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Multiorifice Catheters Are Required to Maximize the Benefits of Intermittent Bolus Continuous Regional Techniques

To the Editor:

In Charous *et al.*'s comparison of continuous *versus* intermittent bolus techniques for continuous femoral nerve block,[1] the authors concluded that "the study did not find evidence to support the hypothesis that varying the method of local anesthetic administration – basal infusion *versus* repeated bolus doses – influences continuous femoral nerve block to a clinically significant degree." However, no mention was made of the study design with respect to the use of an end-hole perineural catheter rather than a multi-orifice design.

The demonstrated benefits of the intermittent bolus technique over the continuous technique (improved analgesia,[2–4] reduced local anesthetic requirement,[2] and perhaps better differential sensory-motor block) are thought to be enhanced by multi-orifice flow;[5,6] and thus, to maximize these benefits, a multi-orifice catheter is required. Flow from a multi-orifice catheter depends on flow rate: below 80 ml/h, multi-orifice catheters function as single-orifice catheters; above 100 ml/h, they progressively function as multi-orifice catheters.[7] Therefore, a continuous-only regimen will likely only deliver single-orifice flow, whereas an intermittent bolus technique will likely deliver multi-orifice flow.[7] Multi-orifice flow results in better local anesthetic spread,[5,6] and it is this better spread that is thought to be responsible for the improved block characteristics with the intermittent bolus technique: improved analgesia and reduced local anesthetic consumption (for a given analgesic effect). Recent evidence also suggests that by enabling a local anesthetic dose reduction through the use of the intermittent bolus technique, a higher sensory-to-motor block ratio can be achieved (less motor block for a given analgesic effect).[8] Although some studies have demonstrated benefits using the intermittent bolus technique with end-hole catheters,[9] the majority have incorporated a multi-orifice design.[2–4,8]

We, therefore, do not believe that the conclusion "it is doubtful that, when using continuous femoral nerve block, varying local anesthetic administration will provide an increased sensory-to-motor block ratio" is yet warranted.

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In Reply:

References 2–6 of our colleagues' letter all involved epidural infusion,[1–5] with references 2–4 suggesting analgesia is improved using repeated bolus doses compared with a simple

basal infusion. But all subjects had multi-orifice epidural catheters.[1–3] References 5 and 6 suggest that with the same infusion method, multi-orifice epidural catheters improve analgesia compared with single-orifice designs. But all had the same local anesthetic administration technique.[4,5] In other words, whereas for epidural infusions repeated boluses appear to improve analgesia compared with a simple basal infusion, all of these studies involved only multi-port catheters, and thus it remains unknown if using a single-orifice catheter would have resulted in different findings (the authors of those reports did not purport such a theory).[1–3] Therefore, we do not believe the data supports our colleagues' statement that a "better differential sensory-motor block" is "thought to be enhanced by multi-orifice flow."

However, even if our colleagues' speculation was correct for epidural infusion, local anesthetic pharmacodynamics varies considerably among various introduction modalities. For example, local anesthetic dose, as opposed to volume or concentration, appears to be the primary determinant of block effects during continuous femoral and posterior lumbar plexus nerve blocks.[6,7] In contrast, the effects are mixed for epidural local anesthetic infusions: total dose is the primary determinant of analgesia quality and dermatomal spread, whereas concentration is the primary determinant of motor block and sympathectomy/hypotension.[8] It is for this very reason that we undertook our investigation: data from the literature involving central nervous system infusions (unfortunately) cannot be directly applied to those of the peripheral nervous system, such as the continuous femoral nerve blocks (cFNB) of our study.[9] We therefore do not believe that the references cited in our colleagues' letter, or any published data, supports their supposition that for continuous peripheral nerve blocks "a multi-orifice catheter is required" to "maximize" benefits.

Regarding continuous peripheral nerve blocks, there are two investigations involving popliteal-sciatic local anesthetic administration suggesting that repeated boluses improve analgesia compared with a basal infusion (our colleagues cited one of these two).[10,11] However, both of these studies involved single-orifice perineural catheters. Therefore, there are actually more investigations suggesting the superiority of repeated boluses that used single-orifice perineural catheters than there are studies (just one involving interscalene catheters) using a multiple-orifice design.[12] It appears that the references cited by our colleagues contradict their theory regarding the importance of multi-orifice catheters on bolus-*versus*-basal administration effects.[10–12] Regardless, dramatic pharmacodynamic differences exist even among various continuous peripheral nerve block catheter anatomic locations, and thus the results for popliteal-sciatic and interscalene catheters are not automatically applicable to cFNB.[13]

Our colleagues' speculation that the results of our study might be different with a multi-orifice catheter may prove accurate in the future. However, given (1) our investigation's randomized, triple-masked, split-body study design using extremely precise sensory and motor outcome measures with established reliability and validity; (2) the lack of data suggesting that the number of catheter orifice(s) impact the success of bolus-*versus*-basal local anesthetic administration for the peripheral (or central) nervous system; and, (3) the dramatic, often opposite, differences in pharmacodynamics among various continuous peripheral nerve block catheter anatomic locations, we believe that our concluding statement is both accurate and warranted: "this study did not find evidence to support the hypothesis that varying the method of local anesthetic administration–basal infusion *versus* repeated bolus doses–influences cFNB effects to a clinically significant degree. Thus, it is doubtful that, when using a cFNB, varying the method of local anesthetic administration will provide an increased sensory-to-motor block ratio and minimize motor block and the risk of falling while optimizing cutaneous analgesia."[9]

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Managing Patients with Abnormal Placentation: What Are the Best Anesthetic and Transfusion Strategies?

To the Editor:

I read with interest the article by Reitman *et al.*[1] describing the case scenario for a pregnant patient with placenta accreta, and wish to make several comments. Although I would concur with the authors that a neuraxial technique is a viable approach for planned cesarean section for these patients, no specific detail was provided by the authors in the "anesthetic management" section of the article about preferred modes of neuraxial anesthesia. As exemplified in recent case series of patients with abnormal placentation undergoing cesarean delivery, an epidural catheter-based technique – epidural *de novo* or combined spinal-epidural (as described in "surgical course") – is advisable.[2,3] For these cases, an epidural catheter allows epidural supplementation of local anesthesia to maintain adequate surgical anesthesia during an anticipated period of prolonged surgery. In addition, the epidural catheter can be employed postoperatively to provide epidural analgesia, especially as these patients often have large midline incisions. These patients may often experience moderate-severe intraoperative blood loss requiring transfusion therapy, therefore verifying that the platelet count and coagulation indices are within a normal range before postoperative epidural catheter removal is advised. Urgent cesarean delivery may also be required because of antenatal vaginal bleeding or spontaneous labor;[4] however, the article did not include discussion of anesthesia in this setting. A general anesthetic is likely to be preferred over a neuraxial technique for cases requiring expedited cesarean delivery, as platelet count/function and coagulation indices may have been altered by the rate and magnitude of vaginal blood loss or may simply be because of pressure of time to deliver for fetal indications.

Although the authors correctly state major blood loss can occur perioperatively, the article underplays the critical importance of early availability of adequate volume of blood products for these cases. The authors imply that the transfusion requirements for placenta accreta are moderate (4–6 units erythrocytes), but transfusion requirements can vary and be substantial for all subtypes of abnormal placentation, including placenta accreta. In a recent case series describing transfusion therapy in 66 cases of abnormal placentation (accrete, increta, percreta), massive transfusion (more than 10 units erythrocytes) was necessary for 26 patients with the majority (65%) diagnosed with placenta accreta.[5] Before scheduled and, in particular, urgent cesarean delivery for patients with placenta accreta, an adequate quantity of blood products should be made available to obstetric anesthesiologists in the operating room to avoid communication and transport delays in the ordering, receipt, and delivery of blood products. Immediate access to blood products is especially important during the perioperative period, as placenta accreta is the most common cause for emergency postpartum hysterectomy for uncontrolled bleeding.[6] As a result, the implementation of a massive transfusion protocol can prove life-saving for cases of life-threatening obstetric hemorrhage in this setting, as this critical initiative can ensure the ongoing availability of adequate amounts of essential blood products (erythrocytes, plasma, platelets) to the operating room until surgical control of active bleeding is achieved.[7,8]

The endorsement of a 1:1:1 ratio of erythrocyte:plasma:platelets for massive obstetric hemorrhage based on evidence from the trauma literature should be viewed with caution. The implication that a high plasma to erythrocyte ratio leads to improved patient outcomes during trauma resuscitation patients has been questioned, as many of the studies supporting this postulated effect are observational, apply to young, healthy males with penetrating trauma and, most importantly, are confounded by survival and probable selection biases.[9] The article that Reitman *et al.* reference to justify a 1:1:1 ratio also highlights a number of these methodologic limitations, and states that the "perfect plasma-to-erythrocyte ratio may be an illusory goal."[10] Recent guidelines from the American Association of Blood Banks do not recommend for or against a fresh frozen plasma:erythrocyte ratio of 3 or more for massive transfusion, which indicates continuing uncertainty regarding ideal transfusion ratios for trauma resuscitation.[11]

Lastly, the coagulopathy associated with trauma is characterized by overt activation of the anticoagulant thrombomodulin protein C pathway and concomitant hyperfibrinolysis.[12,13] However, results of recent studies of hemostatic changes during postpartum hemorrhage (PPH) suggest that decreased fibrinogen levels are significantly associated with severe PPH.[14–16] Charbit *et al.* reported that fibrinogen, factor V, antithrombin, and protein C levels are significantly decreased in women with severe PPH compared with those with nonsevere PPH, and observed no differences in fibrinolytic parameters between severe and nonsevere PPH.[15] As a result, therapeutic approaches for treating coagulopathy in