Anesthesiology
68:808-809, 1988

In Reply:—We thank Dr. Leighton *et al.* for their letter. It is true that our study design was unblinded, since all parturients (study 4 and 5) received 12.5 mg bupivacaine and 12.5 μg epinephrine.[1] All our patients demonstrated an increase in heart rate and arterial blood pressure. In study 5, however, maternal heart rate (MHR) was recorded using the direct mode of a fetal monitor, as suggested by Chestnut and Weiner,[2] and modified by ourselves.[3] It is this recording of the beat-to-beat MHR that allows us to identify the rapidly developing peak in MHR following the intravenous (iv) test dose in all patients. If a clear peak is observed within 1 min after injection of the test dose, and if this is accompanied by an increase in arterial blood pressure and a temporary decrease in contraction intensity or contraction frequency, the anesthesiologist should be alerted. This peak is almost always easily identified, even in the presence of a highly variable MHR (illustrated by fig. 3 in our study).[1] If a peak in MHR is suspected but not really clearly visible the test dose should be repeated. It has to be stressed that, in contrast to Moore and Batra[4] and Leighton *et al.*,[5] we do not believe that rigid criteria, such as an increase in MHR of 30 bpm should be applied, since this would make the use of a test dose based on changes in MHR impossible in patients having a variable heart rate, which is frequently seen in parturients.[6] Leighton *et al.*[5] admit that ". . . monitoring sophisticated enough to detect a transient 10 beats/min increase in the maximum maternal heart rate . . . could make epinephrine 15 μg an effective test dose of intravascular injection in laboring patients." Since a fetal cardiotocograph is readily available in the obstetric unit, we believe we should apply this existing technology.

Everybody is concerned about the safety of using epinephrine as a marker of iv injection, because it temporarily decreases uterine blood flow in sheep and guinea pigs.[7,8] However, total uterine blood flow was measured in these studies; therefore, no differentiation was made between myometrial and placental blood flow. Furthermore, species differences might be present, since all animals had bradycardia after iv epinephrine. Although we realize that a small dose of iv epinephrine could further decrease uteroplacental blood flow in preeclamptic patients or when compromised uteroplacental blood flow is present, we do believe that adding epinephrine to the test dose to detect an iv position is justified to prevent accidental iv administration of a large dose of local anesthetics, which could lead to serious complications, especially in the presence of complicated labor.

We admit that we initially studied non-obstetric patients. However, this does not invalidate our conclusions, since they were mainly based on part 4 and 5 of our study.[1] We agree that the cronotropic response to epinephrine is different in pregnant patients, but this does not seem to interfere with the visibility of the peak in MHR after iv epinephrine.

In conclusion, we do not use rigid criteria concerning changes in MHR. Instead, the MHR tracing obtained from a fetal cardiotocograph is observed. If the specific peak in MHR is clearly present, intravascular location is very likely, especially if accompanied by other signs or symptoms. If in doubt, the test dose can be repeated. Although we too are concerned about the effects of epinephrine on placental perfusion, we believe that adding a small dose of epinephrine to the test dose to detect an accidental iv injection is justified to prevent a possible catastrophe from injection of a large dose of local anesthetics. A small dose of epinephrine in the test dose during obstetric epidural anesthesia is used by other authors as well.[9-11] We advise the use of a small dose of epinephrine in the test dose until another reliable, and, perhaps, safer, marker of iv injection is available. Yet, we should keep in mind that ". . . there is no substitute for close observation of the patient by someone trained to detect adverse effects."[12]

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Intrapleural Infusion of Local Anesthetic: A Word of Caution

To the Editor:—The clinical report by Rosenberg *et al.* evaluating the use of a continuous intrapleural infusion of bupivacaine for analgesia after thoracic surgery[1] suggests that intrapleural bipuvacaine, either as a bolus injection of 0.5% (15-20 ml) or as a continuous infusion of 0.25% (5-10 ml/h), was unsatisfactory in the management of postoperative pain after thoracic surgery. This report contradicts the initial reports of excellent analgesia achieved with the intrapleural administration of bupivacaine and lidocaine after abdominal and thoracic surgery.[2-5]*†

We were interested in evaluating the use of continuous intrapleural lidocaine infusion for pain relief after thoracic surgery. We designed a study to compare the effects of intrapleural analgesia to our routine method of continuous epidural analgesia. A pilot study was conducted and three patients received continuous intrapleural infusions of lidocaine 2% with epinephrine 1:200,000 at 15-20 ml/h. Intrapleural lidocaine produced unfavorable results, and the study was terminated because of the following problems:

1. Pain relief after thoracic surgery was inadequate. Two patients complained of severe pain (analogue pain score between 8 and 10) and one patient complained of moderate pain (pain score between 6 and 8). Pain relief was achieved in these patients by the additional use of large doses of systemic narcotics (morphine iv at 34-48 mg/24 h).

2. The dose of lidocaine (300-400 mg/h) caused systemic side effects in all patients. Somnolence, disorientation, and muscle twitches were frequent. Somnolence impaired nursing care and the patients' communications with their families. Serum lidocaine after 12-16 h was between 2.4 and 4.7 μg/ml; none of the patients had seizures. Seltzer *et al.* reported a 9% incidence of convulsions during their evaluation of intrapleural bupivacaine.[4]

3. Tachycardia and hypertension occurred in all patients. Epinephrine is added to intrapleural local anesthetics to slow the absorption, prolong the effect on the intercostal nerves, and reduce the systemic side effects of local anesthetics. The large dose of epinephrine infused (75-100 μg/h) in our patients was the probable cause of postoperative hypertension. High blood pressure was adequately controlled with iv narcotics in two patients and was treated with a sodium nitroprusside infusion in one patient. The side effects of intrapleural infusion of epinephrine are not desirable in patients with history of hypertension and coronary artery disease.

4. This method is technically difficult. Insertion of the epidural needle into the pleural space and threading the catheter was easily achieved at the end of surgery. However, confirmation of catheter position by withdrawal of air through the small catheter was difficult to achieve, despite air bubbling through the chest tubes. The position of the catheter in the intrapleural space was confirmed in two patients by injection of radio opaque dye (amipaque) through the catheter during an

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