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Patient-controlled Epidural Analgesia after Thoracic and Upper Abdominal Surgery using Sufentanil with and without Bupivacaine 0.125%

R Poopalalingam, M Y H Chow, L T Wong

ABSTRACT

Background: Epidural sufentanil can relieve postoperative pain after thoracic and upper abdominal surgery but it has some unwanted side effects. Patient-controlled epidural analgesia (PCEA) allows patients to titrate and reduce their analgesic requirements.

Objective: The study aims to assess the use of demand-only PCEA after thoracotomy and upper abdominal surgery using sufentanil with or without bupivacaine in terms of pain control, amount of analgesic required and side effect profile.

Methods: After the Hospital Ethics Committee approval and written informed consent, 34 ASA I and II patients were enrolled in this prospective, randomised, double-blinded controlled study. Post-operatively, after achieving adequate analgesia in the recovery, the patients were randomised to receive either sufentanil 1 μg/ml in normal saline (Group S) or sufentanil 1 μg/ml with bupivacaine 0.125% (Group SB) in a demand-only PCEA programme. Pain scores, side effects and amount of analgesia used were reviewed every hour.

Results: The demographic profile of both groups was similar. The amount of sufentanil used was higher in Group S than in Group SB but it was not statistically significant. The numbers of patients with high pain scores at rest and during movement were not significantly different between the two groups. The side effect profiles of both groups were similar.

Conclusions: The PCEA demand-only programme using sufentanil 1 μg/ml with and without bupivacaine 0.125% was satisfactory after thoracotomy and upper abdominal surgery in our patient population. The addition of bupivacaine to sufentanil did not significantly reduce the amount of sufentanil required, the pain scores or the side effects.

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INTRODUCTION

Patients are known to experience greater post-operative pain after thoracic and upper abdominal surgeries than any other surgery[1]. Opioids such as sufentanil, have been shown to produce excellent analgesia from its spinal effect when administered in the epidural space[2]. However, it is associated with certain unwanted side effects such as respiratory depression, sedation and pruritis[3]. The incidences of these side effects are dose related[4]. Patient-controlled epidural analgesia (PCEA) in a demand-only programme allows patients to better titrate their analgesic requirements and reduce the amount of analgesia required. The objective of the study was to assess the use of demand-only PCEA after thoracotomy and upper abdominal surgery using sufentanil with and without bupivacaine 0.125%.

METHODS

This was a prospective, randomised, double-blinded, controlled study. After obtaining approval from the Hospital Ethics Committee, 34 ASA I and II patients with written informed consent between ages 18 and 80 years and weighing between 40 and 100 kg undergoing upper abdominal surgery or lateral thoracotomy were included in the study. Patients with contraindication to regional anaesthesia e.g. coagulation disorder, sepsis or infection at the puncture site of epidural were excluded from the study. Those patients who did not understand the use of the PCEA device were also excluded.

Baseline heart rate and non-invasive blood pressure were taken. The patients did not receive any premedication. An epidural catheter was introduced in the patient while awake in the lateral position via a paramedian approach using an 18-G Touhy needle at the levels of T4-T6 for thoracic surgery and T7-T9 for upper abdominal surgery. “Loss of resistance to air”

technique was used to identify the epidural space and a 20-G epidural catheter was then inserted cephalad 3-5 cm into the epidural space. After negative aspiration for blood and cerebrospinal fluid, 3 ml lignocaine 1.5% with adrenaline 1:200 000 was administered through the epidural catheter. After ascertaining appropriate placement of the epidural catheter, 5-10 ml of 0.25% bupivacaine was titrated into the epidural catheter to achieve adequate sensory level for surgery as determined by bilateral sensory level to pinprick. General anaesthesia was induced with intravenous propofol and maintained with inhaled isoflurane, nitrous oxide and oxygen mixtures. A non-depolarising neuromuscular blocker was used to facilitate tracheal intubation and surgery. No opioids or antiemetics were used during the operation. Intraoperatively, bupivacaine 0.25% was given in 3-5 ml increments via the epidural catheter as needed while maintaining stable haemodynamics. At the end of the operation, after extubation, all the patients were transferred to the Post Anaesthetic Care Unit. The efficacy of pain relief was evaluated by a verbal descriptor scale (VDS; 0 = no pain; 1 = mild pain; 2 = moderate pain; 3 = severe pain). Additional bupivacaine 0.25% in 3-5 ml increments up to 10 ml was given as required postoperatively via the epidural catheter to achieve VDS score of 0 or 1 at rest. The patients were then started on a patient-controlled epidural analgesia programme delivered by Graseby 9300 PCA Pump. They were randomised into two groups to receive PCEA solutions of:

Group S: sufentanil 1 μg/ml in normal saline

Group SB: sufentanil 1 μg/ml in bupivacaine 0.125%

The PCEA was programmed to a demand-only mode with no background infusion with a bolus of 0.05 ml/kg, a lockout time of 10 min and a maximum of 0.2 ml/kg/hr.

In the High Dependency Wards, the patients were reviewed every hour till the removal of the epidural catheter with regards to:

1. Non-invasive blood pressure, heart rate and oxygen saturation via pulse oximetry. Hypotension (20% fall in mean blood pressure or systolic blood pressure fall below 90 mmHg) was treated with intravenous fluid loading and/or ephedrine.
2. Pain scores at rest and during movement (coughing or deep inspiration). Rescue medication consisting of bupivacaine 0.25% 3-5 ml aliquots up to a maximum of 10ml were available to the patient when the pain was deemed intolerable (VDS 2 at rest or 3 on coughing or deep breathing).
3. Sedation was assessed and documented as either awake and alert; mildly sedated and occasionally drowsy; moderately sedated and frequently drowsy; severely drowsy and not arousable.
4. Side effects such as pruritis, nausea and vomiting were graded as none, mild (not requiring medication), moderate (obtaining relief from antihistamines or antiemetics) or severe (unrelieved by antihistamines or antiemetics).
5. Motor weakness of the legs was assessed using Bromage score (0-3).
6. The cumulative amount of PCEA solution consumption by the patient.

The assessments were made by the High Dependency Nurses who were blinded to the study. Arterial blood gas estimations were taken pre-operatively and on the first postoperative day.

The unpaired student's t test was used to compare means and the chi-square test was used to analyse non-parametric data. $P<0.05$ was taken to be statistically significant. The sample size was calculated to detect a 25% decrease in the amount of sufentanil consumed as compared to the control group. ($\alpha=0.05$, $\beta=0.8$).

Table I. Demographic data.

	Group SB (n=16)	Group S (n=17)
Age (years)	61.6 ± 8.9	54.2 ± 19.0
Height (cm)	160.6 ± 7.0	161.1 ± 7.7
Weight (kg)	57.6 ± 10.3	54.8 ± 9.4
Sex: Male/Female	10/6	9/8
Duration of surgery (min)	153.8 ± 97.8	156.2 ± 101.5
Intraoperative bupivacaine dose (mg)	46.0 ± 21.7	48.8 ± 32.0

SB = Sufentanil 1 μg/ml + Bupivacaine 0.125%, S = Sufentanil 1 μg/ml

Data are presented as mean ± SD except sex, which is expressed as absolute numbers.

Table II. Type of surgery and epidural level.

	Group SB (n=16)	Group S (n=17)
Type of surgery		
Gastrectomy	3	2
Hepatectomy	1	1
Whipple's	0	2
Lobectomy	6	9
Pneumonectomy	3	2
Thoracotomy	3	1
Epidural level		
T4/5-T6/7	12	11
T7/8-T9/10	4	6

SB = Sufentanil 1 μg/ml + Bupivacaine 0.125%, S = Sufentanil 1 μg/ml

Data presented as absolute numbers of patients.

Table III. Side effects.

	Group SB (n=16)	Group S (n=17)
Nausea and vomiting	6 (37.5)	7 (41.2)
Pruritis	2 (12.5)	2 (11.8)
Sedation	0 (0.0)	0 (0.0)
Hypotension	0 (0.0)	0 (0.0)
Motor blockade	0 (0.0)	0 (0.0
Rescue analgesia	0 (0.0)	0 (0.0)

SB = Sufentanil 1 μg/ml + Bupivacaine 0.125%, S = Sufentanil 1 μg/ml

Side effects are in numbers of patients (percentage).

Fig. 1 Verbal descriptive scores for pain at rest during the study period. Mean scores are displayed.

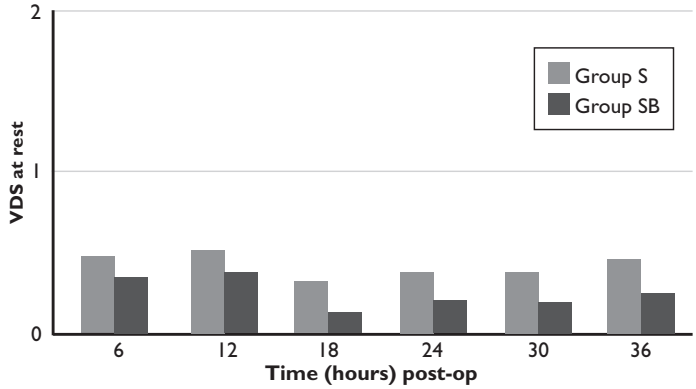
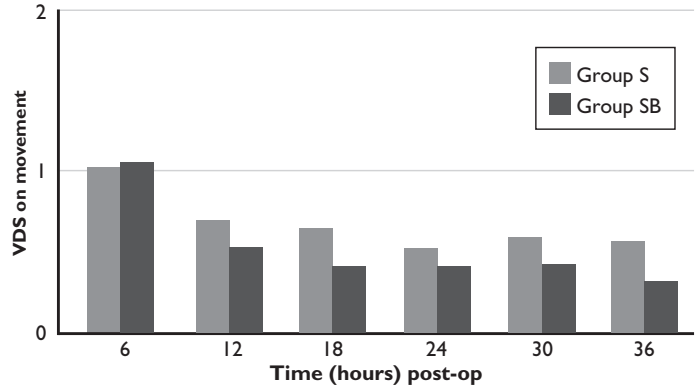


Fig. 2 Verbal descriptive scores for pain during movement throughout the study period. Mean scores are displayed.



RESULTS

Thirty-three ASA I and II patients completed the study. One patient was excluded as he had excessive blood loss from a gastrectomy and required mechanical ventilation postoperatively. The demographic data such as age, height, weight, sex, duration of surgery and the amount of epidural bupivacaine used intraoperatively in the both groups were comparable (Table I). The distribution of surgical procedures and location of epidural catheter were similar in the two groups (Table II).

Fig. 1 shows the mean pain scores (VDS scores) at rest throughout the period of the study while Fig. 2 demonstrates the mean pain scores on movement during the period of the study. Both the pain scores at rest as well as during movement were not significantly different between the two groups. There were no patients who required physician administered rescue boluses. The amount of sufentanil used throughout the study period was higher in Group S than in Group SB but this did not reach statistical significance (Fig. 3).

The side effect profiles of the patients were similar for both groups (Table III). No patient required antiemetics to relieve nausea and vomiting. Two patients in each group required antihistamine for the pruritis. One patient from Group S had severe pruritis that was relieved only after the epidural sufentanil was stopped. This patient used 210 μg of sufentanil over 48 hours, which was well above the mean used by the study population of 50 μg sufentanil in 24 hours. No patient was hypotensive, moderately or severely sedated during the study period and all the patients had a Bromage score of 0 at all times.

DISCUSSION

Sufentanil has a rapid onset and potent analgesic effect when given epidurally[5]. However, it is associated with some unwanted side effects namely nausea, vomiting, pruritis, sedation and respiratory depression. Using a combination of local anaesthetic and opioid for epidural analgesia appears to have additive or synergistic effect[6-8] and may reduce the requirement of the epidural opioid and its associated side effects. However, the benefit of adding bupivacaine to an opioid for post-operative epidural analgesia has been much debated[9]. Some studies have shown a reduction in opioid consumption and some have elicited better pain scores when adding bupivacaine to an opioid[3,8,10,11], while others have shown no advantage of combining the two drugs[12,13]. We decided to use bupivacaine 0.125% in our study because lower concentrations of bupivacaine do not appear to improve the analgesic effect of the epidural opioids[14,15] while higher concentrations may increase motor blockade[11].

Patient-controlled epidural analgesia (PCEA) allows patients to self-titrate their analgesic requirements and thereby reduce the amount of analgesia required[16]. Using a demand-only mode has been shown to further reduce this amount and may minimise the incidence of side effects[17,18].

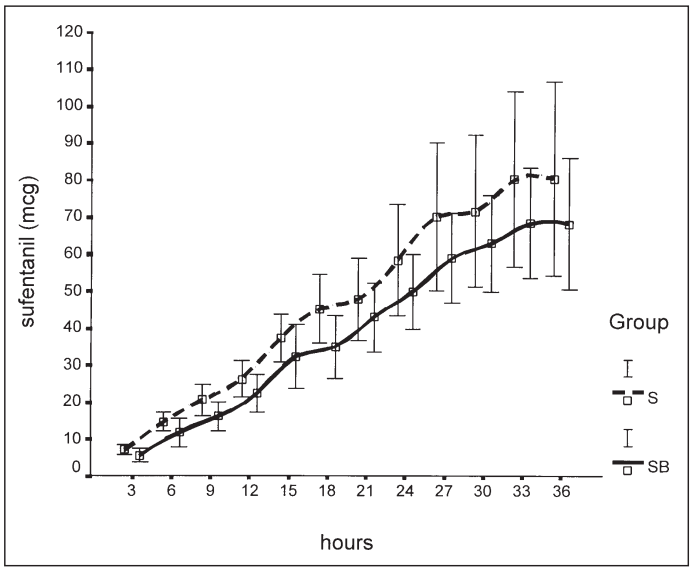
We hoped that the PCEA demand-only programme would eliminate the confounding effect of the

mandatory basal infusion and better elicit the opioid sparing effect of bupivacaine 0.125%[19]. However, although we found that the amount of sufentanil used was lower when combined with bupivacaine 0.125% the difference did not reach statistical significance. This could also have explained the comparable incidence of side effects in both groups, which is dose related, since the amount of sufentanil used was not significantly different. The reduction in sufentanil requirement when bupivacaine was added did not decrease the incidence of pruritis in our study. Furthermore, the combination of sufentanil and bupivacaine did not reduce the mean pain scores at rest and during movement in our study.

Indeed, we found the average amount of sufentanil used by our study patients smaller (50 µg in 24 hours) compared to other similar studies by Geller et al[20] (149 µg) and Hansdottir et al[3] (120 µg). This could be due to the demand only PCEA programme, which minimised the amount of sufentanil consumed. Furthermore, our ethnic Asian patients generally have a lower tolerance to opioids. The Asians may require less analgesia because they are more likely to experience the adverse effects of opioids. Some Asians are likely to demand for less analgesia due to a stoical attitude towards coping with pain[21]. Similarly, the mean cumulative amount of bupivacaine 0.125% used in the study group was 80 ml in 36 hours or less than 3 ml bupivacaine 0.125% per hour. Therefore, the addition of bupivacaine did not increase the incidence of hypotension in our patients.

The demand-only PCEA mode has not been commonly used for post thoracotomy and upper abdominal surgeries. In our study, we found that the PCEA demand-only programme using sufentanil with and without bupivacaine 0.125% was satisfactory after thoracotomy and upper abdominal surgery. The percentage of patients who experienced moderate and severe pain on movement in our study decreased gradually from 33.3% in the first six hours to 21.2% in the next 6 hours and below 9.1% after 24 hours. For epidural analgesia as postoperative analgesia, review articles have quoted the average incidence of moderate-severe pain as 20.9% and severe pain as 7.8% and these scores are taken at rest[22]. The addition of bupivacaine 0.125% to sufentanil 1 µg/ml did not significantly reduce the amount of sufentanil required, the pain scores or the side effects associated with it. We felt that the comparable incidence of side effects was possibly due to the usage of demand-only PCEA programme in our study, which would already have minimised the amount of sufentanil and bupivacaine consumed. However, further studies may be necessary to look into the other potential benefits of adding local anaesthetics such as improved gastrointestinal function, increasing microcirculation and thromboembolic prophylaxis.

Fig. 3 Amount of sufentanil used from patient-controlled epidural analgesia (PCEA) throughout the period of the study. Data presented as mean with SD.



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