www.jkns.or.kr http://dx.doi.org/10.3340/jkns.2011.50.3.205
Print ISSN 2005-3711 On-line ISSN 1598-7876
J Korean Neurosurg Soc 50 : 205-208, 2011

Clinical Article

A Comparison of the Effect of Epidural Patient-Controlled Analgesia with Intravenous Patient-Controlled Analgesia on Pain Control after Posterior Lumbar Instrumented Fusion

Sang Hoon Lee, M.D., Kyung Hyun Kim, M.D., Seong-Mee Cheong, M.D., Sumi Kim, M.D., Mirang Kooh, M.D., Dong Kyu Chin, M.D., Ph.D.
Department of Neurosurgery, The Spine and Spinal Cord Institute, Gangnam Severance Spine Hospital, Yonsei University College of Medicine, Seoul, Korea

Objective : Retrospective analysis to compare the effect and complication of epidural patient-controlled analgesia (epidural PCA) with intravenous patient-controlled analgesia (IV PCA) for the treatment of the post-operative pain after posterior lumbar instrumented fusion.
Methods : Sixty patients who underwent posterior lumbar instrumented fusion for degenerative lumbar disease at our institution from September 2007 to January 2008 were enrolled in this study. Out of sixty patients, thirty patients received IV PCA group and thirty patients received epidural PCA group. The pain scale was measured by the visual analogue scale (VAS) score.
Results : There were no significant difference between IV PCA group and epidural PCA group on the PCA related complications (p=0.7168). Ten patients in IV PCA group and six patients in epidural PCA group showed PCA related complications. Also, there were no significant differences in reduction of VAS score between two groups on postoperative 2 hours (p=0.9618) and 6 hours (p=0.0744). However, postoperative 12 hours, 24 hours and 48 hours showed the significant differences as mean of reduction of VAS score (p=0.0069, 0.0165, 0.0058 respectively).
Conclusion : The epidural PCA is more effective method to control the post-operative pain than IV PCA after 12 hours of spinal fusion operation. However, during the first twelve hours after operation, there were no differences between IV PCA and epidural PCA.

Key Words : Patient-controlled analgesia · Postoperative pain · Spinal fusion.

INTRODUCTION

Traditional posterior lumbar interbody fusion and posterior transpedicular screw fixation is associated with high degree of postoperative pain. Most patients require parenteral administration of analgesics especially during 2 days after operations or more. High degree of postoperative pain precludes them from early mobilization, which is known to lengthen hospital stay and might result in various complications[7,11].

Patient-controlled analgesia (PCA) has long been used for pain control after spinal operations[3,5,6,13,14,20]. And, there were various methods to administrate the analgesics such as epidural or intravenous route. Excellent pain control and a decrease in the total amount of narcotic used and therefore less respiratory depression and sedation are the benefits of the epidural PCA although there were serious side effects including pruiritus, nausea, urine retention and neurologic abnormality[12,18]. this property should facilitate mobilization and improve patient outcome and satisfaction[5]. This retrospective comparative study was designed to compare the efficacy and complication of epidural PCA with intravenous (IV) PCA in patients who underwent posterior lumbar instrumented fusion at our institute.

• Received : April 18, 2011 • Revised : June 20, 2011
• Accepted : September 8, 2011
• Address for reprints : Dong Kyu Chin, M.D., Ph.D.
Department of Neurosurgery, The Spine and Spinal Cord Institute, Gangnam Severance Spine Hospital, Yonsei University College of Medicine, 211 Eonju-ro, Gangnam-gu, Seoul 135-720, Korea
Tel : +82-2-2019-3397, Fax : +82-2-3461-9229
E-mail : dkchin@yuhs.ac

MATERIALS AND METHODS

Indication and evaluation

We included consecutive 60 patients who underwent one or two level posterior lumbar instrumented fusion for degenerative disc disease, spondylolisthesis, or spinal instability between Sep 2007 and Jan 2008. IV PCA group included 30 patients, 12 male and 18 female and epidural PCA group included 30 patients, 7 male and 23 female. Average age of epidural PCA was 57.66±10.38 and IV PCA was 57.06±9.79 (Table 1).

Pain was assessed using a printed copy of both verbal numerical analogue scale and faced pain scale by researcher and members of this research (nurses) and recorded for time periods of 2, 6, 12, 48 hours after surgery unless PCA was removed before 48 hours (Fig. 1).

All symptoms such as nausea, vomiting, headache, dizziness, chest discomfort, urine retention and neurologic deficit were recorded as adverse effects. Among patients who were not removed the PCA until 48 hours after surgery, the number of additional analgesics injected were counted.

All data were compared statistically using chi-square test and Student's t-test for homogeneity between two groups, Fisher's exact test for adverse effect and Student's t-test for pain scale (SAS 9.1) and significance was defined as $p<0.05$.

Technique and protocol

Using continuous and bolus infusion kit (continuous and bolus ambix anaplus), the PCA medication were dosed in the following manners : flow rate was 2mL/hr and additional doses of 0.5 mL/5 min with 20-minute lockout are given by patient-controlled demand.

1) IV PCA medications : total mixture of Ketoracin® (ketorolac tromethamine, Roche, Korea) 120 mg, Fentanyl citrate (Hana Pharm CO LTD, Korea) 1,000 μg and Zofran® (Ondanstron dehydrate, GlaxoSmithKline) 16 mg with saline (100 mL).

2) Epidural PCA medications : total mixture of Morphine 5 mg and 0.75% Ropivacaine 20 cc with saline (100 mL).

Epidural catheter was inserted into the epidural space 5 cm above laminectomy level under direct visualization and was passed retrograde through the needle in the paraspinal muscles after removal of the stylet by the surgeon before wound closure.

RESULTS

Patient profile and homogeneity

There were a total of 60 patients. Thirty patients were in IV PCA group and 30 patients were in epidural PCA group. There were no statistically significant differences in regards to patients' demographic data, number of fused level and operative time between two groups (Student's t-test, chi-square test) (Table 1).

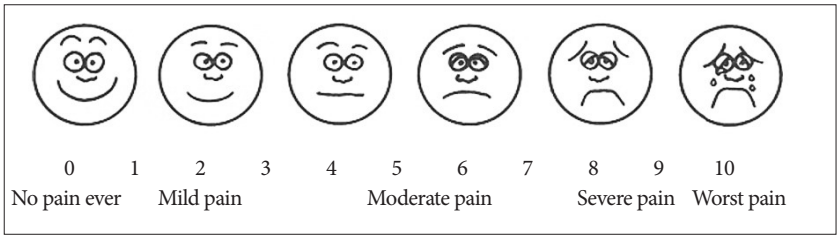

Fig. 1. VAS score. Pain was assessed using the VAS ranging from "0" (no pain) to "10" (worst imaginable pain). VAS : visual analogue scale.

Table 1. Demographics of patients

	IV PCA (M±SD)	Epidural PCA (M±SD)	*p*-value
Age	57.06±9.79	57.66±10.38	0.601
Sex M	12	7	0.1652
F	18	23	
Height (cm)	159.46±10.25	154.3±7.87	0.3459
Weight (kg)	63.96±9.81	62.63±11.29	0.1860
Operative time	4.50±1.83	3.83±0.91	0.0818
Preoperative pain score	6.25±2.80	6.08±2.35	0.7935
Fused level	1.44±0.91	1.46±0.63	0.927

IV : intravenous PCA : patient-controlled analgesia

Table 2. Postoperative pain scores

	IV PCA (M±SD) (n=20)	Epidural PCA (M±SD) (n=24)	*p*-value
Preop	6.25±2.80	6.08±2.35	0.7935
Postop 2 hrs	6.50±2.23	6.50±2.06	0.9618
postop 6 hrs	6.65±2.08	5.37±1.63	0.0744*
postop 12 hrs	5.50±1.67	4.20±1.21	0.0069*
postop 24 hrs	5.15±1.78	4.12±1.65	0.0165*
postop 48 hrs	4.50±1.23	3.50±1.38	0.0058*

*$p<0.05$. preop : preoperatively, postop : postoperatively, hrs : hours, IV : intravenous PCA : patient-controlled analgesia

Pain score results

There was no significant difference about preoperative pain score between two groups. Average preoperative pain score of IV PCA group was 6.25±2.80, and epidural PCA was 6.08±2.35 (p=0.7935). There was also no significant difference between two groups about postoperative pain score at 2 hours and 6 hours (p=0.9618, p=0.0744 respectively). However, epidural PCA group showed significant lower pain score than IV PCA group at 12 hours, 24 hours and 48 hours postoperatively (all $p<0.05$) (Table 2).

We also reviewed, based on medical records, for the number of injection of additional analgesics (intravenous ketoracin 30 mg/ample) in patients who did not remove PCA until 48 hours. Although there was no significant difference between two groups, epidural PCA group (aver 3.10±2.26) required less additional analgesics than IV PCA group (aver 1.91±1.69) (p=0.0543) (Table 3).

Adverse effect

There was no significant difference in regard to adverse effect between two groups.

PCA had to be removed in 10 patients of IV PCA group versus 6 patients of epidural PCA group. Of 10 patients of

IV PCA group, 6 patients complained nausea, 1 patient had vomiting, and 3 patients had both symptoms. Among 6 patients of epidural PCA group, 4 patients complained nausea, 1 patient had both nausea and vomiting, and 1 patient had both leg hypoesthesia. These symptoms and neurologic deficit were improved after removal of PCA (Table 4).

Table 3. Number of additional analgesic injections

	IV PCA (M±SD) (n=20)	Epidural PCA (M±SD) (n=24)	*p*-value
Number	3.10±2.26	1.91±1.69	0.0543

IV : intravenous, PCA : patient-controlled analgesia

Table 4. Adverse effects

	IV PCA (n=10)	Epidural PCA (n=6)	*p*-value
Nausea	6	4	0.7168
Vomiting	1	0	
Nausea and vomiting	3	1	
Neurologic deficit	0	1	
Total	10	6	

IV : intravenous, PCA : patient-controlled analgesia

DISCUSSION

In posterior lumbar instrumented fusion, appropriate postoperative pain management is essential for early ambulation, reduced hospital stay, avoidance of additional analgesics, and consequently for improvement of patient outcome. PCA via ether intravenous or epidural route has been considered standard management after major orthopedic or spinal surgery[2,8,9] and there have been many comparative studiess on the effectiveness and complication of epidural PCA with intravenous PCA[10,15,17,19]. Postoperative pain score (visual analog scale) were significantly lower in the epidural PCA group when compared with that in the IV PCA group[16,20]. Epidural PCA group showed superior result in pain control on post-operation day 1 and 2 than on the day of operation[20].

Other studies have reported that the capacity of excellent pain control in Epidural PCA were probably due to the higher concentration of ropivacaine, the higher infusion rate and the use of an epidural opioid lately[14,16]. But, the total amount of opioid used in epidural PCA was less than IV PCA group[14].

In present study, epidural PCA group showed superior postoperative pain control after 6 hours of operation to IV PCA group (p=0.0744 respectively at 6 hours, all p<0.05 at 12 hours, 24 hours and 48 hours postoperatively). Also, in patients who was not removed PCA until 48 hours, epidural PCA group required less additional analgesics than IV PCA group although it was not statistically significant (p=0.0543).

In addition, although we did not investigate in this study, shorter hospital stay and earlier full diet were other positive effects of the epidural PCA[20]. Van Boerum et al., reported that the patient in the epidural PCA group could start a full diet earlier and were discharged earlier in one and half days on average than the IV PCA group[10,15,17,19]. Also, patients in the epidural PCA group started ambulation earlier than in the IV PCA group[16,20]. Moreover, patients in the PCEA group were significantly more satisfied with pain therapy[16].

Common side effects associated with epidural administration of local anesthetics or opioids, such as nausea and vomiting or pruritus were not evaluated systematically by all authors[14,16,20]. Pruritus was described with an incidence between 7% and 43%, nausea and vomiting with an incidence between 14% and 86%[16]. Because of the amount of opioid used in PCA is small, the nausea and vomititng can be reduced[1,10,15,17,19]. Nausea and vomiting are the most common and distress side effect of IV PCA, although the pain control medication is morphine or fentanyl[14,16,20]. Because of small amount of morphine used in epidural PCA, some patients have nausea symptom but patients with vomiting are usually tolerable[8,10,15,17,19].

Other side effects associated with epidural PCA include, respiratory depression and motor deficit and infection[18]. Mild respiratory depression occurred rarely in patients with epidural PCA, which was unresponsive to naloxone, but needed no ventilator support, and the resolved uneventfully[16,18,20]. In this study, none of patients suffered from respiratory depression.

Although spine surgery causes severe postoperative pain, epidural PCA is not commonly used[16]. The main reason is that it might cause some complications such as motor block[16,18,20]. The motor block can make difficulty in early detection of surgical related neurologic deficit[16,18,20]. In our study, one patient in epidural PCA group had temporary hypoesthesia of bilateral lower extremities, we assumed that the cause of hypoesthesia might be associated with local analgesics (ropivacane), not epidural procedure, surgery or opioid because it showed bilaterally involved whole dermatome of the lower extremities[10]. Thus, we thought this problem could be resolved by controlling the amount of medication and as soon as we removed the epidural PCA, the symptom had disappeared[10,14,18]. A small number of patients showed significant postoperative ileus. But it was recovered shortly (1 or 2 days) and no adverse sequelae[16].

IV PCA has been more commonly accepted postoperative pain control method for several reason[2]. First, IV PCA needs no additional surgical procedure[2,5,18]. Second, because fentanyl, the main pain killer of IV PCA, usually does not cause neurologic deficit, it is possible to detect surgical procedure related neurologic deficit immediately after operation[2,5,10,16].

However, nausea and vomiting are the most common and distress side effect of fentanyl in IV PCA[4,5,14,18,20]. In our study, PCA had to be removed in 10 patients of IV PCA group. The most common cause to discontinue PCA infusion in IV PCA group was intolerable nausea and vomiting.

The two limitations of this study are as follows. The first, the

main medications of two PCA were different, we used morphine in epidural PCA and fentanyl in IV PCA. Fentanyl is the most common medication which used in IV PCA[2,4,5,14,16]. Because morphine is usually associated with nausea and vomiting symptom (incidence being 10%), morphine is commonly used rather than fentanyl in IV PCA[2,4,5,14,18]. Secondly, we investigated only pain relief for patient' outcome in two PCA groups. The future prospective randomized controlled study should be done for patient's functional outcome, hospital stay, time to ambulation and time to start full diet beyond pain control.

CONCLUSION

Epidural PCA group showed significant lower pain score than IV PCA group after 6 hours postoperatively (p<0.05). There was no statistically significant difference in adverse effect of PCA between two groups. The number of additional analgesics injection in epidural PCA group was lower than IV PCA group (p=0.0543). Prospective randomized controlled study should be needed for pain control, functional outcome, duration of hospital stay, time to ambulation, and time to start full diet.

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