually regarded as "failed" spinal anesthesia. Surely, an unusually large lumbosacral CSF volume might explain such failure. However, there are other possible explanations, including a technical failure resulting in less than the intended amount of lidocaine reaching the subarachnoid space. It has been shown that repeated spinal anesthesia in the same person results in a comparatively consistent sensory spread.[2] However, it is our personal experience that, in patients with a history of failed spinal anesthesia, a satisfactory sensory and motor block can be achieved using an average dose of local anesthetic. This comes as no surprise because the main reason for failed spinal anesthesia is probably technical failure. Has technical failure led to the low sensory block height in subject 9 or was it his large CSF volume? A second spinal anesthesia could resolve this issue. Let us assume that, in a second attempt, the sensory block height in subject 9 reaches the median value of his covolunteers (*i.e.*, Th9). This would result in a statistically insignificant correlation (correlation coefficient -0.44; $P = 0.094$) of sensory block height and CSF volume.

The inclusion or exclusion of one particular subject fundamentally alters the results of the study of Carpenter and colleagues.[1] What conclusions can be drawn from this? Extreme values may have a disproportionate influence on the results of any correlation, and subject 9 is characterized by two extreme values. Because of the results presented, it is impossible to decide whether lumbosacral CSF fluid volume is a primary determinant of sensory block extent during spinal anesthesia. One major problem of the study of Carpenter and colleagues[1] is the small number (10) of subjects included. Because of the variability in CSF volume and sensory spread, a larger sample is necessary to determine the impact, if any, of CSF volume on characteristics of spinal anesthesia.

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In Reply:—Dr. Marsch and Dr. Staender correctly criticize our study for including only 10 volunteers.[1] In defense, however, it took several years to convince 10 volunteers to undergo both a spinal anesthetic and magnetic resonance imaging. Furthermore, we do not have funding to pay for additional imaging procedures. Consequently, it is extremely unlikely that we will be able to expand our database.

Dr. Marsch and Dr. Staender are also correct that one volunteer had an extremely limited spread of sensory anesthesia. Indeed, it is quite logical to conclude that the anesthetic was a technical failure and that the data should be discarded. However, we do not believe this was a technical failure because, as the authors suggested, we performed two spinal anesthetics on this volunteer and he had a similar spread of

sensory analgesia on both occasions. Furthermore, the volunteer was thin, anatomic landmarks were normal, and both procedures were technically uncomplicated. Cerebrospinal fluid (CSF) was aspirated before and after injection of the local anesthetic during each procedure. One anesthetic was performed with 50 mg lidocaine and the other with 50 mg lidocaine plus 0.2 mg epinephrine. The maximum sensory block level was L3 on one occasion and L4 on the other.

As you know, our group has performed numerous studies in which each volunteer received two, or more, spinal anesthetics. During the conduct of these studies, we became impressed by the relative consistency in peak sensory block level achieved in individual patients. Indeed, the consistency in volunteers with extremely low or high sensory block levels was the primary incentive for performing axial imaging. We suspected that anatomic variability may correlate with variability in spread of spinal anesthesia.

In retrospect, we are fortunate to have enrolled a volunteer with such an extreme CSF volume (approximately 4 standard deviations more than the mean). The finding that peak sensory block height in this volunteer was several standard deviations less than the mean of the group supports our conclusion regarding the relation between CSF volume and the distribution of spinal anesthesia. Although we believe that data from this patient should be included in the statistical analysis and that our conclusions are valid, we caution that there is no magic to the 0.05 threshold for statistical significance. Despite achieving the threshold for statistical significance, the correlation we observed could still be caused by chance. Similarly, we do not believe it is prudent to completely dismiss an interesting correlation just because the *P* value is 0.07. We fully agree that additional data are necessary to conclusively establish the relation between lumbosacral CSF volume and the extent and duration of spinal anesthesia. We hope that additional studies will be performed to either confirm or refute our conclusions.

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The Cuffed Oropharyngeal Airway and Management of the Difficult Airway

To the Editor:—We read with interest the case report by Uezona *et al.*[1] regarding the use of the cuffed oropharyngeal airway (COPA) as an adjunct to the management of the difficult airway.

The authors comment on the loss of oropharyngeal tone after general anesthesia and the use of a COPA to maintain a patent airway with spontaneous ventilation during fiberscopy by connecting the anesthesia circuit directly to the 15-mm connector of the COPA. The authors state "the COPA eliminates the need of an assistant who holds the mask and applies a chin lift/jaw thrust, which may make this device more useful than the endoscopic mask." In our experience, however, the COPA does not always eliminate the need to apply a chin lift/jaw thrust, and, in the first of the two cases reported, an assistant provided "slight neck extension and modest chin lift" for an adequate airway. Also, a recent study[2] has suggested that, despite good position of the COPA, as confirmed by fiberscopic examination, the cuff is not sealed tightly in the upper pharynx, and ventilation of the lungs with positive pressure is more secure with a face mask while the COPA is in place and inflated than when it is attached directly to the breathing system.

The authors also describe a series of 25 patients with normal airway anatomy who underwent fiberoptic intubation alongside the COPA. As the fiberscope was passed down the nostril it was deviated from the midline, forcing the fiberscope to pass around the lateral side of the cuff of the COPA with a view of the larynx at the 9-o'clock position. A 90° rotation and a 90° downward bending of the distal tip was required for visualization of the vocal cords. This technique may not be optimal in a patient with a difficult airway in which a midline approach will most readily direct the fiberscope to the larynx. The COPA in this respect compares unfavorably with a number of devices available[3,4,5] that allow the fiberscope to enter the pharynx in the midline and that require minimum rotation or manipulation of the distal tip.

Inflation of the cuff of the COPA, in theory, widens collapsed pharyngeal structures, leading to a better chance of producing a patent airway; and it may be useful when ventilation through a face mask alone is difficult.[6] However, the COPA may not be ideal in the difficult airway because the seal in the upper pharynx is not always tight, airway manipulation by an assistant may still be required, and visualization of the larynx during fiberscopy may be more difficult because the midline approach is not possible.