# Efficacy and Adverse Effects of Patient-Controlled Epidural or Intravenous Analgesia after Major Surgery

Yun-Hui Teng, MD; Jenkin S. Hu[1], MD; Shen-Kou Tsai[1], MD, PhD; Chinsan Liew[2], MD; Ping-Wing Lui, MD, PhD

**Background:** The purpose of this retrospective study was to determine whether epidural fentanyl-bupivacaine patient-controlled analgesia (PCA) was more efficacious and had fewer adverse effects than epidural or intravenous morphine PCA.

**Methods:** We retrospectively retrieved data from 859 patients (mean age 64±7 years) who received continuous epidural medication, either morphine or fentanyl-bupivacaine PCA, or intravenous morphine PCA for postoperative pain control after major elective surgery from 1999 to 2000. Pain was assessed postoperatively using a verbal analogue pain scale (VAS, 0-10) during rest, mobilization, and coughing. Adverse effects including nausea, vomiting, pruritus, urinary retention, sedation, motor block, and respiratory depression (< 8 breaths per minute) were recorded. On the third postoperative day, the overall quality of pain control was evaluated using a pain relief scale (PRS, 1-4).

**Results:** There were 201 patients who had epidural morphine PCA, 427 patients who had fentanyl-bupivacaine PCA, and 231 patients who had intravenous morphine PCA. Most patients (> 86%) who received epidural or intravenous PCA, either morphine or fentanyl combined with bupivacaine, experienced good pain relief (VAS, 0-3) during rest, mobilization, and coughing. Nonetheless, patients who received epidural morphine or fentanyl-bupivacaine had greater satisfaction with overall pain relief (PRS = 4) than did those who received intravenous morphine ($p < 0.05$). Nausea and vomiting were most common in the epidural morphine group ($p < 0.05$). Pruritus occurred least often in patients who received epidural fentanyl-bupivacaine analgesia ($p < 0.05$). There were no differences in other adverse events such as urinary retention, sedation, and motor block among the three groups. No respiratory depression was found in any patient.

**Conclusions:** Patients receiving epidural fentanyl-bupivacaine PCA experienced better overall pain relief, while morphine PCA, either epidurally or intravenously, caused more side effects. It is considered safe to use continuous epidural PCA with fentanyl-bupivacaine in patients receiving major elective surgery.
*(Chang Gung Med J 2004;27:877-86)*

**Key words: patient-controlled analgesia, opioid, bupivacaine, patient safety.**

From the Department of Anesthesiology, Chang Gung Memorial Hospital, Taipei and Chang Gung University, Taoyuan; [1]Department of Anesthesiology, Taipei Veterans General Hospital, Taipei; [2]Department of Pain Management, Chang Gung Memorial Hospital, Taipei.

Received: Jun. 4, 2004; Accepted: Oct. 19, 2004

Address for reprints: Dr. Ping-Wing Lui, Department of Anesthesiology, Chang Gung Memorial Hospital. 5, Fushing Street, Gueishan Shiang, Taoyuan, Taiwan 333, R.O.C. Tel. & Fax: 886-3-3281200 ext.3624; E-mail: pwlui@adm.cgmh.org.tw

The implementation of a well-organized program for acute pain control can improve the quality of postoperative pain relief in patients undergoing major elective surgery.[1] The use of intravenous opiates is still limited because of side effects such as respiratory depression. Epidural opiates in combination with local anesthetics are commonly used for postoperative analgesia. Several lines of evidence indicate that opiates administered through the epidural route are safe, with proven benefits such as good pain relief,[2-5] less pain during movement,[6] better mental status,[7] fewer cardiopulmonary complications,[8,9] less thromboembolism, and earlier discharge from the hospital.[10,11] Nonetheless, epidural analgesia is only an adjuvant during the process of surgical treatment, and is not primarily expected to alter patients' outcomes.[12] Comparisons among epidural opiates, opiate-local anesthetics, and intravenous opiates have rarely been reported in clinical studies in Taiwan. In this study, we retrospectively compared epidural fentanyl-bupivacaine patient-controlled analgesia (PCA) with epidural or intravenous morphine PCA for postoperative pain relief and adverse effects following major elective surgery.

## METHODS

We retrospectively retrieved data from American Society of Anesthesiologists (ASA) class I-II patients in whom epidural (EPI), or intravenous (IV) PCA was requested postoperatively, following major thoraco-abdominal or abdominal (upper or lower) surgery. This was a retrospective study without randomization due to the various kinds of surgeries and the preferences of anesthesiologists for EPI or IV drug administration. In surgical procedures where epidural analgesia was contraindicated, or was not needed, intravenous morphine PCA was started after surgery. Patients undergoing minor surgical procedures were excluded from this study.

Thoraco-abdominal surgery consisted of lobectomy and esophagectomy, while upper abdominal surgery included open cholecystectomy, gastrectomy, liver, and pancreatic resection. Lower abdominal surgery was defined as rectum or colon surgery, radical prostatectomy, cystectomy, and ventral hernia. Orthopedic surgery included total hip replacement and spine surgery. The attending anesthesiologists decided the choice of premedication and the management of general anesthesia in accordance with the routines of the department. Induction of anesthesia was accomplished with propofol or thiopental, and fentanyl. A non-depolarizing muscle relaxant, either atracurium or vecuronium bromide, was used to facilitate endotracheal intubation. General anesthesia was maintained with isoflurane or sevoflurane in oxygen/nitrous oxide (1:1). Patients' lungs were mechanically ventilated using a low-flow (0.5-1.5 L/min) technique.

The placement of the epidural catheter, either in the thoracic or lumbar region, was determined by the dermatomal extent of the surgery, and the skill of the attending anesthesiologists. Thoracic catheterization was preferred for upper abdominal or thoracic surgery, while lumbar catheter placement was chosen for lower abdominal surgery. With the patient lying in the lateral position, we used the loss-of-resistance technique to identify the epidural space into which the catheter was inserted cephalically 4-6 cm.[13] Before induction of general anesthesia, a test dose of 2% lidocaine (2 mL) with 10 μg of epinephrine was injected epidurally to rule out possible intrathecal injection. The catheter was secured by a Tegaderm (3M Health Care, St. Paul, MN, USA) transparent dressing for daily inspections of the insertion site. The catheter was taped along the midline of the back. All postoperative treatments were begun at the end of surgery. A Bard Ambulatory PCA (Baxter, Bard MedSystems division, North Reading. MA, USA) infusion pump was used for intravenous PCA, while Abbott (LifeCare PCA Plus II, Abbott Laboratories Ltd., Illinois, USA) and Graseby (Model 9300/9500, SIMS Graseby Medical Ltd, Watford, UK) infusion pumps were used for epidural PCA. Three sizes of infusion bags were used to avoid medication errors. For epidural PCA, 300 mL bags (normal saline) with morphine (0.1 mg/mL) or 500 mL bags with fentanyl-bupivacaine (1 μg/mL-1 mg/mL) were used. Intravenous morphine (1 mg/mL) was diluted with normal saline in 250 mL bags.

For the epidural morphine group, the background infusion rate was set at 2-4 mL/h, with PCA of 1.5-2 mL and a lockout interval of 30 minutes. For the epidural fentanyl-bupivacaine group, the background infusion rate was set at 5-6 mL/h, with PCA of 2-4 mL and a lockout interval of 30 minutes. In the intravenous (IV) morphine group, the drug was administered at 0.5-2 mL/h, with PCA of 0.5-3 mL

and a 10-minute lockout interval. Usually one infusion bag was sufficient for the entire treatment period. Based on daily evaluation of the patient, we tried to lower the preset dosage for PCA maintenance in all three groups. The Verbal Analogue Scale (VAS) was used for assessing the degree of pain relief during PCA treatment. The VAS ranged from 0 = no pain to 10 = unbearable pain. The PCA dose was adjusted until all patients had pain scores at rest of less than 4, which was considered adequate analgesia.[14] Supplemental IV ketorolac (30-60 mg) was administered if the adjustment of the infusion pump still resulted in insufficient pain alleviation. Antiemetic (prochlorperazine, 5 mg every 4 hours intramuscularly or by IV drip) or antipruritic (chlorpheniramine maleate, 5 mg every 4 hours IV) drugs were prescribed on an "as-required" basis.

In the recovery room, all patients were closely observed for at least 2 hours and then discharged to the surgical wards. The ward nurse routinely monitored the blood pressure, respiratory rate, pulse rate, and sedation of the patients every hour for the first 4 hours, and then every 6 hours until 24 hours after surgery. Patient monitoring was stopped 6 hours after the discontinuation of PCA.

Respiratory depression was defined as less than 8 breaths/minute, while sedation was defined as difficulty arousing the patient verbally. Motor blockade was defined as the inability to walk due to muscular weakness. A nurse in the acute pain service recorded the VAS (on rest, mobilization, and coughing) and adverse effects, which were entered into the database for further analysis. The total PCA dose administered was registered at the end of PCA, and the patients' overall satisfaction with pain relief was assessed using the Pain Relief Scale (PRS). The PRS was scored as 1 = not effective at all, 2 = mildly effective, 3 = very effective, or 4 = completely effective.

Ordinal data were compared using the chi-square test. Data for the PCA doses given were analyzed among the three groups using ANOVA with post hoc comparisons. Data were expressed as mean ±SD. Statistical significance was defined as $p < 0.05$.

## RESULTS

There were 859 patients (mean age, 64±7 years), 540 men and 319 women, included in this study. Patient data and types of surgery are presented in Table 1. Patients receiving epidural fentanyl-bupivacaine outnumbered those in the other two groups. The VAS score was similar among patients in all three groups (Fig. 1) because the PCA doses were adjusted to attain a VAS score < 4 at rest. However, patients experienced more pain when they moved or coughed (Fig. 1, middle & lower panels). Patients with epidural PCA, either morphine or fentanyl-

**Table 1.** Patient Data and Types of Surgery

| | Epi-m group (n=201)ll | Epi-f group (n=427)π | IV-m group (n=231)** | p* | p† | p‡ |
|---|---|---|---|---|---|---|
| Mean age (±SD)‡‡ | 63 (± 5) | 66 (± 7) | 62 (± 9) | NS | NS | NS |
| Gender (M/F) | 126/75 | 279/148 | 135/96 | NS | NS | NS |
| Thoraco-abdominal | 8 | 14 | 5 | NS | NS | NS |
| Upper-abdominal | 100 | 350 | 35 | < 0.0001 | < 0.0001 | < 0.0001 |
| Lower abdominal | 52 | 34 | 15 | < 0.0001 | NS | < 0.0001 |
| Orthopedic | 21 | 35 | 110 | NS | < 0.0001 | < 0.0001 |

**Abbreviation:** SD: standard deviation; M: male; F: female; Epi-m: epidural morphine; Epi-f: epidural fentanyl-bupivacaine; IV-m: intravenous morphine.

*p: Epi-m vs. Epi-f group, significant at less than 0.05 by chi-square test.

†p: Epi-f vs. IV-m group, significant at less than 0.05 by chi-square test.

‡p: Epi-m vs. IV-m group, significant at less than 0.05 by chi-square test.

II: 20 patients received other surgery.

π: 6 patients received more than one surgery.

**: 66 patients received other surgery.

‡‡: by ANOVA test with post hoc Tukey test.

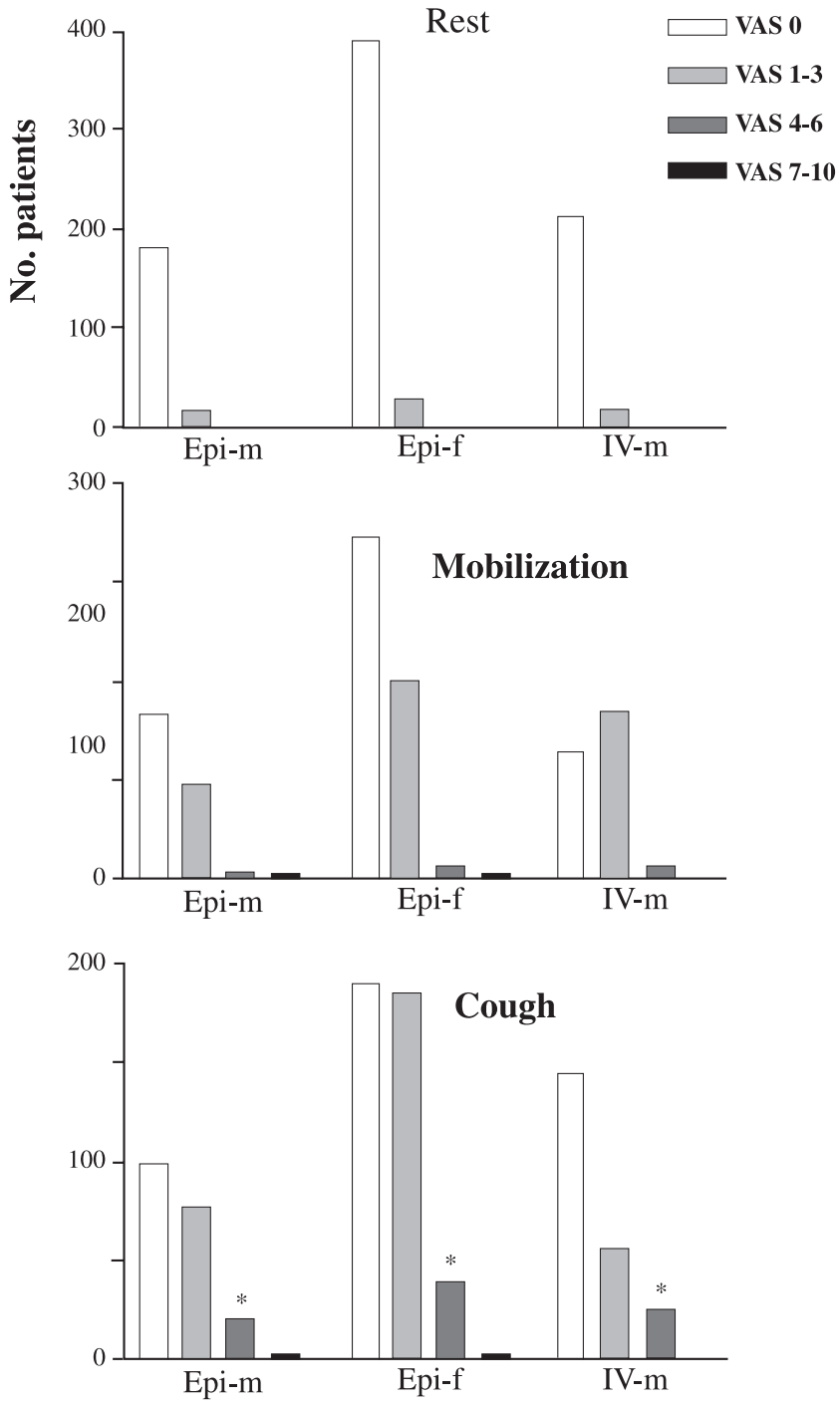


**Fig. 1** The Verbal Analogue Score (VAS) during rest, mobilization and coughing in patients receiving epidural morphine (Epi-m), epidural fentanyl-bupivacaine (Epi-f) or intravenous morphine (IV-m) after major elective surgery. A significant difference between cough vs. rest, and cough vs. mobilization on the same postoperative day is indicated by * $p < 0.05$ in the chi-square test.

bupivacaine, enjoyed greater overall pain relief (PRS = 4) than did those who received intravenous morphine (31.1% vs. 28.1% vs. 17.3%, $p < 0.05$, Fig. 2).

Side effects such as nausea, vomiting and pruritus were more common in the epidural morphine group than the other two groups (Table 2). Urinary retention could not be accurately assessed because a urinary catheter remained in place in the majority of patients who underwent major surgery. Thoracic epidural catheter placement resulted in a slightly higher incidence of motor block in comparison with lumbar epidural catheterization (1.6% vs. 1.0%). Neither epidural morphine nor epidural fentanyl-bupivacaine PCA caused sedation, while 1.5% patients using IV morphine PCA were sedated. Most importantly, no respiratory depression was found in any patient. The Graseby pump had more mechanical problems (e.g., low battery, false alarm) than the Abbott and Baxter pumps (18% vs. 4% vs. 6.4%; $p < 0.05$).

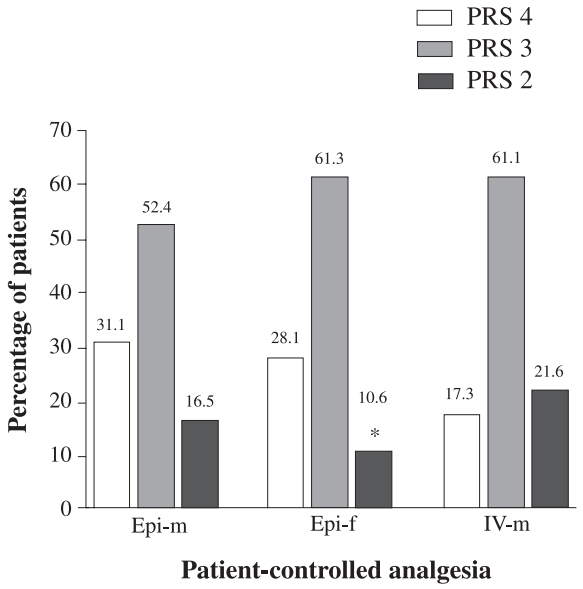


**Fig. 2** The overall Pain Relief Score (PRS) at the end of PCA treatment in patients receiving epidural morphine (Epi-m), epidural fentanyl-bupivacaine (Epi-f) or intravenous morphine (IV-m) after major elective surgery. Patients who received Epi-f had higher satisfaction (less PRS < 2) than those in the other two groups. * $p < 0.05$ Epi-f group vs. Epi-m and IV-m groups in the chi-square tests.

## DISCUSSION

The results of the present study demonstrated that both epidural and intravenous PCA yielded more than 95% pain relief in patients during rest, but not during mobilization and coughing. Pruritus was more frequent with epidural morphine PCA, while the incidence of sedation was higher in patients receiving IV morphine. It is interesting to note that no respiratory depression was found among patients receiving epidural or intravenous analgesia.

A lower dose of opioid was used in this study for IV and epidural background infusion in order to maintain adequate pain relief. The constant infusion

**Table 2.** Side Effects and Analgesic Needed

| | Epi-m group | Epi-f group | IV-m group | $p$* | $p$† | $p$‡ |
|---|---|---|---|---|---|---|
| Nausea (vomiting) | 21% (9%) | 8% (3%) | 18% (4%) | < 0.005 | < 0.005 | NS |
| Pruritus | 21%* | 5% | 13% | <0.05 | < 0.05 | << 0.05 |
| Urinary retention | 0.5% | 0.6% | 0.8% | NS | NS | NS |
| Sedation | 0% | 0% | 1.5% | NS | < 0.05 | < 0.05 |
| Motor block | 1% | 1.5% | 0% | NS | NS | NS |
| Respiratory depression | 0 | 0 | 0 | NS | NS | NS |
| PCA dose[II] (ml) | 360 ± 70 | 385 ± 68 | 175 ± 58 | NS | < 0.001 | < 0.001 |

**Abbreviation:** PCA: patient-controlled analgesia; Epi-m: epidural morphine; Epi-f: epidural fentanyl-bupivacaine; IV-m: intravenous morphine; NS: not significant.

*p: Epi-m vs. Epi-f group, significant at less than 0.05 by chi-square test.

†p: Epi-f vs. IV-m group, significant at less than 0.05 by chi-square test.

‡p: Epi-m vs. IV-m group, significant at less than 0.05 by chi-square test.

II: by ANOVA test with post hoc Tukey test.

of lower doses of opiates results in more predicable analgesic effects than does intermittent injections.[15] Although low-dose background infusion for postoperative analgesia avoids the risk of overdose resulting in serious complications,[16,17] more adverse effects are also occasionally reported.[18,19] While the risks and benefits of using background infusion of opiates should be taken into consideration, in terms of safety and efficacy, continuous infusion of opioid for the maintenance of analgesia is suggested by most authors.

Dahl et al. reported that the efficacy of postoperative analgesia during coughing and mobilization was not satisfactory among patients receiving small doses (0.2 mg/h) of epidural morphine.[20] However, in the study by Liu et al., significant pruritus occurred when administering epidural morphine at a dose of 0.5 mg/h.[21] This adverse effect appears to be directly associated with the dose of morphine.[22] To balance the chance of side effects and the efficacy of epidural morphine, a dose of 0.2 to 0.4 mg/h was chosen for our study. Although our patients experienced pain during coughing and mobilization than when resting, most patients (> 86%) experienced good pain relief (VAS 0-3) during rest, mobilization, and coughing without serious side effects. Therefore, epidural morphine analgesia at a dose of 0.2 to 0.4 mg/h is adequate for postoperative pain control.

Our study indicated that patients using epidural PCA with either morphine or fentanyl-bupivacaine enjoyed greater overall pain relief (PRS = 4) than those who used IV morphine PCA. Despite the continuous IV infusion of morphine, pain relief was not as good as that in the epidural PCA group. Elderly patients undergoing major surgery received far more epidural analgesia than younger patients because the former tended to have pre-existing disorders. Our current PCA policy reflects this notion in reserving the epidural technique for high-risk patients of advanced age.[23] Regardless of the route of administration, continuous infusion of opiates given at fixed or variable rates is associated with a higher risk of respiratory depression.[24] There is a higher incidence of ventilatory depression when patients are given intravenous morphine, especially continuous IV morphine infusion,[25] compared to continuous epidural morphine.[26] In a large survey of patients using continuous epidural opiates, the incidence of respiratory depression ranged from 0.09% to 0.9%,[26] while among elderly patients, the incidence may be as high as 10%-15%.[23] The discrepancy between these two groups could reflect differences in the doses of epidural opiates. It is interesting to note that none of our patients had respiratory depression. The reason is probably multifactorial. Among patients receiving morphine, either intravenously or epidurally, the low-dose infusion technique could be an important contributing factor. In additon, a continuous infusion of morphine may result in less apnea than that seen with intermittent bolus injections. In patients using epidural fentanyl-bupivacaine, the combined effect of opiate and local anesthetic also contributed to fewer respiratory adverse effects than found with either drug alone. The synergistic interactions between these two drugs could result in a reduction in the need for opiates. Our results give further credence to the notion that downward titration of opiates for infusion results in less respiratory depression secondary to drug accumulation.

In the present study, pruritus was more common in patients receiving epidural morphine than in those receiving IV morphine. This is the most common undesirable effect related to regional analgesia with opiates. A previous study reported that pruritus could occur in up to 50% of patients using epidural morphine for postoperative analgesia.[26] It seems apparent that epidural morphine at a dose of 0.2 to 0.4 mg/mL effectively reduces the incidence of pruritus, compared to that seen in a previous study using higher dosages.[21]

The incidences of nausea and vomiting caused by IV morphine were similar to that of epidural morphine, but were much higher than that of patients receiving epidural fentanyl-bupivacaine. This is consistent with other reports.[21,26] In one prospective study of morphine analgesia, the incidences of nausea and vomiting were similar regardless of the route of administration., No relationship has been found between the dose of epidural morphine and the incidence of nausea and vomiting.[21,22] Thus, the incidence of these adverse effects is not expected to decrease when epidural opiates are combined with local anesthetics. In our study, epidural infusion of fentanyl-bupivacaine yielded a lower incidence of adverse effects such as nausea, vomiting and pruritus than did IV or epidural morphine. These side effects were mainly due to the systemic action of morphine after IV infusion or epidural administration. Infusion

leads to cephalic spread of morphine via the cerebrospinal fluid (CSF). The mdication then reaches the respiratory center in the medulla oblongata. On the contrary, epidural infusion of more lipophilic opiates such as fentanyl, especially when combined with bupivacaine, could provide more complete segmental analgesia.[27] Our results are in line with other studies in which nausea (3.1%-20%), vomiting (0%-30%), and pruritus (10.2%-30%) occurred among patients receiving IV or epidural morphine PCA.

A high incidence of orthostatic hypotension has been reported when epidural bupivacaine is given solely, while pruritus frequently occurs when epidural morphine is used alone.[21] The combination of opiate and local anesthetic appears to enhance the effects of the opiate when given epidurally.[28] Infusing the mixture of local anesthetic and opiate into the epidural space can reduce the total amount of each drug needed, resulting in fewer unwanted side effects. Thus, better postoperative analgesia and respiratory function can be achieved, especially in older patients. There was no severe hypotension (systolic blood pressure < 80 mmHg) directly related to PCA in any of our patients.

Fentanyl, a high lipophilic opiate, is rapidly absorbed into the spinal cord and blood stream, causing a more rapid decrease in the CSF concentration as compared to morphine. This property reduces the risk of cephalic spread of fentanyl in the CSF. The epidural administration of fentanyl usually results in segmental spinal analgesia.[29] Analgesia and adverse effects exerted by epidural fentanyl are closely related to the site of epidural catheterization.[27] Exact positioning of the epidural catheter can reduce the dose of analgesic and also the incidence of its side effects. As such, epidural fentanyl-bupivacaine provides better postoperative analgesia in patients undergoing surgery of the upper extremities, thorax, and upper abdomen.

Some evidence demonstrates that adequate pain relief among patients after surgery can be obtained using different concentrations of fentanyl, from 2 to 10 μg/mL.[30-34] In general, the concentration of fentanyl rarely exceeds 10 μg/mL in the infusion mixture. In the present study, 1.0 μg/mL of fentanyl in addition to 0.1% bupivacaine provided satisfactory pain relief among our patients after surgery. Komatsu et al. reported that a background infusion of epidural PCA using a mixture of 10 μg/mL fentanyl and 0.2% bupivacaine reduced pain on coughing without causing serious side effects in patients undergoing gastrectomy.[35] During the past decade, there has been a trend toward using a lower concentration of drug mixtures in the epidural space. Mahon et al. demonstrated that 0.1% bupivacaine improved epidural analgesia when combined with fentanyl in patients undergoing lung resection, and this dose was not associated with the disadvantages encountered with 0.2% bupivacaine.[36] The incidence of transient neurological complications was higher in patients receiving bupivacaine in doses over 0.2%.[36,37] Reports showed that epidural mixtures of 0.05%, 0.0625% and 0.1% bupivacaine and fentanyl gave adequate postoperative pain relief.[31-33]

It is interesting to note that the Graseby infusion pump had more mechanical problems such as low battery and false alarms than the other two brands used in our study. This is the first report of mechanical problems with pumps used for PCA. We also found that the Graseby pump was very sensitive to air bubbles which readily triggered the alarms during intravenous or epidural infusion. The alarm setting cannot be altered in the present version, but this problem should be solved with next generation pumps. There were no medication errors or incorrect settings of infusion rates for these pumps during the study period.

In conclusion, better pain relief can be achieved in patients receiving epidural PCA with fentanyl-bupivacaine than with IV or epidural morphine PCA. Morphine, administered either epidurally or intravenously, caused more common adverse effects. It is considered safe to use continuous epidural PCA with fentanyl-bupivacaine in patients receiving major elective surgery.

## REFERENCES

1. Karci A, Tasdogen A, Erkin Y, Sahinoz B, Kara H, Elar Z. Evaluation of quality in patient-controlled analgesia provided by an acute pain service. Eur Surg Res 2003; 35:363-71.
2. Burstal R, Wegener F, Hayes C, Lantry G. Epidural analgesia. Prospective audit of 1062 patients. Anaesth Intens Care 1998;26:165-72.
3. Liu SS, Hugh AW, Olsson GL. Patient-controlled epidural analgesia with bupivacaine and fentanyl on hospital wards. Prospective experience with 1,030 surgical patients. Anesthesiology 1998;88:688-95.

4. Rygnestad T, Borchgrevink PC, Eide E. Postoperative epidural infusion of morphine and bupivacaine is safe on surgical wards - Organisation of the treatment, effects and side-effects in 2000 consecutive patients. Acta Anaesthesiol Scand 1997;41:868-76.
5. Hui YL, Liew CS. Epidural morphine analgesia for post-operative pain control. Chang Gung Med J 1981;4:22-27.
6. Flisberg P, Törnebrandt K, Walther B, Lundberg J. Pain relief after esophagectomy: Thoracic epidural analgesia is better than parenteral opioids. J Cardiothorac Anesth 2001;15:282-7.
7. Mann C, Pouzeratte Y, Boccara G, Peccoux C, Vergne C, Brunat G, Domergue J, Millat B, Colson P. Comparision of intravenous or epidural patient controlled analgesia in the elderly after major abdominal surgery. Anesthesiology 2000;92:433-41.
8. Rodgers A, Walker N, McKee A, Kehlet H, van Zundert A, Sage D, Futter M, Saville G, Clark T, MacMahon S. Reduction of postoperative mortality and morbidity with epidural or spinal anaesthesia: results from overview of randomised trials. BMJ 2000;321:1493-7.
9. Ballantyne JC, Carr DB, deFerranti S, Suarez T, Lau J, Chalmers TC, Angelillo IF, Mosteller F. The comparative effects of postoperative analgesic therapies on pulmonary outcome: cumulative meta-analyses of randomised, controlled trials. Anesth Analg 1998;86:598-612.
10. Modig J, Borg T, Karlstr_m G, Maripuu E, Sahlstedt B. Thromboembolism after total hip replacement: Role of epidural and general anesthesia. Anesth Analg 1983; 62:174-80.
11. Van Boerum DH, Smith JT, Curtin MJ. A comparison of the effects of patient-controlled analgesia with intravenous opioids versus epidural analgesia on recovery after surgery for idiopathic scoliosis. Spine 2000;25:2355-7.
12. Norris EJ, Beattie C, Perler BA, Martinez EA, Meinert CL, Anderson GF, Grass JA, Sakima NT, Gorman R, Achuff SC, Martin BK, Minken SL, Williams GM, Traystman RJ. Double-masked randomised trial comparing alternate combinations of intraoperative anesthesia and postoperative analgesia in abdominal aortic surgery. Anesthesiology 2001;95:1054-67.
13. Beilin Y, Bernstein HH, Zucker-Pinchoff B. The optimal distance that a multiorifice epidural catheter should be threaded into the epidural space. Anesth Analg 1995;81: 301-4.
14. Rawal N, Berggren L. Organization of acute pain services a low-cost model. Pain 1994;57:117-23.
15. Rauck RL, Raj PP, Knarr DC, Denson DD, Speight KL. Comparison of the efficacy of epidural morphine given by intermittent injection or continuous infusion for the management of postoperative pain. Reg Anesth 1994;19:316-24.
16. Schug SA, Fry RA. Continuous regional analgesia in comparison with intravenous opiate administration for routine postoperative pain control. Anaesthesia 1994;49: 528-32.
17. Tan PH, Chia YY, Perng JS, Chou AK, Chung HC, Lee CC. Intermittent bolus versus patient-controlled epidural morphine for postoperative analgesia. Acta Anaesthesiol Sin 1997;35:149-54.
18. Dawson PJ, Libreri FC, Jones DJ, Bjorkstein AR, Royse CF. The efficacy of adding a continuous intravenous morphine infusion to patient-controlled analgesia (PCA) in abdominal surgery. Anaesth Intens Care 1995;23:453-8.
19. Vercauteren MP, Coppejans HC, ten Broecke PW, Van Steenberge AL, Adriaensen HA. Epidural sufentanil for postoperative patient-controlled analgesia (PCA) with or without background infusion: a double-blind comparison. Anesth Analg 1995;80:76-80.
20. Dahl JB, Rosenberg J, Hansen BL, Hjortso NC, Kehlet H. Differential analgesic effects of low-dose epidural morphine and morphine-bupivacaine at rest and during mobilization after major abdominal surgery. Anesth Analg 1992;74:362-5.
21. Liu SS, Carpenter RL, Mackey DC, Thirlby RC, Rupp SM, Shine TS, Feinglass NG, Metzger PP, Fulmer JT, Smith SL. Effects of perioperative analgesic technique on rate of recovery after colon surgery. Anesthesiology 1995;83:757-65.
22. Palmer CM, Nogami WM, Van Maren G, Alves DM. Postcesarean epidural morphine: a dose-response study. Anesth Analg 2000;90:887-91.
23. Mann C, Pouzeratte Y, BoccaraG, Peccoux C, Vergne C, Brunat G, Domergue J, Millat B, Colson P. Comparison of intravenous or epidural patient-controlled analgesia in the elderly after major abdominal surgery. Anesthesiology 2000;92: 433-41.
24. Boylan JF, Katz J, Kavanagh BP, Klinck JR, Cheng DC, DeMajo WC, Walker PM, Johnston KW, Sandler AN. Epidural bupivacaine-morphine analgesia versus patient - controlled analgesia following abdominal aortic surgery: analgesic, respiratory, and myocardial effects. Anesthesiology 1998;89:585-93.
25. Catley DM, Thornton C, Jordan C, Lehane JR, Royston D, Jones JG. Pronounced, episodic oxygen desaturation in the postoperative period: its association with ventilatory pattern and analgesic regimen. Anesthesiology 1985;63: 20-8.
26. Flisberg P, Rudin Å, Linnér R, Lundberg CJ. Pain relief and safety after major surgery. A prospective study of epidural and intravenous analgesia in 2696 patients. Acta Anaesthesiol Scand 2003;47:457-65.
27. Eichenberger U, Giani C, Petersen-Felix S, Graven-Nielsen T, Arendt-Nielsen L, Curatolo M. Lumbar epidural fentanyl: segmental spread and effect on temporal summation and muscle pain. Br J Anaesth 2003;90:467-73.
28. Akerman B, Arwestrom E, Post C. Local anesthetics potentiate spinal morphine antinociception. Anesth Analg 1988;67:943-8.
29. Inagaki Y, Mashimo T, Yoshiya I. Segmental analgesic effect and reduction of halothane MAC from epidural fen-

tanyl in humans. Anesth Analg 1992;74:856-64.
30. Sjostrom S, Blass J. Postoperative analgesia with epidural bupivacaine and low-dose fentanyl-a comparison of two concentrations. Acta Anaesthesiol Scand 1998;42:776-82.
31. Tsui SL, Lee DK, Ng KF, Chan TY, Chan WS, Lo JW. Epidural infusion of bupivacaine 0.0625% plus fentanyl 3.3 micrograms/ml provides better postoperative analgesia than patient-controlled analgesia with intravenous morphine after gynaecological laparotomy. Anaesth Intensive Care 1997;25:476-81.
32. Liu SS, Allen HW, Olsson GL. Patient-controlled epidural analgesia with bupivacaine and fentanyl on hospital wards: prospective experience with 1030 surgical patients. Anesthesiology 1998;88:688-95.
33. Wigfull J, Welchew E. Survey of 1057 patients receiving postoperative patient-controlled epidural analgesia. Anaesthesia 2001;56:70-5.
34. Chisakuta AM, George KA, Hawthorne CT. Postoperative epidural infusion of a mixture of bupivacaine 0.2% with fentanyl for upper abdominal surgery. A comparison of thoracic and lumbar routes. Anaesthesia 1995;50:72-5.
35. Komatsu H, Matsumoto S, Mitsuhata H, Abe K, Toriyabe S. Comparison of patient-controlled epidural analgesia with and without background infusion after gastrectomy. Anesth Analg 1998;87:907-10.
36. Mahon SV, Berry PD, Jackson M, Russell GN, Pennefather SH. Thoracic epidural infusions for post-thoracotomy pain: a comparison of fentanyl-bupivacaine mixtures vs. fentanyl alone. Anaesthesia 1999;54:641-6.
37. Badner NH, Bhandari R, Komar WE. Bupivacaine 0.125% improves continuous postoperative epidural fentanyl analgesia after abdominal or thoracic surgery. Can J Anaesth 1994;41:387-92.

# 硬脊膜外和靜脈內自控式術後止痛的效果和副作用之比較

鄧雲慧 胡新實[1] 蔡勝國[1] 劉清山[2] 呂炳榮

**背 景：** 此實驗旨研究硬脊膜外吩坦尼合併bupivacaine的病患自控式止痛，是否會比硬脊膜外或靜脈給予嗎啡、更有效且副作用較少。

**方 法：** 859位接受大手術的病人(平均年齡爲64±7歲)，術後需經硬脊膜外持續性給予嗎啡(EPI-m 組)或吩坦尼合併bupivacaine (EPI-f組) 作病患自控式止痛，第三組使用靜脈持續性給予嗎啡作術後止痛。於術後第一天使用verbal analogue scale (0-10)，分別在病人休息、移動和咳嗽時，評估其疼痛的程度。副作用包括嘔吐、噁心、皮膚癢、尿滯留、鎮靜、運動功能阻斷等則分別予以紀錄。第3天止痛結束時，用pain relief scale (PRS, 1-4分) 來評估整體的疼痛品質滿意度。

**結 果：** 接受硬脊膜外嗎啡止痛和硬脊膜外吩坦尼合併bupivacaine止痛分別有201和427位病人，而接受靜脈嗎啡止痛有231位。大多數(超過86%) 接受術後硬脊膜外或靜脈止痛的病人，不論使用嗎啡或合併bupivacaine ，在休息、移動和咳嗽時，都有良好的止痛效果 (VAS 0-3)。但使用硬脊膜外止痛者，不論是用嗎啡或吩坦尼合併bupivacaine，相較於靜脈嗎啡，有較令人滿意的止痛效果 ($p<0.05$)。硬脊膜外嗎啡止痛有較高的噁心、嘔吐發生率 ($p<0.05$)。使用硬脊膜外吩坦尼和bupivacaine止痛的病人較少有皮膚癢的副作用 ($p<0.05$)。其他像尿滯留、鎮靜、運動功能阻斷等副作用，各組間並沒有不同。在所有參予止痛術的病人中，沒有發生呼吸抑制。

**結 論：** 接受硬脊膜外吩坦尼合併bupivacaine病患自控式術後止痛術的病人有較好的整體止痛效果。然而，不論是硬脊膜外或靜脈給予嗎啡，均引起較多的副作用。 結論認爲硬脊膜外持續性病患自控式術後止痛術是安全的。

(長庚醫誌2004;27:877-86)

**關鍵字：** 病患自控式止痛，鴉片類，bupivacaine，病患安全。

長庚紀念醫院 台北院區 麻醉部，[1]台北榮民總醫院 麻醉部，[2]長庚紀念醫院 台北院區 疼痛科

受文日期：民國93年6月4日；接受刊載：民國93年10月19日。

索取抽印本處：呂炳榮醫師，長庚紀念醫院 麻醉部。桃園縣333龜山鄉復興街5號。Tel. & Fax: (03)3281200轉3624; E-mail: pwlui@adm.cgmh.org.tw