CORRESPONDENCE

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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