ORIGINAL ARTICLE

Epidural Anaesthesia for Caesarean Section: A Comparison of 0.5% Bupivacaine Plain, 0.5% Bupivacaine plus 100 μg Fentanyl and 0.5% Bupivacaine plus 50 μg Fentanyl

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Summary

Thirty-one healthy women who underwent Caesarean section were studied in a double-blind trial to compare the effectiveness of epidural 0.5% bupivacaine plain, 0.5% bupivacaine plus 100 μg fentanyl and 0.5% bupivacaine plus 50 μg fentanyl in the prevention of intraoperative pain. There was no difference in the quality of analgesia between the three groups. The incidence of complications was significantly higher in the 0.5% bupivacaine plus 100 μg fentanyl group compared with the other two groups.

Key Words: Anaesthetic techniques: epidural; Anaesthetics, local: bupivacaine; Analgesics, Narcotic: fentanyl

Introduction

Regional anaesthesia offers advantages over general anaesthesia for Caesarean section[1]. One eliminates the risks of inability to intubate and of aspiration pneumonitis. The mother can enjoy the baby's delivery and encourage early bonding. Epidural anaesthesia is associated with better early neonatal condition and higher Apgar scores than general anaesthesia[2,3]. However, even with an apparently good block, the mother may experience intraoperative pain and discomfort of visceral origin during surgical manipulations, which necessitates conversion to general anaesthesia with its inherent risk[4]. Epidural opioid-local anaesthesia combinations have proven of benefit in obstetric patients during labour and postoperative pain in obstetrics and in Caesarean section[5,6,7]. Most previous studies used epidural fentanyl, in a dose of 100 μg administered before delivery at caesarean section to improve intraoperative comfort[8,9]. However a lower dosage of fentanyl requirement may be sufficient in the Asian population. This randomised double blind controlled trial was therefore undertaken to compare 0.5% bupivacaine plain, 0.5% bupivacaine plus 100 μg fentanyl and 0.5% bupivacaine plus 50 μg fentanyl in mothers for Caesarean section.

Patients and Methods

Epidural anaesthesia with fentanyl for Caesarean section is an accepted technique in the developed countries and its safety has been established[8,9,10,11]. Thirty-three healthy patients (ASA classification 1) scheduled to undergo elective Caesarean section at a gestation of 36 weeks or greater were studied. All the patients gave consent. All women were premedicated orally on the evening before and two hours before the procedure with ranitidine 150 mg. They were also given sodium citrate 30 ml on arrival in the anaesthetic room.

Before an extradural block was induced, the patient received Ringer's lactate solution 1 litre. Continuous patient monitoring included ECG, non-invasive arterial pressure measurement (Dinamap) and pulse oximetry (Nellcor). With the patient in the left lateral position, the L2-3 extradural space was identified with a 16-gauge Tuohy needle, using loss of resistance to saline. An extradural catheter was passed 4 cm cephalad and 0.5% bupivacaine 3 ml was injected through a Millipore filter as a test dose. After 5 min, and with no evidence of intrathecal or intravascular administration, 0.5% bupivacaine 7 ml was injected in divided doses over 5 min with the patient positioned with the pelvis tilted 15° to the left using a wedge under the right hip.

The mothers were randomly allocated to receive the next epidural top-up in divided doses over 10 minutes of, either 8 ml 0.5% bupivacaine plus 2 ml 0.9% saline (group I) or 8 ml 0.5% bupivacaine plus 100 μg fentanyl (group II) or 0.5% bupivacaine plus 50 μg fentanyl and 1 ml of 0.9% saline (group III). These solutions were prepared by an independent anaesthetist and neither the anaesthetist involved in the study, nor the patient was aware of whether fentanyl or saline was administered. The level of anaesthesia attained was tested with the sharp end of a 23 gauge needle at five minute intervals. Additional increments (up to 5 ml) of 0.5% bupivacaine were administered until a bilateral sensory block to T6 or higher was attained, if a bilateral sensory block to T6 or higher was not present at 30 minutes. The total volume injected epidurally and the time taken to attain block T6 were recorded.

All patients received supplemental oxygen 3 litre per min via an intranasal cannula. To avoid aorto-caval compression, a right uterine wedge was maintained during the entire surgical procedure.

Blood pressure, heart rate, oxygen saturation and respiratory rate were measured at 5 min intervals. Adverse effects, including nausea, vomiting, pruritus, hypotension, dizziness, drowsiness, and evidence of ventilatory depression (respiratory rate <12 breaths per minute) were noted. Hypotension was defined as a systolic arterial pressure of less than 90 mm Hg or a reduction of more than 20% from baseline and was treated with ephedrine and fluids. Nausea and vomiting were treated with ephedrine (if hypotension-related) or metoclopromide. All patients received syntocinon 10 IU intravenously after delivery.

Neonatal outcome was assessed by Apgar scores at one and five minutes.

Intra-operative pain was assessed by the anaesthetist conducting the anaesthetic. The mothers were asked to rank any pain as absent, mild, moderate, or severe at eight stimulating events; skin incision, stretching of the recti muscle, peritoneal incision, delivery, suturing of the uterus, manual exploration, removal of the pack and peritoneal closure. Mild pain was regarded as discomfort that did not require treatment. Patients were offered Entonox to breathe or i.v. fentanyl were administered to treat moderate pain as indicated clinically. In general failure of Entonox was an indication for i.v. fentanyl after delivery. Patients with severe pain were offered induction of general anaesthesia.

All mothers were observed on a recovery unit after operation and subsequently returned to the ward.

Pain occurrence, supplemental analgesic requirements, and adverse effects were analysed with Fisher's exact test. A p value <0.05 was taken as significant.

Results

Two patients were excluded after randomisation: one procedure was abandoned because of unilateral analgesia with no analgesia above L1 on one side; and another procedure was abandoned due to evidence of i.v. injection. One patient had been allocated to group II and the other to group III.

Patient characteristics were similar. There were no differences in the volume of epidural bupivacaine 0.5% required to produce block to T6, nor in the speed of onset of block (Table I).

Four patients in group I and two patients in group III required entonox to breathe during the procedure, compared with only one in group II. In addition three patients in group I required i.v. fentanyl, compared with two in group III and none in group II. One

patient in group I required general anaesthesia after delivery when both entonox and I.V. fentanyl failed to control pain.

There was no statistically significant difference between the three groups (Chi-square-2.919 with 2 degrees of freedom; P=0.232), although group II tended to require fewer analgesic supplements than the other two groups (Table II).

The incidence of hypotension, nausea or vomiting were similar between groups (Table III).

One patient in group II was given naloxone for respiratory depression. The patient has been reported in detail elsewhere[12]. In this patient, surgery was commenced 30 min after completion of the injection. Before delivery, the mother received oxygen 3 litre per min via an intranasal cannula and the pulse oximeter

Table I
Patient characteristic and volume of epidural 0.5% bupivacaine, time to achieve block to T6 from administration of epidural fentanyl or saline and duration of surgery, mean (SD)

	Group I (saline) (n=10)	Group II (fentanyl 100 ug) (n=11)	Group III (fentanyl 50 ug) (n=10)
Age, years	29.1 (4.6)	31.2 (5.9)	31.3 (5.7)
Weight, kg	60.3 (7.8)	66.0 (8.8)	62.6 (7.2)
Volume of bupivacaine administered, ml	18.3 (0.9)	18.3 (0.9)	18.8 (1.7)
Time to achieve block to T6, minutes	18.5 (9.7)	15.0 (11.7)	17.5 (11.6)
Duration of surgery, minutes	47.8 (12.5)	52.3 (16.1)	46.4 (14.9)

Table II
Number of patients requiring supplementary analgesia for Caesarean section

	Group I (n=10)	Group II (n=11)	Group III (n=10)	
Supplementation				
(a) Entonox	4	1	2	
(b) I.V. opioid	3	0	2	
(c) General anaesthesia	1	0	0	
Required no supplemental analgesia	6	10	8	p=0.232

Table III
Number of patients with complications during operation

	Group I (n=10)	Group II (n=11)	Group III (n=10)	
One or more episodes of hypotension	2	3	4	ns
Nausea	1	5	2	ns
Vomiting	0	3	2	ns
Respiratory depression	0	1	0	ns

ns=not significant

Table IV
Maternal #complications during operation that required medication to treat

	Group I (n=10)	Group II (n=11)	Group III (n=10)
Complications during operation requiring medication to treat	3	8*	2

**p=0.033 (Fisher's exact test) compared with Groups I and II. Significantly higher rate of complications during operation in Group II requiring medication to treat compared with Group I and Group III.*

#Complications – Hypotension treated with ephedrine
Nausea/vomiting treated with metoclopromide
Respiratory depression treated with naloxone

showed 100% saturation. Just before the start of surgery the patient said that she felt drowsy and complained of persistent nausea; she was given metoclopramide 10 mg i.v. A healthy child was delivered with an Apgar score of 9 at 1 min; syntocinon 10 iu was given i.v. The anaesthesia and the surgery continued smoothly until 80 min after the initial injection of bupivacaine and fentanyl. The patient became increasingly drowsy and her ventilatory frequency decreased from 12 to 3 b.p.m. and oxygen saturation (SpO2) had decreased from 96% to 86% (breathing air). Her heart rate remained unchanged. Administration of oxygen 3 litre per min was recommenced via an intranasal cannula and on command she took deep breaths and SpO2 improved. The patient's ventilatory frequency repeatedly decreased to 2-3 b.p.m with decreases in saturation to between 86% and 90% and on each occasion she was instructed to take deep breaths. After 10 min, when it had become obvious that the increasing drowsiness with ventilatory frequency of 2-3 b.p.m. was persistent, naloxone 0.2 mg i.v. was administered. Approximately 30 s later, the patient became alert and the ventilatory frequency increased to 16 b.p.m. and she was able to maintain SpO2 greater than 96%. Five minutes later, she was again drowsy but responded to verbal encouragement to awaken and breathe deeply and was able to maintain her oxygen saturation greater than 96%. Over the next 20 min the patient's condition improved without further administration of naloxone.

After the operation the patient was observed and oxygen saturation was monitored continuously in the recovery room and there was no further episode of desaturation.

There were eight complications in group II (Table IV) during the procedure requiring medication to treat compared with only three in group I and two in group II. These differences did reach statistical significance (Chi-square=6.844 with 2 degrees of freedom; P=0.033).

All Apgar scores were 10 by 5 minutes after birth and no drugs were required in neonatal resuscitation (Table V).

Discussion

Unsupplemented extradural bupivacaine for Caesarean section is associated with an incidence of visceral pain approaching 50% and so there is scope for improvement in maternal comfort[13]. The addition of fentanyl has been shown to improve its efficacy[8,9]. However, in this study of 31 patients, the results show no major clinical difference in analgesia between the three techniques [Table I]. It could be argued that the pain assessment system was not sensitive enough to discern differences between the three groups. However, significant differences have been demonstrated in previous studies using this assessment system[8,9]. The other factor may be due to a different population group that was studied.

In this study there was a higher incidence of maternal complications in the 100μg fentanyl group which required medication to treat. This was found to be statistically significant (See Table IV). The most worrying adverse effect seen in this study was respiratory depression which occurred in one patient. Although many previously published studies have not documented clinically severe respiratory depression, these studies have been small and the absence of side effects gave only limited reassurance[14]. However in a study by Brockway *et al*[15] profound respiratory depression was documented in two patients. This effect was attributed to the relatively rapid injection of solution that may have produced a "longitudinal sleeve" of dilute fentanyl within the extradural space, which may have enhanced rostral spread of fentanyl.

In this study, it was considered that the respiratory depression in this patient was probably caused by the larger dose of fentanyl being administered, enhancing rostral spread via a direct perimedullary vascular channel[16].

There was no differences in the neonatal outcome between the three groups. Most published studies suggest that epidural administration of opioid is safe for infants[2,3,17], although they have been observed with high doses of extradural sufentanil (80 μg)[18]. Just as there is a small but tangible risk of severe maternal respiratory depression after epidural administration of opioid[12,15], is it possible that epidural opioid administration causes infrequent but significant

Table V
Number of neonates with Apgar scores, 7, 8, 9, and 10 and at 1 and 5 minutes after birth

	Group I (n=10)		Group II (n=11)		Group III (n=10)	
	1 min	5 min	1 min	5 min	1 min	5 min
Apgar Score 10		10		11		10
9	10		11		10	
8						
7						
< 7						

neonatal depression?. Clearly, as yet there is no study sufficiently large to answer this question.

In conclusion, this study failed to show any difference between groups with respect to improvement of intraoperative comfort, although 100 μg fentanyl tended to require fewer supplementation as compared with the other two groups and 50 μg fentanyl was intermediate to saline and 100 μg fentanyl.

However, this study has demonstrated that 100 μg fentanyl was associated with a significant greater incidence of complications that required medication to treat. It therefore highlights the need to limit extradural administration of fentanyl to small doses. One case of maternal respiratory depression suggests the need for continuous monitoring of patients for an adequate period after extradural fentanyl.

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