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POSTOPERATIVE ANALGESIA FOR LUMBAR LAMINOPLASTY: SUBCUTANEOUS FENTANYL VS. EPIDURAL FENTANYL WITH ROPIVACAINE

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ABSTRACT
Spine surgery has severe postoperative pain. The present study compared postoperative analgesic effects of epidural infusion of bupivacaine with fentanyl and subcutaneous infusion of fentanyl in lumbar laminoplasty. Forty five patients for lumbar laminoplasty were divided into three groups; control, epidural and subcutaneous groups. Before the end of surgery, an epidural catheter was put into the center of the surgical region under direct vision by a surgeon in the epidural group. From the end of surgery, fentanyl 1000 µg + droperidol + 0.2% ropivacaine 76 mL (total 100 mL) was administered epidurally at 2 mL/h in the epidural group, fentanyl 1000 µg + droperidol + saline 26 mL (total 50 mL) was administered subcutaneously at 1 mL/h in the subcutaneous group. Nothing was administered in the control group. Postoperative pain was rated using a visual analogue scale (VAS) 0 to 10. Analgesic rescue was intramuscular pentazocine 15 mg. The frequency of pentazocine, VAS scores, hemodynamics, nausea/vomit and headache were compared among the groups. Frequency of pentazocine was significantly larger in the order of the Control, Subcutaneous, and Epidural groups. VAS scores were significantly lower in the order of the Epidural, Subcutaneous, and Control groups. Frequency of nausea, vomit, and headache were not different among the groups. In conclusion. for postoperative analgesia in lumbar laminoplasty, an epidural infusion of fentanyl, droperidol and 0.2% ropivacaine had better postoperative analgesia than subcutaneous infusion of fentanyl and droperidol without increasing side effects.

KEYWORDS: Spine surgery, Postoperative analgesia, Epidural, Subcutaneous, Fentanyl, Ropivacaine.

1. INTRODUCTION
Spine surgery has severe postoperative pain in comparison with other surgical procedures. Severe pain persisted for 3 days after spine surgery.[1] Incisional pain comes the first, which activates peripheral receptors that transmit the information via spinal cord to the brain. Secondary, damage to muscle, ligament, bone, intervertebral disc and facet joint induced musculoskeletal pain. Intravenous infusion of opioids or non-steroidal anti-inflammatory drugs (NSAIDS) had been used for postoperative analgesia in spine surgery. After spine surgery, intravenous fluid infusion is not necessary on the next day because patients can eat and drink, therefore, to keep analgesia for a few postoperative days, we have used subcutaneous infusion not intravenous infusion of fentanyl. However, opioid infusion or NSAIDS are not enough for postoperative analgesia in spine surgery. Many studies investigated effects and side effects of epidural analgesia. Most of the studies resulted in benefits of epidural analgesia with a little side effects,[1-4] but some did not have positive results for epidural analgesia.[5,6] In contrast, there is no study of continuous subcutaneous fentanyl for postoperative analgesia in spine surgery. The present study compared postoperative analgesic effects of epidural infusion of bupivacaine with fentanyl and subcutaneous infusion of fentanyl in lumbar laminoplasty.

2. MATERIALS AND METHODS
2.1. Materials
After the approval of the ethics committee of the hospital and informed consent from patients, 45 patients aged 30 to 60 years, ASA physical status I and II, for lumbar laminoplasty were enrolled in this study. Those who had allergy to agents used, liver, renal, heart, or brain disease, who were in drug abuse, who had a history of spine surgery, or whose body mass index > 30 were excluded. They were randomly divided into three groups; control, epidural and subcutaneous groups with each 15 patients by a sealed envelope technique on the day of surgery.

2.2. Intervention
No premedication was administered. Anesthesia was induced with midazolam, propofol, fentanyl and vecuronium and maintained with propofol, fentanyl and 50% nitrous oxide.

Before the end of surgery, an epidural catheter was put into the center of the surgical region under direct vision by a surgeon in the epidural group. From the end of surgery, fentanyl 1000 μg + droperidol 10 mg + 0.2% ropivacaine 76 mL (total 100 mL) was administered epidurally at 2 mL/h in the epidural group, fentanyl 1000 μg + droperidol 10 mg + saline 26 mL (total 50 mL) was administered subcutaneously at 1 mL/h in the subcutaneous group. Nothing was administered in the control group.

2.3. Measurements

Postoperative analgesia was rated using a visual analogue scale (VAS) 0 to 10. When VAS score was 5 or more, pentazocine 15 mg was administered intramuscularly. The frequency of pentazocine administration, hemodynamics and side effects such as nausea / vomit and headache were compared among the three groups in postoperative 48 hours.

2.4. Data analysis

Power analysis was performed to detect the differences of VAS scores with power of 0.90 and effect size of 0.25 using the G Power™ software (University Mannheim, Germany). It showed that 45 patients were necessary.

Statistical analysis was performed with factorial analysis of variance (ANOVA) and chi-square test for demographic data, Kruskal Wallis test followed by Mann-Whitney U test for VAS score, repeated measures ANOVA for hemodynamics and chi-square test for the number of patients. The p value less than 0.05 was considered statistically significant.

3. RESULTS

Data were expressed as mean ± standard deviation, median and range, or number. Demographic data were not different among the groups (Table 1). No patients in the Epidural group had a trouble of epidural catheterization during the study. Frequency of pentazocine administration was significantly larger in the order of the Control, Subcutaneous and Epidural groups (Table 2). VAS scores were significantly lower in the order of the Epidural, Subcutaneous and Control groups (Fig.1). Frequency of nausea, vomit and headache were not different among the three groups (Table 3).

Table 1. Demographic data

	Epidural	Subcutaneous	Control
Age (years)	48 ± 9	53 ± 10	51 ± 10
Male/Female	6/9	7/8	5/10
Height (cm)	158 ± 17	154 ± 13	152 ± 14
Body weight (kg)	57 ± 10	61 ± 12	59 ± 11
Duration of surgery (min)	248 ± 46	273 ± 71	255 ± 59
Number of spine operated	2 (1-3)	2 (1-3)	2 (1-3)

Mean ± standard deviation or number.

Table 2. Frequency of pentazocine

	Epidural	Subcutaneous	Control
0 – 24 h	1 (0-2)*,+	3 (1-4)*	6 (3-8)
24 – 48 h	1 (0-2)*,+	2 (0-3)*	4 (2-5)

Median and range (parenthesis); *: P < 0.05 vs. Control group; +: P < 0.05 vs. Subcutaneous group.

Table 3. Nausea, vomit and headache

		Epidural	Subcutaneous	Control
Nausea	0 – 24 h	2 (0-4)	3 (1-4)	2 (0-4)
	24 – 48 h	2 (0-3)	2 (0-3)	1 (0-2)
Vomit	0 - 24 h	1 (0-2)	1 (0-2)	0 (0-1)
	24 – 48 h	0 (0-1)	1 (0-2)	0 (0-1)
Headache	0 – 24 h	1 (0-2)	1 (0-1)	1 (0-1)
	24 – 48 h	0 (0-1)	0 (0-1)	0 (0-1)

Median and range (parenthesis).

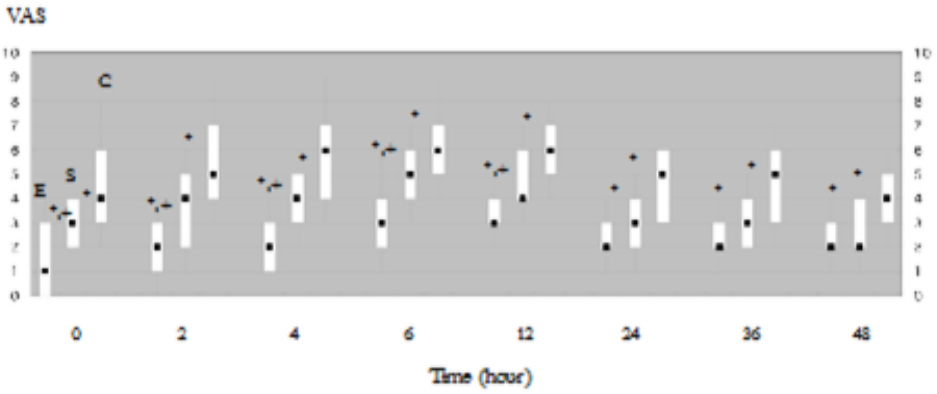

Fig.1

Fig.1 FIGURE LEGENDS

Fig.1 Visual Analogue Scale (VAS) score

Median (black square), first and third quartile (box), and maximum and minimum (bar) are shown. E, Epidural group; S, Subcutaneous group,; C, Control group

*: P < 0.05 vs. the Control group; +: P < 0.05 vs. the Subcutaneous group.

4. DISCUSSION

This study showed an epidural infusion of 2 mL/h of fentanyl 1000 μg + droperidol 10 mg + 0.2% ropivacaine 76 mL had better postoperative analgesia than subcutaneous infusion of 1 mL/h of fentanyl 1000 μg + droperidol 10 mg + saline 26 mL in lumbar laminoplasty of 1 to 3 segments. Neither epidural infusion nor subcutaneous infusion increased postoperative nausea, vomit and headache.

Postoperative analgesic requirement was related to the number of vertebrae involved in spine surgery.[7] Our study included 1 to 3 segments of the lumbar spine and no differences of the number of segments were observed among the three groups. Therefore, our three groups were comparable.

We could not find any studies to use subcutaneous infusion of opioids for postoperative pain in spine surgery. Subcutaneous fentanyl 0.5 μg/kg/h decreased postoperative pain, but increased nausea and vomit in upper extremity surgery.[8] Their infusion dose was larger than our dose (20 μg/h), but we could not compare the effects between different surgeries. However, our results suggest that subcutaneous fentanyl about 20 μg/h decreased postoperative pain without increasing nausea, vomit and headache.

In spinal fusion surgery of 1 -2 segments, an epidural infusion of 0.2% ropivacaine at 8 ml/h with bolus of 8 mg ropivacaine every 20-min. decreased postoperative pain in comparison with intravenous piritramide 7.5 mg on patient demand.[3] Their infusion rate was larger than ours, but their procedure was spinal fusion while our procedure was laminoplasty. In addition, they used intermittent piritramide, but we used infusion of fentanyl. Therefore, we could not compare their results with ours. Van Boerum et al.[9] reported that epidural infusion of 0.1% bupivacaine and morphine had better analgesia than intravenous patient controlled analgesia (PCA) in spinal fusion surgery, but they did not show the contents of intravenous PCA. Our patients received laminoplasty, which might induce less postoperative pain than spinal fusion.

Matsui et al.[10] reported a continuous epidural block with 0.25% bupivacaine and buprenorphine at 0.83 mL/h with patient controlled 3 mL bolus of 2% lidocaine with 0.015 mg buprenorphine decreased postoperative pain in lumbar laminectomy of 1 to 3 segments. Their surgical procedure was like ours. They used less infusion rate than us, but they administered through the epidural catheter inserted 2 cm cranial from the surgical site, while we put the epidural catheter in the center of surgical area. Their effects might be mostly due to buprenorphine because 0.83 mL/h of buprenorphine infused at 2 cm cranial from the surgical region could not reach surgical site. However, our ropivacaine was infused at 2 mL/h in the center of surgical region, which might have the effects on the surgical site. Sundarathiti et al.[11] inserted an epidural catheter 3 to 5 cm cephalad from the incision and they administered epidural levobupivacaine through surgery. After surgery, 0.1% levobupivacaine with morphine was infused at only 4 mL/h in patients received at least 5 segments instrumentation of the vertebrae. This had great postoperative analgesic effects. Theirs also might be the effects of morphine.

A single epidural injection of 0.1% ropivacaine before one-level posterior lumbar interbody arthrodesis was effective for reducing postoperative pain.[12] In this study, C-reactive protein on the third postoperative day was lower in the epidural group than the control group. This suggests that anti-inflammatory action of ropivacaine decreased inflammation by surgery, which might affect postoperative pain. Epidural anesthesia and postoperative epidural infusion of ropivacaine, fentanyl and epinephrine decreased postoperative pain and stress response.[2] We did not measure inflammatory and stress

parameters, but we could expect the same effects as their results. In contrast, an epidural 0.125% levobupivacaine 0.1 mL/kg/h added to continuous intravenous infusion of piritramide provided better analgesia than piritramide alone but had no effects on stress response.[4]

However, 40% of the patients had transient sensory deficits and 22% had transient motor block by epidural infusion after spine surgery.[1] Kanamori et al.[13] reported that postoperative epidural infusion of 0.25% bupivacaine and buprenorphine with PCA decreased pain but delayed recovery of enteroparesis. We did not check bowel peristalsis in this study, but we had no complaints from patients and nurses. Therefore, we thought an epidural ropivacaine with fentanyl did not inhibit bowel peristalsis.

Cohen et al.[5] reported that epidural morphine with bupivacaine had no clinical advantage over intravenous morphine for postoperative analgesia in lumbar spinal fusion of 1 to 2 segments. They used 0.0625% bupivacaine, which might not be enough concentration to have analgesic effects. In addition, there was no epidural infusion rate in their article. Therefore, another possibility was low infusion rate. There is another report that shows an epidural infusion of 0.1% bupivacaine and 5 μg/mL fentanyl at 2 mL/h and intravenous infusion of 10 μg/h fentanyl had no difference in postoperative analgesia in spinal fusion of 1 to 2 segments.[6] We had better analgesia with 2 mL/h of epidural 0.2% ropivacaine + fentanyl 20 μg than intravenous fentanyl about 20 μg/h in laminoplasty of 1 to 3 segments. Therefore, their epidural infusion rate might be low for postoperative analgesia in spinal fusion. Cassady et al.[14] studied that an epidural 0.125% bupivacaine with fentanyl 0.0025 mg/mL at 0.28 mL/kg/h and intravenous PCA with morphine had no difference in postoperative analgesia in spinal fusion of over 12 segments for scoliosis. In their cases, even a high infusion rate could not cover all the surgical segments from one epidural catheter. Our present study focused on lumbar laminoplasty of 1 to 3 segments, therefore, further studies are necessary on spine fusion and longer segments.

5. CONCLUSION

An epidural infusion of 2 mL/h of fentanyl 1000 μg + droperidol 10 mg + 0.2% ropivacaine 76 mL had better postoperative analgesia than subcutaneous infusion of 1 mL/h of fentanyl 1000 μg + droperidol 10 mg + saline 26 mL without increasing side effects in lumbar laminoplasty of 1 to 3 segments.

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