Original Article

The Efficacy of Epidural Analgesia after Video-Assisted Thoracoscopic Surgery: A Randomized Control Study

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Purpose: Video-assisted thoracoscopic surgery (VATS) is known to reduce the severity of pain after surgery. However, it has not yet been established whether epidural anesthesia/analgesia (EA) is necessary after VATS. We therefore conducted a randomized control study to examine whether or not EA is necessary for pain control after VATS.

Patients and Methods: Forty-six patients undergoing VATS were randomly allocated to one of 2 groups: 24 who were given EA after the procedure (EA group) and 22 who were not (NEA group). Patients in the EA group received a continuous infusion of fentanyl and bupivacaine via an epidural catheter for 2 days after VATS. The degree of postoperative pain was assessed on the total dose of additional analgesics administered, a visual analog scale (VAS), a verbal pain score at rest (VPS-R) and on movement (VPS-M), from the day of surgery to the 2nd postoperative day (2 POD).

Results: Additional use of rectal diclofenac sodium and intramuscular pentazocine was more frequent in the NEA group than in the EA group ($p<0.05$). The VAS, VPS-R, and VPS-M scores were significantly lower in the EA group than in the NEA group at 0 POD, from 0 to 1 POD, and from 0 to 2 POD, respectively ($p<0.0001$–0.05). Stepwise regression analysis revealed that EA was a significant independent variable of VPS-R and VPS-M from 0 to 1 POD ($p<0.05$). However, the incidence of nausea/vomiting in the EA group was 29%, which was more frequent than in the NEA group (5%) ($p<0.05$).

Conclusion: While EA causes nausea/vomiting in some patients, it is effective for pain control until 1 POD after VATS, especially for pain on movements. (Ann Thorac Cardiovasc Surg 2006; 12: 313–8)

Key words: epidural anesthesia, video-assisted thoracoscopic surgery, pain control

Introduction

The application of video-assisted surgery has not only provided the benefit of minimal invasion but has also revolutionized operative procedures and postoperative management. Video-assisted thoracoscopic surgery (VATS) requires only a small skin incision and no rib retraction. This causes minimal damage to the thoracic wall, resulting in a decrease in postoperative pain, postoperative pulmonary dysfunction, and postoperative morbidity and mortality.[1–6] The application of VATS has led to a change in postoperative management, especially in pain control.[7,8]

There is no precise data on how many patients receive epidural anesthesia/analgesia (EA) following thoracic surgery. In 2004, Wu et al. reported the effect of postop-

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erative EA following surgery in medicare patients.[9] Out of 68,723 patients analyzed, 3,796 patients underwent thoracic surgery. Fifty percent of these patients had postoperative epidural usage following thoracic surgery (1,899 patients). EA has emerged as the preferred pain control. While EA has been used after thoracic surgery, it is debatable whether VATS patients would require EA because of the lower severity of postoperative pain in comparison with open thoracotomy.[1,4,6] However, it has not been clarified whether EA is necessary after VATS. To address this issue, we examined the pain score and side effects of EA in post-VATS patients using a randomized control study.

Patients and Methods

Patient entry and randomization

This study was approved by the ethics committee of Kumamoto University Hospital in August 1999. Patients who were scheduled to undergo lobectomy or partial lung resection by VATS at Kumamoto University Hospital from September 1999 to September 2001 were enrolled. Exclusion criteria included emergency cases, American Society of Anesthesiology (ASA) risk grade over III, and contraindication for EA.

At the time of entry, the patients received an explanation about the study by both an anesthesiologist and a surgeon before the operation, and a written informed consent was obtained from them. Patients who agreed to participate were randomly allocated using envelopes to one of 2 groups: an EA group and an NEA group.

Anesthesia and postoperative pain control

All patients received premedication with an intramuscular injection of atropine sulfate 0.25–0.5 mg and midazolam 0.06 mg/kg. In the operating room, epidural catheters of patients in the EA group were placed in Th5/6 or Th6/7 level before induction of general anesthesia. General anesthesia was induced with intravenous thiamylal sodium (4–6 mg/kg) and vecuronium bromide (0.1 mg/kg). Anesthesia was maintained with isoflurane, air and oxygen. Vecuronium bromide was occasionally given for muscle relaxation as required. Neither narcotics nor epidural anesthesia were used during surgery.

Immediately after surgery, patients in the EA group were given a single injection of 5 ml of 0.25% bupivacaine hydrochloride via the epidural catheter, followed by continuous infusion of 80 ml of 0.25% bupivacaine hydrochloride (90 ml in patients over 70 years old) and 1 mg of fentanyl citrate (0.5 mg in patients over 70 years old) using a balloon infuser at a rate of 2.0 ml/h. If adequate postoperative pain relief could not be achieved, additional analgesics were administered in both groups. The total dose of each additional analgesic was compared between the 2 groups.

Assessment of postoperative pain

Each patient was interviewed by anesthesiologists, who were not included by the authors in this study, every night from the day of surgery (0 POD) to the 2nd postoperative day (2 POD). The patients were asked to indicate their degree of postoperative pain on a visual analog scale (VAS) ranging from 0 mm (no pain) to 100 mm (extreme pain) on a 100-mm line drawing.[10] The verbal pain score at rest (VPS-R) was graded from 0 to 3 (0 = no pain, 1 = slight pain, 2 = moderate pain without analgesics, 3 = pain requiring analgesics). The verbal pain score on movement (VPS-M) was graded from 0 to 2 (0 = no pain on movement, 1 = pain on coughing and moving but controlled, 2 = pain on coughing or moving and not controlled).[11] The requirement for additional analgesics was examined from 0 to 2 POD. Postoperative symptoms, complications, and side effects related to EA were examined.

Operative procedure

VATS lobectomy was undertaken via one access port (12 mm) and one lateral utility thoracotomy (6 cm) without a rib retractor. Mediastinal lymph node dissection was performed routinely with VATS lobectomy. Partial lung resection was undertaken via 3 surgical ports (12 mm) for benign pulmonary nodules or bronchiolo-alveolar cell carcinomas less than 10 mm in diameter. A 28F intercostal drain was inserted through an access port incision in each patient. These drains were removed when the underlying lung was fully expanded with no residual air leak.

Statistical analysis

The χ^2 test and Fisher's exact test were used to compare discrete variables. Stepwise forward analysis was performed, with drop in VPS-R and VPS-M as dependent variables. Factors considered among the independent variables included EA, age, sex, ASA, the duration of surgery, and the duration of chest tube drainage. Statistical significance was assumed at $p<0.05$. All analysis was performed using StatView software (version 5.0, SAS Institute Inc., Cary, NC, USA). All values in the text and tables are given as mean$\pm$SD (standard deviation).

Table 1. Patient classification

	EA group	NEA group
Number	24	22
Age (years)	64.4±12.3	62.4±9.9
BMI (kg/m^2)	22.9±3.2	22.9±2.7
Sex (M/F)	11/13	10/12
Duration of surgery (min)	170.7±94.8	172.0±96.5
Partial resection/lobectomy	10/14	10/12
ASA I/II/III	8/13/3	9/12/1
Chest tube drainage over 2 POD	13	12

BMI, body mass index; M, male; F, female; ASA, risk grade according to criteria set down by American Society of Anesthesiology; POD, postoperative day; EA, epidural anesthesia; NEA, non-EA.

Table 2. Number of patients required additional analgesia

Drug	Route of administration	Number of patients		p value
		EA group	NEA group	
Diclofenac sodium	Rectally	16	22	0.0040
Pentazocine	im	3	16	<0.0001
Loxoprofen sodium	Orally	6	9	0.3480

im, intramuscularly; EA, epidural anesthesia; NEA, non-EA.

Table 3. Total dose of diclofenac sodium and pentazocine per patient

Drug	EA group	NEA group	p value
Diclofenac sodium (mg)	44.8±44.2	109.1±93.7	0.0040
Pentazocine (mg)	1.9±5.1	20.5±18.7	<0.0001

EA, epidural anesthesia; NEA, non-EA.

Results

Forty-six patients were enrolled. There were 24 patients in the EA group and 22 patients in the NEA group (Table 1). There were no significant differences in age, body mass index (BMI), sex, duration of surgery, extent of surgery (partial resection or lobectomy) or ASA score between the 2 groups.

Most of the patients needed additional analgesics postoperatively until 2 POD. Rectal suppositories of diclofenac sodium, intramuscular injection of pentazocine, and oral loxoprofen sodium were commonly used in each group (Table 2). Rectal diclofenac sodium and intramuscular pentazocine were needed more frequently in the NEA group than in the EA group ($p<0.05$). Total doses of diclofenac sodium and pentazocine per patient were also higher in the NEA group than in the EA group ($p=0.0040$ and $p<0.0001$, respectively)(Table 3).

Pain scores assessed by VAS, VPS-R and VPS-M are shown in Figs. 1–3. The mean VAS scores in the NEA and EA groups were 35.3±28.6 and 18.7±25.5 at 0 POD, 29.6±20.5 and 21.6±19.1 at 1 POD, and 20.1±20.6 and 12.7±14.0 at 2 POD, respectively (Fig. 1). The mean VAS score in the EA group was significantly lower than that in the NEA group at 0 POD ($p=0.045$), but there was no significant difference at 1 and 2 POD. The mean VPS-R scores in the NEA and EA groups were 1.41±1.01 and 0.54±0.88 at 0 POD, 1.00±0.05 and 0.50±0.72 at 1 POD, and 0.73±0.83 and 0.38±0.58 at 2 POD, respectively (Fig. 2). The difference between the 2 groups was significant at 0 and 1 POD ($p=0.003$ and $p=0.046$, respectively). At 0 POD, VPS-R grade 0 (no pain at rest) was seen in 16 patients of the EA group (67%) and 4 of the NEA group (17%), while VPS-R grade 3 (pain requiring analgesics) was seen in one patient of the EA group (4%) and 4 of the NEA group (18%). At 1 POD, VPS-R grade 0 was seen in 15 patients of the EA group (63%) and 8 of the NEA group (36%), while grade 3 was

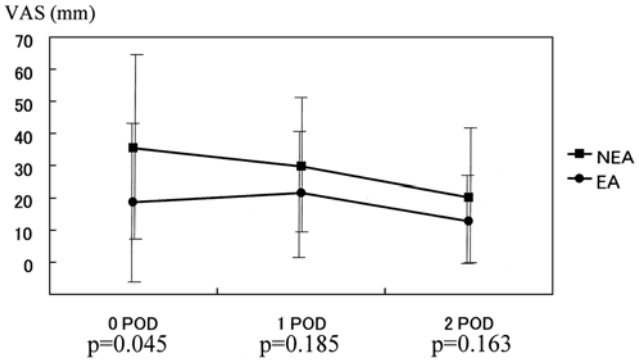

Fig. 1. Mean VAS score after VATS.
VAS, visual analogue scale; VATS, video-assisted thoracoscopic surgery; EA, epidural anesthesia; NEA, not EA; POD, postoperative day.

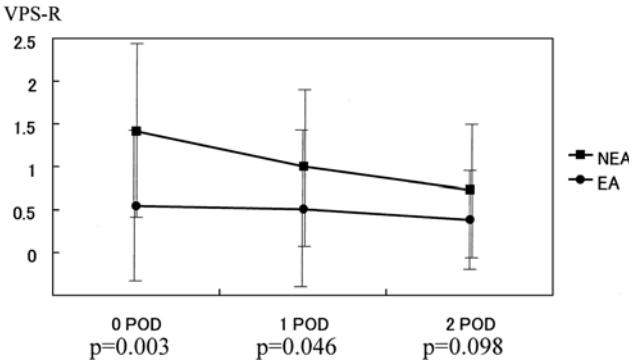

Fig. 2. Mean VPS-R score after VATS.
VPS-R, verbal pain score at rest; VATS, video-assisted thoracoscopic surgery; EA, epidural anesthesia; NEA, not EA; POD, postoperative day.

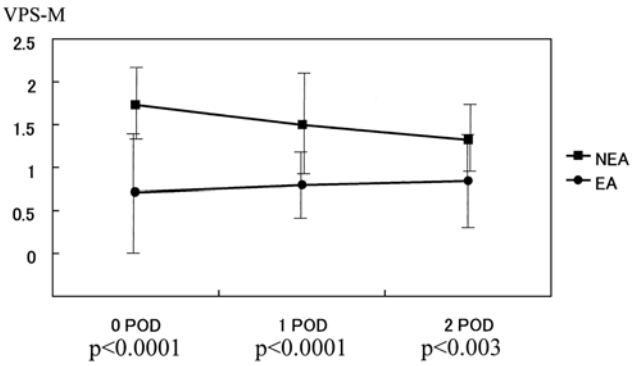

Fig. 3. Mean VPS-M score after VATS.
VPS-M, verbal pain score on movement; VATS, video-assisted thoracoscopic surgery; EA, epidural anesthesia; NEA, not EA; POD, postoperative day.

seen in none of the EA group (0%) and one of the NEA group (5%). The mean VPS-M scores in the NEA and EA groups were 1.73±0.46 and 0.71±0.69 at 0 POD, 1.50±0.60 and 0.79±0.42 at 1 POD, and 1.32±0.48 and 0.83±0.57 at 2 POD, respectively (Fig. 3). The difference between the 2 groups was significant from 0 to 2 POD ($p<0.0001$).

Table 4 presents the result of stepwise regression analysis, showing that EA was only one independent predictor of VPS-R at 0 and 1 POD (p=0.0033 and 0.0462). However, there was no predictor of VPS-R at 2 POD. With VPS-M, there were a few independent predictors at 0–2 POD, i.e. EA from 0 to 2 POD, ASA risk grade at 0 POD and the duration of surgery (DOS) at 2 POD ($p<0.0001$ and 0.0017).

Table 5 shows the incidence of EA-related side effects and complications after surgery. Seven patients in the EA group (29%) suffered nausea or vomiting, of which the frequency was higher than in the NEA group (1 patient, 5%)($p<0.05$). All patients who complained of nausea or vomiting were over 60 years old. While one patient in the NEA group had air leakage for more than 7 days after VATS, none of the other patients in both groups suffered any postoperative complications. EA was discontinued in 3 patients because of nausea or vomiting, but there were no incidences of marked hypotension in any of the patients in the EA group.

Discussion

In thoracic surgery, adequate control of acute postoperative pain is known to decrease postoperative morbidity and mortality and result in a lower incidence of chronic postsurgical pain.[12,13] For this reason, thoracic surgeons have pursued both minimally invasive surgery and better management of postoperative pain. VATS represents the ultimate minimally invasive surgery, and results in a significant reduction in postoperative pain.[14] EA and systemic opioids have been commonly used for postoperative analgesia. It is necessary to establish the most suitable type of pain management after VATS.[15]

There has been clinical debate about which analgesic techniques provides the most effective postoperative pain control, i.e., intravenous or epidural opioids, epidural or paravertebral local anesthetics with or without opioids, patient controlled analgesia (PCA) or continuous injection, cryoanalgesia, transcutaneous electrical nerve stimulation (TENS), or non-steroidal anti-inflammatory drugs

Table 4. Stepwise regression analysis

Dependent variable		Independent variable	Intercept	p value
VPS-R	0 POD	EA	1.409	0.0033
	1 POD	EA	1.000	0.0462
	2 POD	–	0.543	–
VPS-M	0 POD	EA, ASA	2.269	<0.0001
	1 POD	EA	1.500	<0.0001
	2 POD	EA, DOS	1.035	0.0017

VPS-R, verbal pain score at rest; VPS-M, verbal pain score on movement; POD, postoperative day; EA, epidural anesthesia; ASA, risk grade according to criteria set down by American Society of Anesthesiology; DOS, duration of surgery.

Table 5. Postoperative complication and side effect of EA

Complication	EA group	NEA group
Nausea/vomiting*	7	1
Pruritus	4	0
Vertigo	1	0
Air leakage (>7 POD)	0	1

POD, postoperative day; EA, epidural anesthesia; NEA, non-EA; *, p<0.05.

(NSAIDs), etc. It is important to find the best effect of each analgesic technique. Intravenous injection of narcotics is usually used for perioperative analgesia. However, we did not use intravenous narcotics in this study, because this would have made it difficult to assess the effect of EA due to the strong and long-lasting analgesic effect of narcotics.

Our first hypothesis was that there would be no need to use EA after VATS, because patients who undergo VATS suffer minimal postoperative pain. However, this study showed that patients in the EA group had less postoperative pain and needed less additional analgesics than those of the NEA group in the early postoperative period. While VAS evaluates global pain, VPS-R and VPS-M evaluate pain at rest and on movement, respectively. The incidences of pain between the 2 groups evaluated by VAS, VPS-R and VPS-M were significant at 0 POD, from 0 to 1 POD, and from 0 to 2 POD, respectively. From these results, we believe that EA is effective for control of postoperative pain until 1 POD, although other kinds of analgesics, such as NSAIDs, would be sufficient from 2 POD. It is notable that EA was effective for pain on movement from 0 to 2 POD. Controling pain on movement will improve the ability to deep breathe, cough and walk to prevent atelectasis and pneumonia. Using meta-analysis, Block et al. demonstrated that EA provided better postoperative analgesia than parenteral opioids during the early postoperative period, but not at the 4 POD.[16] Our study obtained similar results in that EA was effective until 1 POD, but that NSAIDs could control postoperaive pain from 2 POD. Nomori et al. stated that prolonged thoracic EA after limited thoracotomy significantly increased the severity of pain after withdrawal.[17] These studies demonstrated that EA should be withdrawn as soon as NSAIDs control postoperative pain.

Several complications of EA have been reported, such as nausea, vomiting, hypotension, pruritus and technical complications.[18] In this study, the patients in the EA group suffered nausea or vomiting more frequently than those in the NEA group. As all patients who complained of nausea or vomiting were over 60 years old, we consider it advisable to discontinue EA from 2 POD, especially in elderly patients.

In conclusion, results suggest that EA is recommended until 1 POD after VATS, and other kinds of analgesics should be employed from 2 POD. However, in patients who complain of side effects due to EA, such as nausea or vomiting, especially in elderly patients, EA should be discontinued within one day after surgery. Although developments have been made recently in VATS, the optimal postoperative analgesic methods have been controversial. We hope this study will help VATS surgeons to decide the optimal postoperative analgesic method.

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