Effects of Meperidine, Pentazocine, Bupivacaine and Lidocaine in Spinal Anesthesia for Cesarean Section

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In recent years there has been a dramatic increase in the frequency of cesarean section. Currently a cesarean section rate of 15 to 20% is common. Spinal anesthesia for cesarean section still continues to be a popular technique because it provides many advantages such as rapid onset, high success rate, minimal maternal and fetal drug exposure and minimal maternal aspiration.

Since a specific opiate receptor was discovered in 1973, the most important new approach of opiate administration is in intrathecal and extradural routes.

It has been reported that small dose of morphine given intrathecally and extradurally produce long lasting relief of chronic and postoperative pain[1].

Since then, the efficacy of meperidine[2], fentanyl[3], methadone and hydromorphone[4] have been studied. Through the extradural route, all the opiates including maperidine are able to interrupt pain at a spinal level without affecting motor or autonomic control[2]. Recent studies have shown that meperidine unlike morphine when given intrathecally do not produce a selective segmental analgesia but exhibit all the effects of the subarachnoid administration of local anesthetics including sensory, motor and sympathetic blockade as well[5,6]. Therefore, spinal anesthesia with meperidine was adequate for surgical intervention[5,7,9].

Pentazocine, a benzomorphane derivative with a high lipid solubility, is very smillar to meperidine in morecular weight and pka. Pentazocine has been used to induce spinal anesthesia as well as meperidine. The main purpose of this study was to evaluate the effectiveness of meperidine and pentazocine as spinal anesthetics for cesarean section and to compare meperidine and pentazocine spinal anesthesia with bupivacaine and lidocaine spinal anesthesia.

Materials and Methods

Forty healthy parturients scheduled for elective cesarean section were selected for this study.

They were devided into four groups (table 1):

Group I (n=10) received 50 mg of preservative-free meperidine mixed with 0.5 ml of 10% dextrose intrathecally.

Group II (n=10) received 45 mg of presrevative-free pentazocine without dextrose intrathecally.

Group III (n=10) received 10 mg of premixed 0.5% bupivacaine in 8% dextrose intrathecally.

Group IV (n=10) received 75 mg of premixed 5% lidocaine in 5% dextrose intrathecally.

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Table 1. Drugs of four groups

	Drugs	SG (20C)	Dose (mg)	Volume (ml)
Group I	5% Meperidine +10% dextrose 0.5 ml	1.029	50	1.5
Group II	3% Pentazocine without dextrose	1.042	45	1.5
Group III	0.5% Bupivacaine in 8% dextrose	1.033	10	2.0
Group IV	5% Lidocaine in 5% dextrose	1.043	75	1.5

. Patient's consents were obtained prior to anesthesia. All patients were ASA class I and all fetuses were at full term with no signs of fetal distress. Premedication consisted of hydroxizen 50 mg and glycopyrrorate 0.2 mg IM one hour prior to spinal anesthesia. All patients were rapidly hydrated with a dextrose free balanced salt solution 1000 to 1500 ml within 20 to 30 min before injection of anesthetics into the subarachnoid space. The heart rate and systolic arterial blood pressure were monitored noninvasivly with an automatic device (ACCUTOR IA). The average of the last three readings of pulse and blood pressure taken during the last 3 min prior to the induction of anesthesia was considered as a baseline value with which all subsequent readings were compared. Hypotension was defined as a decrease in systolic arterial blood pressure equal to or more than 20% less than the baseline level. If hypotension occurred 8 to 16 mg of ephedrine was administered.

Spinal anesthesia was induced with the patient in a sitting position. Lumbar puncture was performed at the L2–3 or L3–4 interspace using a 25 guage spinal needle. After the injection of the anesthetic, the patient was gently turned to the supine horizontal position with a left lateral displacement of the uterus. From injection to the delivery, 4 L/min of oygen was administered through the face mask.

After delivery, 200 mg of thiopental was injected and 50 to 60% of nitrous oxide was administered until the end of surgery. The time of anesthetic injection, skin incision, delivery and termination of surgery was recorded. On arrival at the recovery room, motor function was assessed using the Bromage scale.

Bromage scale:
0 – ability to flex the knees and feet
1 – just able to move the knees
2 – able to move the feet only
3 – unable to move the feet or knees

The time of complete motor recovery ranged from the time of subarachnoid injection to the bromage scale 0. The duration and quality of postoperative analgesia were assessed by asking the patient and the ward nurse. The patient was instructed to ask for additional analgesia when it was felt necessary. The duration of analgesia ranged from the time of subarachnoid injection to the time that pain become severe enough to require additional analgesia.

Postanesthetic complications were noted with particular attention being paid to the possibility of respiratory depression and the other side effects ascribed to spinal opiate analgesia such as pruritus, nausea, vomiting and urinary retention.

Results

The subarachnoid injection of meperidine and pentazocine resulted in anesthesia similar to that noted with the intrathecal administration of local anesthetics. Sensory and motor blockades in all patients with meperidine and pentazocine spinal anesthesia were obtained. There were no significant differences among the four groups in height,

Table 2. Age, Height and Body weight distribution (mean±SD)

	Age (years)	Height (cm)	Body weight (kg)
Group I	29.7±2.6	160.5±3.9	61.8±4.5
Group II	28.3±4.0	159.9±3.1	64.2±6.1
Group III	28.5±2.9	159.2±3.8	65.0±6.1
Group IV	30.5±3.5	159.4±2.2	64.2±3.8

Table 3. Incidence rate of hypotension and dosage of ephedrine used and Apgar score

	Group I (n=10)	Group II (n=10)	Group III (n=10)	Group IV (n=10)
Hypotension	6 (60%)	5 (50%)	4 (40%)	5 (50%)
Ephedrine used (mg)	20.6±10.5	16.5±10.5	14.0±4.0	14.5±3.5
Apgar score (1 min)	9–10	9–10	9–10	9–10

Ephedrine dose given as mean ± SD

Table 4. Time interval of skin incision, delivery and termination of surgery

	Group I	Group II	Group III	Group IV
From injection to skin incision (min)	6.2±3.4	6.5±1.8	5.8±1.6	5.3±1.1
From injection to delivery (min)	11.9±6.0	7.0±2.2	5.3±1.6	5.3±1.1
From injection to termination of surgery	55.6±13.3	55.2±8.6	56.3±8.1	61.6±13.5

Value given are mean ± SD

Table 5. Recovery from anesthesia

	Group I	Group II	Group III	Group IV
Complete motor recovery (min)	73.4±13.0 a	83.5±17.3 a	160±18.2 c	131.0±11.9
Duration of analgesia	481.8±197.8 b	496±283.7 b	120±21.0 c	89.0±21.8

Value given are mean ± SD
a; $P<0.001$ for group I vs. group IV and group II vs. group IV
b; $P<0.001$ for group I vs. group IV and group II vs. group IV
c; $P<0.005$ for group III vs. group IV

weight and age (table 2). Incidence of hypotension and dosage of ephedrine used to correct maternal hypotension among the four groups were comparatively insignificant (table 3). At birth, newborns of all four groups cried immediately and had Apgar scores of 9 to 10 at 1 min and 10 at 5 min (table 3). The time interval from anesthetic injection to the skin incision, delivery and termination of surgery were not significantly different among the four groups (table 4). In meperidine and pentazocine spinal anesthesia, the time of complete motor recovery was significantly shorter ($P<0.001$) compared with lidocaine spinal anesthesia (table 5). The duration of analgesia of meperidine and pentazocine spinal anesthesia were significantly longer ($P<0.001$) in comparison with lidocaine anesthesia (table 5).

In the bupivacaine spinal anesthesia, the time of complete motor recovery and duration of analgesia were significantly longer ($P<0.05$) than with lidocaine anesthesia (table 5).

Patients who received bupivacaine and lidocaine spinal anesthesia complained of severe abdominal pain before complete reverse of the motor blockade in the recovery room. On the other hand, all patients who received meperidine and pentazocine spinal anesthesia were calm and comfortable in the recovery room.

Other side effects ascribed to spinal opiate analgesia were not noticed except two patients with meperidine spinal anesthesia complained of mild nausea without hypotension before delivery. Urinary retention could not be assesed because indwelling catheters in the urinary bladder were left in place for approximatery 24 hours postoperatively. Slight sedation was noticed in most of the patients with meperidine and pentazocine spinal anesthesia before delivery but no clinical signs of respiratory depression were observed during the operation and recovery. Data are expressed as mean ± SD.

The statistical significance of difference among the groups' mean values was determined by using the Analysis of Varience (ANOVA) and the Student's t-test. $P<0.05$ was considered to be stastically significant.

Discussion

Our results bear out the efficacy of meperidine and pentazocine as spinal anesthetics following subarachnoid injection. Yaksh demonstrated in unanesthetized rats that intrathecal narcotics produced profound segmental analgesia which was dose dependent and naloxone reversible[8].

However, recent studies by Mircea, et al. and Sandu, et al. showed that meperidine, unlike morphine when given intrathecally did not produce a selective segmental analgesia where-as it exhibited all the effects of the subarachnoid administration of local anesthetics including motor, sensory and sympathetic blockades[5,6].

Intrathecal opiates with high lipid solubility like meperidine and pentazocine have a rapid onset, rapid clearance from the CSF and relatively short duration of action[11]. Intrathecal morphine which is one of the most hydrophilic opiates, has a slow onset, slow clearance from CSF and long duration of action and greater potential for rostral spread[11].

The mechanism of motor blockade and prolonged postoperative analgesia following intrathecal meperidine and pentazocine is not completly understood. However, the mechanism of a motor blockaed may be due to a direct action on spinal grey matter, a mediation by opiate receptors in the ventral horn of the spinal cord and on motor fibers and a local anesthetic action on axonal membrane in the anterior spinal nerve roots[9].

It is known that meperidine has local anesthetic properties (Blacow, 1972: Martin, 1975)[10] which were demonstrated in a recent experiment on an isolated frog nerve-muscle preparation[6]. However, motor blockade could not be obtained after the extradural administration of 100 mg meperidine (Cousins et al. 1979), the sole effect being a selective analgesia[2]. The losses from vascular absorption and distribution into epidural fat may explain the absence of motor blockade.

The small quantity of drug left available

for transfer across the dura could reach the spinal cord via the posterior radicular artery which has branches that penetrate directly to the dorsal region[11]. On the other hand, a subarachnoid injection of meperidine and pentazocine avoid loss of drugs. Absorbtion into the capillaries of the spinal cord is very slow and high lipid soluble drugs like meperidine and pentazocine are rapidly absorbed by the lipid tissue of the spinal roots leading to the development of an anesthetic blockade.

The axonal blockades produced by meperidine and pentazocine in the spinal nerve roots do not explain the postoperative analgesia noted in our patients after the recovery of a motor blockade. The duration of analgesia produced by intrathecal meperidine and pentazocine exceed the duration action when administered subcutaneously[12].

This suggests that intrathecal meperidine and pentazocine also have an effect upon nociceptive synaptic junctions in the dorsal horn of the spinal cord[12].

Slight sedation noticed in meperidine and pentazocine groups may be due to the agonistic action on kappa-opioid receptors. The kappa – receptors are responsible for sedation as well as spinal analgesia[13].

The low incidence of complications indicates that the rostral spread of meperidine and pentazocine in CSF is minimal and could be attributed to their higher lipid solubility as compared with morphine. Although not very prolonged, the associated postoperative analgesia was advantageous.

The recent availability of bupivacaine for spinal anesthesia has provided us with an attractive alternative to the use of tetracaine. More experience with bupivacaine will help us further define its role as a spinal anesthetic for cesarean section.

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