Epidural Analgesia for Pain Relief in Thoracic Surgery

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Abstract

The effectiveness and adverse effects of continuous epidural analgesia was studied in 104 patients undergoing thoracic operations at Siriraj Hospital. Patients were divided into 3 groups according to the type of surgical approach and the technique of epidural analgesia. Group 1 patients (n = 72) received thoracic epidural block using bupivacaine and morphine combined with light general anesthesia for exploratory thoracotomy; group 2 patients (n = 21) received the identical anesthetic technique, the operation was achieved through median sternotomy; group 3 patients (n = 11) had a similar type of operation to group 1, the anesthetic technique was lumbar epidural block using morphine and combined with light general anesthesia. Continuous epidural morphine infusion was given 0.1-0.4 mg/h during postoperation in all patients for providing adequate pain relief.

The results revealed that a 10 cm visual analogue scale (VAS) pain scores were satisfactory and comparable in all groups. Lumbar epidural patients consumed a significantly larger dose of morphine than thoracic epidural groups ($P < 0.01$). Intraoperative hypotension occurred 43.05 per cent and 19.05 per cent in group 1 and 2, but none was found in group 3 ($P < 0.05$). Postoperative respiratory depression was found 54.16 per cent in group 1, 33.33 per cent in group 2 and 9.09 per cent in group 3 ($P < 0.05$), and was mostly mild to moderate, except three patients in group 1 and one in group 2 who needed mechanical ventilatory support. There were no differences among the groups in the incidence of nausea/vomiting and pruritus. It is concluded that both thoracic and lumbar epidural morphine provide excellent postthoracotomy pain relief, whereas, respiratory depression is more common with thoracic than lumbar epidural morphine.

Key word : Analgesia: Postoperative, Analgesic Technique: Epidural Morphine, Surgery : Thoracic

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Surgery involving the intrathoracic structures may be successfully approached from thoracotomy or median sternotomy. General anesthesia with tracheal intubation is commonly used mainly for providing adequate oxygenation as well as controlled ventilation during surgery. These patients always experience the most intense pain after recovery from anesthesia unless potent analgesic drugs are administered adequately. Different methods of post-thoracotomy pain relief have been described[1-4]; among these techniques, combined light general anesthesia with epidural analgesia provides the most effective pain relief but is often accompanied by a high incidence of side effects[5,6]. Hypotension and motor block are limitations of epidural local anesthesia, while epidural narcotic appears to produce the risk of respiratory depression. Continuous infusion of thoracic epidural morphine was associated with fewer adverse effects than intermittent bolus administration by the same route. In addition, other investigators reported that lumbar epidural morphine reduced the pain score and improved pulmonary function after thoracotomy[7]. The objective of this study was to compare the effectiveness and the adverse effects of continuous epidural analgesia between different approaches of thoracic operations, and different approaches of epidural analgesia.

MATERIAL AND METHOD

Following the approval of the Institution of Human Investigation Committee and informed consent, 104 consecutive patients with ASA physical status I-III undergoing elective thoracic procedures were enrolled in this study. Patients were assigned to three groups according to the anesthetic regimen *versus* surgical approach. Group I received continuous thoracic epidural block combined with light general anesthesia for exploratory thoracotomy. Group 2 received identical anesthetic technique but surgery was performed through the median sternotomy approach. Group 3 consisted of patients in whom thoracic epidural blocks were attempted but were unsuccessful, continuous lumbar epidural blocks were given in combination with light general anesthesia for exploratory thoracotomy.

All patients received 7.5 mg orally administered midazolam approximately 2 hours before anesthetic induction. Intraoperative monitoring consisted of continuous electrocardiogram, pulse oximetry, capnograph, urine output, direct arterial pressure as well as blood gas measurements.

Epidural anesthesia

Before induction of anesthesia, an 18 gauge epidural catheter was introduced through a 17 gauge needle at a level between sixth and seventh thoracic spinal process in group 1 and 2, or fourth and fifth lumbar spinal process in group 3. Patients in the thoracic epidural groups received a bolus dose of 0.25 per cent bupivacaine 10 ml with morphine 4-5 mg *via* epidural catheter. During operation, local anesthetic was added 4-6 ml/h intermittently. Patients in group 3 received a bolus dose of morphine 4-5 mg in 10 ml normal saline given epidurally before anesthetic induction.

General anesthesia

After preoxygenation with 100 per cent oxygen, general anesthesia was induced with intravenous fentanyl (1-2 μg/kg) and thiopental (4-5 mg/kg). Pancuronium (0.15 mg/kg) was used for facilitating tracheal intubation with an appropriate size of double lumen endobronchial tube in thoracotomy, whereas, endotracheal tube was used in median sternotomy operations. Following intubation, anesthesia was maintained with nitrous oxide and 0.5-1 per cent of isoflurane in oxygen. Inspired oxygen concentration was increased to 100 per cent during one lung ventilation. End-tidal carbon dioxide tension was monitored continuously and arterial blood gas tension was measured at least every 30 min to maintain normoventilation. Pulmonary operations were performed through a standard posterolateral thoracotomy at the fifth intercostal space. At termination of the operative procedure, patients were extubated when neuromuscular blockade had been successfully reversed by using atropine and prostigmine.

Postoperative pain management

After arrival in the cardiothoracic intensive care unit, epidural morphine infusion of 0.01 per cent solution was begun at a rate of 1 ml/h for patients >60 yr of age, and 2 ml/h for the younger patients. If any patient complained of postoperative pain, the rate of epidural infusion was increased in 1 ml/h increments to a maximal rate of 4 ml/h. Contrarily, the rate of infusion was reduced 1 ml/h whenever the carbon dioxide tension ($PaCO_2$) had increased >50 mmHg, and infusion was stopped if

the respiratory rate was <10 beats/min or $PaCO_2$ >55 mmHg.

The intensity of postoperative pain was assessed on the following day after surgery using a 10 cm visual analogue scale (VAS; 0, no pain; 10 worst possible pain). The assessment also included the total consumption of morphine and possible complications consisting of hemodynamic and respiratory depression, nausea, vomiting and pruritus.

Statistical analysis

One way analysis of variance, F test and least significant difference (LSD) were used to determine the comparability of three groups with regard to age, VAS score and morphine consumption. All parameters were expressed in mean ± SD. The presence or absence of cardiovascular or respiratory depression, nausea, vomiting and pruritus were compared using the chi-square test. $P<0.05$ was considered statistically significant.

RESULTS

Data characteristics demonstrated that the age of patients in group 1 was significantly higher than the other groups, and 29 patients in all groups were >60 yr of age. The postoperative pain relief, reported as pain score, appeared to be optimum and similar in all three groups (Table 1). However, group 3 (lumbar epidural) consumed a statistically larger dose of morphine than group 1 and 2 (thoracic epidural) ($P<0.01$).

Intraoperative hypotension, defined as decreasing systolic blood pressure lower than 30 per cent of preoperative value, occurred in 31 of 72 patients (43.05%) in group 1, four of 21 patients (19.05%) in group 2, but none was found in group 3 ($P<0.05$).

During 24 h postoperation, 39 patients (54.16%) in group 1, seven (33.33%) in group 2 and one (9.09%) in group 3 had respiratory depression ($P<0.05$), which was mostly mild to moderate degree ($PaCO_2$ <50 mmHg), except four patients, three in group 1 and one in group 2, who required a few hours of respiratory support. There were no significant differences between the groups in other adverse effects (Table 2-3).

DISCUSSION

In this study, our results have demonstrated the comparable analgesia not only between thoracic and lumbar epidural block in postthoracotomy patients, but also in the different surgical approach between lateral thoracotomy and median sternotomy incision. All patients received morphine epidurally before surgical stimulation to provide preemptive analgesia, that would result in lower postoperative pain intensity then reduce postoperative analgesic requirements. Fromme et al[8] found no difference in the dosage, duration and quality of analgesia whether epidural morphine was given by thoracic or lumbar routes. However, a combination of thoracic epidural morphine and bupivacaine tended to produce more complete pain relief compared to epidural morphine when administered alone[5,6]. We observed in our patients, the total amount of morphine consumption which produced equivalent postoperative analgesia was significantly larger in the lumbar epidural morphine group than the administration of thoracic epidural combination of morphine and bupivacaine. It could be argued that the ages of patients in group 1 were significantly older than patients in group 2 and 3 (Table 1). Several studies have suggested that elderly patients may need a remarkably small dose

Table 1. Age distribution, visual analogue scale (VAS) pain scores and dosage of morphine consumption of the patients in three groups.

	Group 1 n = 72	Group 2 n = 21	Group 3 n = 11
Age (yr)	50.9 ± 16.9*	33.1 ± 10.5	38.4 ± 20.6
Pain scores (10 cm)	2.3 ± 2.6	3.0 ± 3.0	2.6 ± 1.3
Morphine (mg/24 h)	7.0 ± 1.9	6.4 ± 1.4	9.1 ± 3.0**

Values are mean ± SD

* Significant difference between group 1-2 and group 1-3 at $P<0.05$.

** Significant difference between group 1-3 and group 2-3 at $P<0.01$.

Table 2. Intraoperative and postoperative complications.

Complications %	Group 1 n = 72	Group 2 n = 21	Group 3 n = 11
Intraoperative hypotension	43.05* (31/72)	19.05 (4/21)	-
Postoperative			
Respiratory depression	54.16** (39/72)	33.33 (7/21)	9.09 (1/11)
Nausea / vomiting	26.38 (19/72)	19.04 (4/21)	27.27 (3/11)
Pruritus	19.44 (14/72)	19.04 (4/21)	-

* Significant difference between group 1-2 and group 1-3 at $P<0.05$.
** Significant difference between group 1-3 at $P<0.05$.

Table 3. Severity of postoperative respiratory depression.

Severity %	Group 1 n = 39/72	Group 2 n = 7/21	Group 3 n = 1/11
Mild	43.6 (17/39)	42.8 (3/7)	-
Moderate	38.5 (15/39)	28.6 (2/7)	100 (1/1)
Severe	17.9 (7/39)	28.6 (2/7)	-

Mild, $PaCO_2$ 45 - <50 mmHg
Moderate, $PaCO_2$ 50 - <55 mmHg
Severe, $PaCO_2$ >55 mmHg, need mechanical ventilatory support

of epidural morphine[9,10]. Therefore, the small amount of morphine consumption in group 1 patients could possibly be affected by advancing age.

In spite of providing excellent analgesia, the epidural combination of morphine and bupivacaine appears to be associated with an increased likelihood of complications, especially hypotension [1,5]. In the present study, fall of blood pressure was found in group 1 patients more often than group 2 although the anesthetic technique in both groups was similar. This may be explained by increasing the extent of sympathetic block caused by arteriosclerotic changes in the anatomy of the epidural s pace in elderly patients[11-13]. However, the change in positioning of the patients could be another reason responsible for this hemodynamic alteration. Eggers et al[14] demonstrated marked reductions in arterial pressure with lateral position during anesthesia compared with supine position. Positional reductions in blood pressure were related to reductions in systemic vascular resistance rather than to decreased venous return. Thoracic epidural block with local anesthetic could further decrease blood pressure beyond the safety range which usually required aggressive treatment.

Postoperative respiratory depression was found to be a major problem in the patients who received thoracic epidural morphine. Actually, most of these patients had mild to moderate symptoms and recovery without a need for respiratory support. Despite morphine consumption being highest in the lumbar epidural group, the respiratory side effect was rarely observed in these patients. Furthermore, the simplicity of lumbar epidural technique tended to provide more successful block than thoracic epidural route. According to our results, it would appear that the lumbar epidural morphine is suitable for postthoracotomy pain relief. However, other complications associated with epidural morphine such as nausea, vomiting and pruritus were comparable in all groups, which were satisfactorily relieved by routine conventional treatment. However, urinary retention could not be assessed since patients routinely had Foley catheters inserted at the time of surgery.

In summary, our results indicate that both thoracic and lumbar epidural morphine can provide excellent postthoracotomy pain relief. However, the respiratory depression is more common with thoracic than lumbar epidural morphine.

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การฉีดมอร์ฟีนเข้าช่องอีพิดูราลเพื่อระงับปวดสำหรับการผ่าตัดทรวงอก

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ได้ทำการศึกษาวิธีดมยาสลบร่วมกับระงับปวดโดยใช้ continuous epidural block สำหรับการผ่าตัดทรวงอกในผู้ป่วยจำนวน 104 ราย โดยแบ่งเป็น 3 กลุ่ม ผู้ป่วยกลุ่ม 1 จำนวน 72 รายจะได้รับการผ่าตัด explore thoracotomy ด้วยวิธีดมยาสลบ ร่วมกับ continuous thoracic epidural block โดยบริหารยาชา bupivacaine ร่วมกับ morphine ผู้ป่วยกลุ่ม 2 จำนวน 21 รายได้รับการผ่าตัด median sternotomy ภายใต้การระงับความรู้สึกเหมือนกลุ่มแรก ผู้ป่วยกลุ่ม 3 จำนวน 11 รายนั้นได้รับการผ่าตัดเหมือนกลุ่มแรกแต่การดมยาสลบจะบริหารร่วมกับ lumbar epidural block โดยใช้ morphine ระยะหลังผ่าตัดผู้ป่วยทั้งสามกลุ่มจะได้รับการระงับปวดด้วย morphine infusion ทาง epidural catheter

ผลการศึกษาปรากฏว่าการระงับปวดระยะหลังผ่าตัดใน 24 ชั่วโมงแรกนั้นเป็นที่น่าพอใจทั้งสามกลุ่ม โดยต้องการยา morphine 7.0 $\pm$ 1.9 มก., 6.4 $\pm$ 1.4 มก. และ 9.1 $\pm$ 3 มก. ในผู้ป่วยกลุ่ม 1, 2 และ 3 ตามลำดับ ($P < 0.01$) พบภาวะความดันเลือดลดต่ำระหว่างการผ่าตัดได้ร้อยละ 43.05 ในกลุ่ม 1 ร้อยละ 19.05 ในกลุ่ม 2 และไม่พบปัญหานี้ในกลุ่ม 3 ($P < 0.05$) ภาวะแทรกซ้อนภายหลังการผ่าตัดที่พบบ่อยที่สุดคือ hypoventilation โดยปรากฏร้อยละ 54.16, 33.33 และ 9.09 ในผู้ป่วยกลุ่ม 1, 2 และ 3 ตามลำดับ ($P < 0.05$) สำหรับภาวะแทรกซ้อนอื่น ๆ ที่พบรองลงมานั้น ได้แก่ คลื่นไส้/อาเจียน และคัน ซึ่งไม่แตกต่างกันระหว่างกลุ่มคณะผู้วิจัยสรุปว่าการบริหาร morphine ทาง thoracic และ lumbar epidural นั้นมีประสิทธิภาพในการระงับปวดภายหลังผ่าตัดทรวงอกได้ดีมาก แต่ต้องระวังฤทธิ์กดการหายใจซึ่งพบบ่อยในผู้ป่วยที่ได้รับ thoracic epidural morphine

คำสำคัญ : ระงับปวดภายหลังการผ่าตัด, ฉีดยามอร์ฟีนทางช่องอีพิดูราล, การผ่าตัดทรวงอก

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