

Chloroprocaine vs. Bupivacaine for Lumbar Epidural Analgesia for Elective Cesarean Section

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The incidence and degree of hypotension, time to establish surgical analgesia, and several other maternal and fetal variables were studied when 2-chloroprocaine, 3 per cent, and bupivacaine, 0.5 per cent, were used for epidural analgesia in 30 women undergoing elective cesarean section. Surgical analgesia occurred 8 min sooner ($P < 0.001$) with chloroprocaine (14 ± 1 min) than with bupivacaine (22 ± 2 min). Blood pressure values were significantly lower with chloroprocaine than with bupivacaine during the 18-to-32 min interval after local anesthetic injection, while pulse rates were higher ($P < 0.05$) at 18, 20, and 22 min. Hypotension necessitating treatment with ephedrine occurred in 33 per cent of chloroprocaine-treated subjects, compared with 13 per cent of those receiving bupivacaine. Newborn outcome was excellent in both groups, as reflected by umbilical vessel blood-gas values, times to sustained respiration, and 5-min Apgar scores. The authors conclude that chloroprocaine disturbs maternal cardiovascular status more than does bupivacaine when used for cesarean section epidural analgesia. However, chloroprocaine can be employed safely in normal pregnancies if maternal hypotension is corrected rapidly. (Key words: Anesthesia, obstetric. Anesthetic techniques, epidural; peridural; lumbar. Anesthetics, local: bupivacaine; chloroprocaine. Blood pressure: drug effects, hypotension. Surgery: cesarean section.)

THE MAJOR DISADVANTAGE of epidural analgesia is the time needed to establish surgical analgesia. A rapidly acting local anesthetic, 2-chloroprocaine, hastens the onset of analgesia, but may disturb maternal cardiovascular status more than a slower acting agent such as bupivacaine, resulting in greater newborn compromise. In this study, we compared the times to establishment of surgical analgesia, the degrees and incidences of hypotension, pulse rate changes, qualities of analgesia, Apgar scores, times to sustained respiration, and umbilical blood-gas values when 2-chloroprocaine and when bupivacaine are

used for epidural analgesia in elective cesarean section.

Methods

The Clinical Research Practices Committee approved the protocol, and all participants gave informed consent. We studied 30 women with uncomplicated term pregnancies¹ scheduled for elective cesarean section. Each received Mylanta[®], 30 ml, *p.o.*, for premedication, and was transported in the lateral position to the delivery suite, where a 20-gauge plastic cannula was placed percutaneously into radial artery for baseline blood pressure, pulse rate, and blood-gas measurements. An epidural catheter was introduced at L2-3 or L3-4 and lidocaine, 2 ml of 1 per cent, was given to test for subarachnoid placement. During the 20 min before initiation of epidural analgesia, the subjects received an intravenous infusion of lactated Ringer's solution equal to 20 per cent of estimated blood volume. With the parturient positioned in a 15-degree left lateral tilt, epidural analgesia was initiated with chloroprocaine, 20 ml of 3 per cent, or bupivacaine, 20 ml of 0.5 per cent, selected randomly. Blood pressure and pulse rate were recorded every 2 min after injection until delivery. If necessary, additional local anesthetic was given to achieve sensory levels of T4-T6. Subjects inhaled 100 per cent oxygen from a tightly fitting face mask, but after surgical incision, nitrous oxide, 25-40 per cent, was given whenever supplementary analgesia was necessary prior to delivery.

Hypotension to systolic blood pressures of less than 100 torr was managed initially with increased left uterine displacement, rapid infusion of intravenous fluids, and increased Trendelenburg position. Ephedrine, 10-15 mg, was given intravenously as needed whenever systolic pressure remained below 90 torr for 3 min. The operation was initiated when the application of an Allis clamp at the site of the skin incision failed to elicit a response. Maternal arterial blood-gas studies were repeated at uterine incision. At delivery, blood was sampled from an umbilical artery and vein from a doubly clamped loop of cord. Times from injection of local anesthetic to establishment of surgical analgesia (I-S), injection of local anesthetic to delivery (I-D), skin incision to delivery (S-D), and uterine

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incision to delivery (U-D), and time to sustained respiration were recorded. A member of the anesthesia team assigned Apgar scores. We used the Student's *t* test for unpaired samples for statistical comparisons, expressed all values as means \pm SEM, and considered $P < 0.05$ to be significant.

Results

Parturients receiving chloroprocaine and bupivacaine were nearly identical with respect to mean values for height, weight, initial blood pressure, and hemoglobin. The onset of surgical analgesia (I-S) was more rapid with chloroprocaine than with bupivacaine (table 1). The longer I-S time for bupivacaine also prolonged the I-D interval for this agent. Other times were similar for the two groups. Systolic blood pressure values were significantly lower in the chloroprocaine experimental group than in the bupivacaine experimental group 22, 26, and 32 min after local anesthetic injection, while pulse rates were significantly higher at 18, 20, and 22 min (fig. 1). When calculated as percent change from control level, systolic pressure had decreased significantly 18, 20, 22, 24, and 32 min after chloroprocaine injection, while remaining quite stable in the bupivacaine group (fig. 2). Hypotension necessitating treatment with 10 to 15 mg ephedrine occurred in 13 per cent of subjects given bupivacaine and 33 per cent of those given chloroprocaine. The responses to ephedrine were prompt and sustained in both groups. Levels of analgesia were T5-T6 in both groups; however, a slightly larger volume of bupivacaine (26 ± 2 ml) than of chloroprocaine (23 ± 2 ml) was given to achieve the desired level. Two women in each group needed nitrous oxide analgesia before delivery. Initial mean values for arterial blood in subjects receiving chloroprocaine were pH 7.46, P_{aO_2} 92 torr, and HCO_3^- 22 mEq/l, compared with 7.44, 98 torr, and 21 mEq/l, respectively, in subjects given bupivacaine. These represent normal values, and although some differences were significant upon statistical analysis they are not of clinical importance. Maternal blood-gas values for the two groups were again normal and virtually identical at the time of the uterine incision.¶ Differences between groups regarding newborn weights times to sustained respiration, 5-min

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TABLE 1. Times Observed (Mean \pm SEM)

	Minutes	
	Bupivacaine (n = 15)	Chloroprocaine (n = 15)
Injection of local anesthetic to establishment of surgical analgesia (I-S)	22 \pm 2*	14 \pm 1
Injection of local anesthetic to delivery (I-D)	30 \pm 2*	22 \pm 2
Surgical incision to delivery (S-D)	8 \pm 1	8 \pm 2
Uterine incision to delivery (U-D)	77 \pm 13	82 \pm 10

* $P < 0.05$.

Apgar scores, and umbilical blood-gas values¶ were not significant. One-minute Apgar scores were less than 7 for two neonates in the chloroprocaine experimental group. In one of these, maternal hypotension did not occur, but U-D was prolonged at 115 sec. In the other, a breech presentation, hypotension occurred but was promptly corrected with ephedrine. Infants of hypotensive mothers treated with ephedrine had umbilical vessel values which were very similar to those of normotensive mothers.¶ All infants did well in the nursery.

Discussion

We studied the local anesthetic agents and concentrations most commonly used in our clinic for epidural analgesia for cesarean section. Avoidance of compromise of newborn neurobehavioral function is an advantage of either bupivacaine or chloroprocaine. Bupivacaine, 0.75 per cent, is probably closer to chloroprocaine, 3 per cent, in potency, but the prolonged motor block that may occur with this concentration of bupivacaine is a disadvantage.

During epidural analgesia for cesarean section the prompt occurrence of surgical analgesia with chloroprocaine, 3 per cent, is advantageous, for both mother and anesthesiologist are more quickly reassured that the block is working, and the surgical procedure can be initiated after less delay. The longer time for bupivacaine to establish analgesia could account for the slightly larger volume used compared with chloroprocaine, for the surgeons were ready to begin the operation as soon as adequate skin analgesia was achieved. The slower-acting bupivacaine may have caused the anesthesia team anxiety concerning the quality of analgesia, resulting in premature use of additional local anesthetic.

Chloroprocaine causes greater decreases in maternal blood pressure and significant increases in pulse rate in comparison with bupivacaine. Both trends

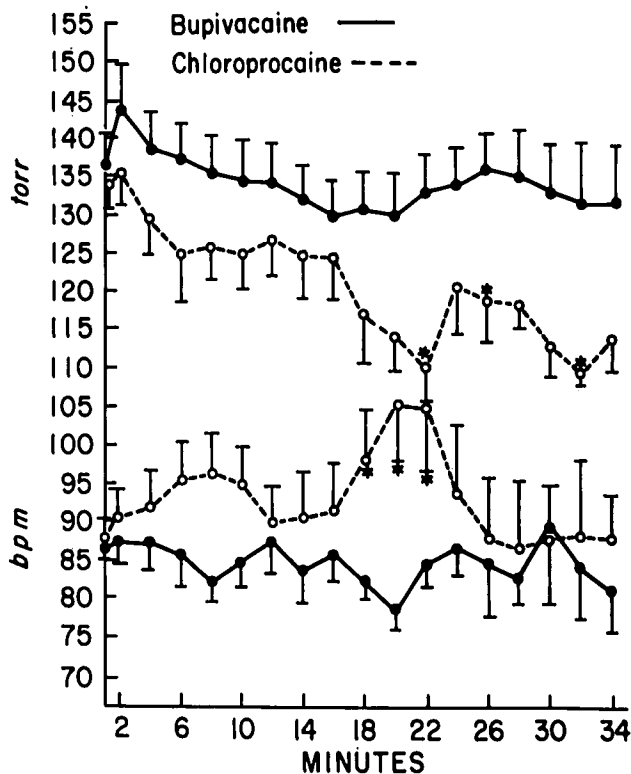


FIG. 1. Differences in actual values of systolic blood pressure and pulse rate (mean \pm SEM) are compared for bupivacaine and chloroprocaine. Some significantly higher pulse rate and lower blood pressure values were found with chloroprocaine. * $P < 0.05$.

are present several minutes before the differences in these variables becomes statistically significant (fig. 1). Although the difference was not statistically significant, the greater incidence of hypotension with chloroprocaine (33 per cent) compared with bupivacaine

(13 per cent) also suggests greater maternal cardiovascular compromise. In a study where prophylactic ephedrine was used. Wright *et al.*** also noticed an increased incidence of hypotension with chloroprocaine as compared with bupivacaine. They used the same concentration of chloroprocaine but a higher concentration of bupivacaine, 0.75 per cent, than was used in our study. The greater overall incidence of hypotension in their study may have been due to the higher level of analgesia (T4 *vs.* T5-6), the higher concentration of bupivacaine used (0.75 *vs.* 0.5 per cent), or less effective left uterine displacement. One of the present authors previously reported a 33 per cent incidence of hypotension with bupivacaine, 0.5 per cent, for epidural analgesia for cesarean section.² However, right as opposed to left uterine displacement was used initially in that study, and Downing has demonstrated that this is less effective in preventing aortocaval compression.³ The more pronounced blood pressure and pulse rate changes seen with chloroprocaine may be due to the more rapid onset of sympathetic nerve blockade, resulting in less time for maternal cardiovascular compensatory mechanisms to act. Maternal hypotension is important, for placental blood flow decreases in proportion to the degree of hypotension.⁴

It must be emphasized that our subjects were experiencing healthy pregnancies in which uterine blood flow and uteroplacental exchange should have been

** Wright RG, Shnider SM, Levinson G, et al: Maternal and fetal plasma norepinephrine levels during epidural anesthesia for elective cesarean section. Abstracts of Scientific Papers, Annual Meeting of the American Society of Anesthesiologists, 1978, pp 109-110.

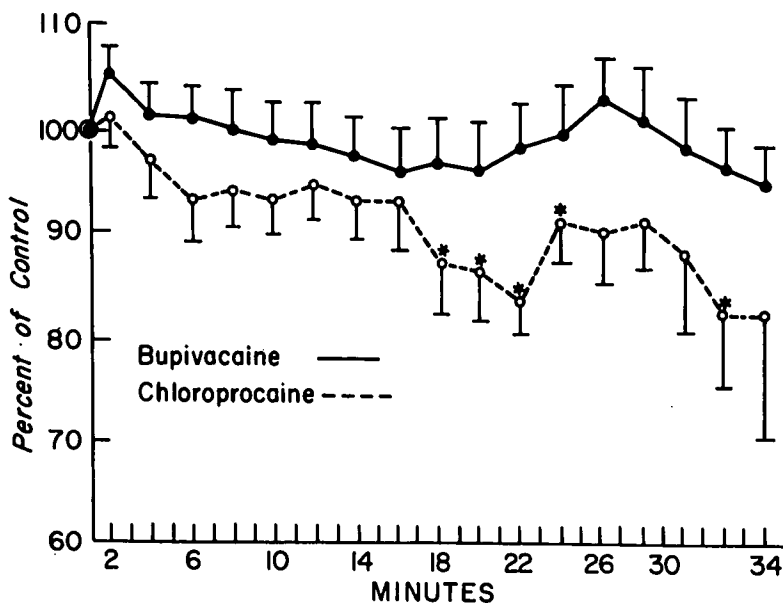


FIG. 2. Blood pressure changes for chloroprocaine and bupivacaine epidural analgesia, calculated as percentage changes from preepidural levels. Values represent means \pm SEM. Significant changes from control occurred with chloroprocaine but not with bupivacaine. * $P < 0.05$.

normal before the start of epidural analgesia. Greiss has implied that a decrease in uterine blood flow of 50 per cent can be tolerated during normal pregnancy before the fetus is compromised.⁴ This may explain why newborn compromise failed to occur in our study when maternal hypotension was corrected rapidly. Only one mother of the two infants with low 1-min Apgar scores was hypotensive. Her infant was delivered as a breech, perhaps accounting for its poor initial Apgar rating. The excellent blood-gas values for infants of mothers with corrected hypotension verify the efficacy of attentive monitoring and rapid correction of maternal hypotension with ephedrine.

Chloroprocaine has the advantage of providing surgical analgesia rapidly when used for epidural analgesia for cesarean section. We conclude that it is safe for the healthy mother and fetus when blood pressure is monitored closely and hypotension is cor-

rected rapidly. Bupivacaine, which disturbs maternal cardiovascular variables less, might be a better choice for use in high-risk pregnancies (diabetes, pregnancy hypertension, postmaturity, etc.), where uteroplacental compromise may already exist⁴ and even a small additional insult to uteroplacental exchange could further jeopardize the fetus.

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Erratum

The article, "Hypoglycemia-induced Seizures in an Infant during Anesthesia (*ANESTHESIOLOGY* 52: 77-78, 1980), contained an error. On page 78, the tenth line in the right column should read: 2-4 ml/kg (0.5-1.0 g/kg), is given intravenously.¹²

In addition, references after reference 6 in this article were inadequately presented. The correct and complete listing is:

7. Thomas KOM: Hypoglycemia in children before operation. Its incidence and prevention. *Br J Anaesth* 46:66-68, 1974
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