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Epinephrine is Unsafe in the Preeclamptic Patient

To the Editor:—The report by Heller and Goodman[1] of four patients suggests that the use of epinephrine-containing local anesthetics for lumbar epidural analgesia (LEA) is safe in the preeclamptic parturient. We disagree with the thesis and the conclusion.

The criterion of patient "well being" in the cases presented was presumably based on indirect measurements of maternal brachial blood pressure with the frequency of determinations not described. During cesarean sections under LEA, the use of epinephrine-containing drugs was associated with markedly greater maternal hemodynamic responses than plain solutions.[2] More importantly, systemic arterial blood pressure may not be correlated with organ blood flow. During a slow, constant infusion of epinephrine in seven pregnant ewes, systemic blood pressure remained unaltered, but total uterine blood flow declined significantly.[3]

One of the basic defects in preeclampsia is generalized arteriolar vasospasm with concomitant decreased uterine blood flow. The goal of any intervention should be to increase, not decrease, uteroplacental perfusion. The overwhelming evidence of many studies is that non-epinephrine-containing anesthetics injected epidurally in gravidae, including preeclamptics, produces a small decrease in maternal blood pressure and an increase of intervillous blood flow.[4] Indirect measurements of umbilical blood flow using a velocity waveform Doppler technique have demonstrated that fetuses with normal umbilical blood flow resistances tolerate the maternal epidural administration of local anesthetics containing epinephrine 1:200,000. However, when the initial umbilical blood flow resistance was abnormally high, even the small doses of epinephrine 1:200,000 contained in 8 ml of anesthetic produced a further increase in resistance.[5]

Finally, accidental intravascular injection is not reliably preventable. In pregnant ewes, uterine blood flow fell 40% and required 5 min to recover after 20 μg of iv epinephrine, a dose associated with mild maternal hypertension and bradycardia.[6] Adverse maternal and fetal sequelae may be pronounced in preeclamptic women because of increased sensitivity to vasopressors and preexisting placental perfusion abnormalities. We are concerned that, if the use of epinephrine containing local anesthetics is adopted for preeclamptic gravidae, physiologically significant doses of exogenous epinephrine may be unintentionally injected iv or be absorbed systemically with ill effects in a subpopulation of fetuses.

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In reply:—We agree entirely with Drs. Costin and Milliken that iv administered epinephrine may cause a reduction in uterine blood flow. However, no mention is made of the fetal response to the iv administration of epinephrine in the studies quoted. Rosenfeld *et al.* make no note of this in their paper.[1] Hood *et al.* described marked dose-dependent reductions in uterine flow in pregnant ewes when given iv epinephrine, but they also noted that there was no effect on the fetal heart rate.[2] Although Drs. Costin and Milliken contend that there is increased sensitivity to vasopressors in preeclampsia, the cases we presented do not bear this out.[3] The arterial blood pressures of these patients were measured every 2 min for 20 min with a standard blood pressure cuff in

three cases, and continuously with a radial artery catheter in one case. In fact, in addition to these four cases, we have administered epinephrine epidurally to another ten preeclamptic patients to date, in varying doses and concentrations (from 1:400,000 to 1:200,000, up to about 25 ml, with either lidocaine-bupivicaine mixtures or lidocaine alone) for both labor analgesia and cesarian section. There was continuous fetal heart rate monitoring in each case. Maternal blood pressure was measured every 1 min with an Accutorr automatic blood pressure device. There has not been a single case of maternal hypertension, nor poor fetal outcome, nor fetal distress that could be attributed to the anesthetic. Even if, in these patients, there is a reduction in umbilical flow, it seems not to matter, implying a significant margin of safety in uterine and intervillous blood flow.

Epinephrine has no significant effects on intervillous blood flow when given epidurally during normal pregnancies.[4,5] Perhaps there is vasodilation of human uteroplacental arteries when exposed to beta adrenergic stimuli,[6] which is the probable effect of the epidurally administered epinephrine.[3,7] Thus, we do not believe that epidurally administered epinephrine is harmful in preeclampsia. We still feel that meticulous technique is necessary to avoid accidental intravenous injection of large amounts of epinephrine.

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Isoflurane-induced Failure of the Bentley-10 Oxygenator

To the Editor:—For many years, we have administered isoflurane *via* vaporizer into the oxygen line during cardiopulmonary bypass to control blood pressure. Recently, we experienced two failures of the Bentley-10® oxygenator during bypass necessitating brief termination of cardiopulmonary bypass and replacement of the oxygenator. The failures were identical in that the attachment of the oxygen inlet separated from the upper portion of the oxygenator housing. The plastic appeared cracked and fragmented as if hammered. In each episode, the patient was hypothermic and the time off bypass was under 3 min. Neither patient suffered injury.

In examining each incident, we found that the isoflurane vaporizer had recently been refilled. On our pump, the vaporizer was located such that liquid isoflurane, if spilled during refilling, might fall upon the oxygenator. We applied 0.25 ml of liquid isoflurane to the top of a new Bentley oxygenator. Seconds later, cracking appeared. Application of an additional 0.75 ml resulted in fracturing of the oxygenator similar to that seen during our cases (figs. 1, 2). Application of liquid isoflurane to a William Harvey® oxygenator and a DIDECO® cardiotomy reservoir produced similar results. All are constructed of polycarbonate plastic.

We were not able to produce any damage using enflurane in volumes up to 10 ml. Halothane softened and distorted the plastic surface, but did not induce cracking. Since most pump oxygenators and other reservoirs are constructed of the same material (polycarbonate), it is likely that they would be adversely affected by isoflurane.

Subsequent to our discovery, we found this problem had been previously reported.*† Because of the limited

* Health Devices 14, 133–134, 1985.
† Health Devices Alerts, No. 1985-11, p 3, March 15, 1985.