catheter passage into the subarachnoid space and possibly may provide more cranially directed catheters.

As a consequence we would like to recommend techniques that facilitate cranial catheter tip placement and advise against the combination of microcatheters and hyperbaric LA for CSA. In light of these aspects we agree with the statement of the authors that we should not discourage the use of microcatheters for CSA.

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In Reply.—Dr. Standl is right in highlighting the fact that several clinical studies have described techniques destined to decrease the incidence of caudally directed spinal catheters. However, it is important to note that these studies were performed when the role of the catheter's sacral direction in the occurrence of maldistribution was just an experimental hypothesis.1,2 The point of our work was to objectively identify the clinical causes of maldistribution. Using 19-gauge, end-hole catheters, the study showed that the caudal orientation of the catheter tip is a factor of maldistribution rather than the caudal direction of the catheter. As such, the sacral flow of local anesthetics seems to be the most important factor of maldistribution; a cranially directed catheter can have a distally oriented catheter tip if a loop is created during catheter insertion, leading to a distal flow of local anesthetics.

Second, the role of injection speed, lower when local anesthetics are administered, is microcatheters and experimentally evoked as being...
associated with the maldistribution of hyperbaric solutions,\(^1\) has already been debated in the literature.\(^3\) According to Wendell and Cianci,\(^2\) and Erani,\(^3\) neither the catheter diameter nor the baricity of the injected solution was a factor of maldistribution. However, once again, these results were derived from experimental models. Using 19-gauge catheters, we demonstrated that maldistribution did not occur more often with either isobaric or hyperbaric bupivacaine. Nevertheless, the comparison has not been clinically studied using microcatheters. As such, I find it difficult to advise against the use of hyperbaric solutions via microcatheters before clinical evaluation. In one study, although retrospective, the required doses of hyperbaric lidocaine, 5%, administered via microcatheters were not greater than those using macrocatheters.\(^4\) Finally, Horlocker et al. reported, also in a retrospective study, that the incidence of inadequate anesthesia was no greater when using microcatheters rather than macrocatheters.\(^5\) As such, in light of these experimental\(^4\) and clinical results,\(^6,7\) we cannot conclude that microcatheters and hyperbaric solutions are factors of maldistribution. The only current, clinically demonstrated factor of maldistribution is the caudal orientation of the catheter tip.\(^8\)

It is important to note, however, as highlighted in our manuscript, that the danger of maldistribution does not lie in its occurrence but rather in its not being diagnosed, leading to the administration of high doses of potentially neurotoxic local anesthetics. The diagnosis and early management of maldistribution, as well as abandoning the administration of high doses of local anesthetics (lidocaine, 5%), should limit the occurrence of cauda equina syndrome after continuous spinal anesthesia.

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Intrathecal Sufentanil Produces Sensory Changes without Hypotension in Male Volunteers

To the Editor.—The article by Riley et al. regarding sensory changes after intrathecal sufentanil was well written, detailed, and informative. The authors stated that the basis for the neuroselectivity of the different stimulus frequencies used in the CPT evaluation performed by the Neurotrons\(^9\) CPT device (Neurotron, Inc., Baltimore, MD) was “theoretical and unsubstantiated.” Unfortunately, the authors must have been unaware of the significant number of peer-reviewed studies that have been published during the past 10 years, establishing the neuroselectivity of the CPT stimulus.\(^1,2\) These studies include, but are not limited to, comparison with other neurodiagnostic tests, peripheral nerve demonstrations of neuroselectivity,\(^1\) and spinal cord demonstrations of neuroselectivity.\(^2\) In fact, there have been more than 190 articles published in peer-reviewed journals using and validating the clinical use, reproducibility, and sensitivity of the CPT evaluation. Apparently, the only statistically significant change detected in CPTs before and after intrathecal administration of sufentanil was at 250 Hz at the knee. I agree with their point in the discussion section that there should have been a greater effect at 5 Hz. The reason for this discrepancy could be the way the data were analyzed. CPT values before and after intervention should always be expressed as a percent change as opposed to change in intensity (mA) because the amount of charge delivered is different for a 5-Hz versus 2,000-Hz sine wave stimulus. For instance, a 1-mA, 5-Hz sine wave stimulus delivers approximately $400$ the charge (coulombs) as a 1-mA, 2,000-Hz sine wave stimulus. Therefore, a 10-CPT unit (100 $\mu$A) change at 5 Hz results in approximately $400$ greater difference in charge delivery than a 10-CPT unit change at 2,000 Hz. Perhaps looking at the data as a percent change before and after sufentanil administration would reveal a significant effect at 5 Hz.

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