the catheter must be inserted to assure that, during movement, its orifice(s) is not dislodged from the epidural space. But what is enough?

In his letter,[1] Beilin, evidently confining his remarks to the mobile parturient, states: ". . . the optimal length for insertion of an epidural catheter is 5–6 cm and not 2–3 cm, as previously recommended (Brown 2–3 cm,[2] Shnider *et al.* 1–2 cm^3)." Why didn't he reference Bromage, who in 1978 advised 3–4 cm?[4] In a previous article, Beilin *et al.*[5] did reference the roentgenographic study of Bridenbaugh *et al.* but neglected to state that, in 198 patients, it showed "the futility of attempting to thread a plastic tube more than 2 inches (5 cm) cephalad within the epidural space."[6] Since that finding, the distances catheters are threaded at the Mason Clinic into the epidural space, regardless of whether the patient is mobile or immobile, is 4–5 cm.

Can investigations based on clinical performance (observation and judgment by anesthesiologists, as done by Beilin *et al.*[5] and D'Angelo *et al.*[7]) determine precisely "the optimal distance" to insert lumbar catheters in mobile patients? I don't think so, and neither do others who were critical of the article by Beilin *et al.*[8,9] If either Beilin *et al.*[5] or D'Angelo *et al.*[7] want to prove conclusively the "optimal distance" to insert lumbar epidural catheters in mobile parturients or any other mobile patients is 5–6 cm, as stated in their correspondence,[1] they should obtain roentgenograms immediately before withdrawal of the catheter, so as to determine the length of catheter remaining in the epidural space and where its tip lies.

To conclude, neither Beilin *et al.*[5] or D'Angelo *et al.*[7] have presented anything new. In addition, they cannot irrefutably state that the "optimal distance" to insert an epidural catheter in mobile patients is 5–6 cm, nor can Beilin be critical of others whose insertion distance may or may not apply to mobile patients.[1] Beilin *et al.*[5] state that a roentgenographic study ". . . is obviously an unrealistic recommendation for women in labor," and they are right. But this does not rule out roentgenographic studies in them after delivery and immediately before removing the lumbar catheter.

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In Reply:—I thank Moore for his interest and comments on my recent correspondence[1] and article.[2] I believe we did indeed determine the optimal distance an epidural catheter should be threaded into the epidural space for the woman in labor receiving 13 ml of 0.25% bupivacaine. Moore is correct that the catheter must not only be placed in the epidural space, but must remain there for continued analgesia. This point was addressed in our study.

The primary purpose of our study was to determine the optimal distance a catheter should be threaded into the epidural space at the time of insertion that would reduce the incidence of incomplete analgesia for the woman in labor. We found (using multiorifice catheters and 0.25% bupivacaine), that women in whom catheters had been threaded 5 cm had a lower incidence of incomplete analgesia than women in whom catheters were threaded 3 or 7 cm. We then followed the patients throughout the course of their labor (as Moore suggested) to determine how many patients, once satisfactory analgesia had been achieved, would require replacement of their catheter. We found only one patient in the entire study (in the 3 cm group) who required catheter replacement.

I do not believe that obtaining a roentgenographic study, either at the time of catheter insertion or after delivery, would add to our clinical study. If the patient was comfortable throughout the course of her labor, x-ray findings would not have changed our conclusions. In addition, an x-ray might even confuse the clinical picture. Gielen *et al.*,[3] in a roentgenographic study, found that only 10% of all epidural catheters were positioned in the midline, yet 95% of all the patients had a bilateral block.

In summary, I believe that Moore's concerns have been addressed in our study. All patients were evaluated for initial quality of analgesia and followed for subsequent failure. Obtaining an x-ray, although

perhaps academically satisfying, would not have added to this clinical study—and may have confused the picture. I do, however, agree with Moore that our conclusions only pertain to the patient population studied (*i.e.,* women in labor who received an epidural anesthetic with 0.25% bupivacaine *via* a multiorifice catheter.

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In Reply:—We appreciate Moore's interest in our uniport epidural catheter insertion study[1]; however, it appears quite clear that he has misinterpreted the focus, findings, and conclusions of this study. In his criticism, Moore refers to recommendations on epidural catheter insertion by Brown,[2] Shnider *et al.,*[3] and Bromage.[4] Ironically, recommendations such as these were the specific impetus for our evaluation of epidural catheter insertion. These recommendations are based solely on "clinical experience" rather than systematic, scientific examination. Our study was the first prospective randomized study to systematically evaluate uniport epidural catheter insertion in laboring patients.

Moore asks, "Can investigations based on clinical performance . . . determine precisely the optimal distance to insert lumbar catheters in mobile patients?" Our anesthetic practice involves direct clinical patient care; therefore, actual patients are the most appropriate model in which to ask, examine, and attempt to answer clinical questions. Volunteer or animal studies would provide little clinically relevant information for this patient population. In addition, Moore suggests that roentgenographic studies were necessary after delivery to "conclusively prove the optimal distance to insert lumbar epidural catheters. . . ." We believe that postdelivery roentgenograms would provide no clinically pertinent information. Documenting the particular distance within the epidural space an epidural catheter's distal tip rests after delivery would provide irrelevant information. What is relevant is that the patient experienced adequate analgesia throughout labor and delivery.

Moore seeks irrefutable proof of the "optimal distance" an epidural catheter should be inserted into a mobile patient. Our findings indicate that no single insertion length is ideal for all patients; and, we conclude that epidural catheter insertion should vary, depending on the expected duration of labor. Uniport epidural catheters should be inserted either 2 cm when rapid labor is anticipated or 6 cm when longer labors or cesarean section are anticipated. In addition, even optimal insertion distances will only reduce the risk of complications, not eliminate them.

Moore further states, "Neither Beilin *et al.*[5] or D'Angelo have presented anything new." We emphatically disagree. These studies were the first prospective randomized examinations of multiport and uniport epidural catheter insertion in laboring patients, respectively. Findings and conclusions from both studies are remarkably similar, yet differ considerably from the aforementioned recommendations[2-4] based on "clinical experience." We have changed our practice and our teaching to reflect what we have learned from our patients. Clinicians may now choose an epidural catheter insertion length that minimizes associated complications in laboring patients.

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