Pre-incisional caudal epidural blockade and the relief of pain after lumbar spine operations

M. Kakiuchi¹, K. Abe²

¹ Department of Orthopaedic Surgery, Osaka Police Hospital, Osaka, Japan

² Department of Anaesthesiology, Osaka University Medical School, Osaka, Japan

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Summary. We report the effect of pre-incisional caudal epidural injection of a mixture of 20 ml 0.25% bupivacaine and 0.1 mg buprenorphine performed under general anaesthesia for relieving wound pain after posterior interbody fusion and laminotomy for spinal stenosis. Pain was compared in groups with and without blockade: 24 and 23 patients with fusion, and 30 and 28 with laminotomy respectively. In the first 12 h after each operation, the group with blockade required additional analgesics less frequently and had a lower visual analogue scale score than those without blockade. In, and after, the second 24 h patients with hypotension of 10 mm Hg, or more, after the blockade required additional analgesics less frequently than those without blockade for both operations and had a lower visual analogue score than those without blockade for laminotomy, but not for fusion. This is a simple procedure for relieving wound pain and in patients with hypotension caused by the block, the effect continued even after the analgesic action had disappeared.

Résumé. Nous rapportons l'action de l'injection épidurale caudale préopératoire d'un mélange de bupivacaine et de buprénorphine appliquée sous anesthésie générale pour diminuer les douleurs après fusion lombaire inter-somatique ou laminotomie pour sténose. Les douleurs ont été comparées chez les groupes avec ou sans bloc épidural: 24 et 23 patients respectivement ayant subi une

arthrodèse lombaire et 30 et 28 patients respectivement ayant subi une laminotomie. Dans les 12 premières heures postopératoires, le groupe avec blocage épidural a nécessité moins souvent des analgésies additionnelles (suppositoire de diclofénac ou pentazocine intra-musculaire) et le score de l'échelle analogique visuelle était meilleur que dans le groupe sans injection épidurale. Dans les secondes 24 h et plus tard, les patients qui avaient une chute tensionnelle de plus de 10 mm de mercure après l'injection épidurale ont eu moins besoin d'analgésie additionnelle que ceux sans bloc épidural et cela pour les deux types d'intervention; d'autre part, le score analogique visuel a été meilleur que dans le groupe sans bloc pour l'intervention de laminotomie mais pas pour l'intervention de fusion inter-somatique. Il n'y a jamais eu de blocage moteur post-opératoire. Cette étude prouve que l'injection épidurale est une méthode simple pour diminuer les douleurs. Chez les patients qui ont eu une baisse de tension artérielle par blocage sympathique, l'effet s'est poursuivi même après que l'action analgésique avait disparu.

Introduction

Tissue damage at operation and, the subsequent inflammatory reaction, generates sensory signals which trigger a prolonged state of increased excitability in the central nervous system and leads to hypersensitivity to pain [2, 3, 7, 11, 14, 15]. Inhalation general anaesthesia produces only a weak

Reprint requests to: M. Kakiuchi, Department of Orthopaedic Surgery, Osaka Police Hospital, 10-31 Kitayama-cho, Tennoji-ku, Osaka 543, Japan

analgesic action and cannot totally block sensory signals. Epidural anaesthesia produces a much stronger analgesic action.

In lumbar spinal surgery, pre-incisional lumbar epidural infusion of anaesthetic agents may increase the risk of cerebrospinal fluid leakage, or distort the anatomy, if there is stenosis or a space-occupying lesion. Caudal injection through the sacral hiatus is easy and does not carry these risks.

We considered whether pre-incisional caudal injection of local anaesthetics and an opioid in the lumbar area could produce analgesia and prevent hypersensitivity to pain, as well as producing a direct analgesic action in the early postoperative period, and whether the prevention of this state could minimise the patient's discomfort, even in the late postoperative period.

The purpose of this study was to evaluate the early and late effects of caudal epidural blockade in relieving wound pain after posterior lumbar surgery under general anaesthesia, and to determine the conditions in which such a blockade is most effective.

Patients and methods

All the operations were done by MK. The patients were given inhalation general anaesthesia and were placed prone on a Hall frame. Additional intraoperative analgesia was achieved by a single pre-incisional caudal epidural injection of a mixture of 0.1 mg buprenorphine hydrochloride and 20 ml of 0.25% bupivacaine hydrochloride at about 20 ml/min, 10 min before the skin incision. The control group received neither opioids nor neural blockade. The patients and the nursing staff were informed of the effect of epidural blockade in relieving intraoperative, but not postoperative, pain.

Patients were selected who had degenerative lumbar stenosis and who were being treated by one of two operations; 60 patients had a bilateral laminotomy and another 60 underwent a single level posterior lumbar interbody fusion (PLIF) with a pedicle screw system (Steffee VSP or TSRH). To reduce the influence of residual pain from the original disease, patients who needed rectal or intramuscular analgesics for pain relief in the last week before operation were excluded.

The patients were alternately allocated to have caudal blockade or not, so that the study and control groups for each operation each consisted of 30 patients. Those who were given an anti-inflammatory drug for subsiding fever, who were given analgesics for postoperative pain other than pain in the wound or who refused rectal analgesic after operation were excluded. The numbers in the two groups were 30 and 28 respectively with a laminotomy and 24 and 23 who had a PLIF. Those receiving caudal epidural blockade were divided into 2 groups depending on whether or not they had a decrease of systolic arterial pressure of 10 mm Hg or more within the first 30 minutes of the injection.

Those who asked for it were given a 50 mg diclofenac suppository after operation. If the pain was still unbearable 30 min later, 15 mg of pentazocaine was given intramuscularly. The frequency of analgesics given on demand, the duration of

Fig. 1. Visual analogue pain scores in patients who underwent lumbar laminotomy (left) and posterior lumbar interbody fusion (right). The values are means of the scores. The level of significance is indicated as difference from the control

administration, the period until the pain had gone, and the score on a visual analogue scale were compared in both groups for each operation.

Unpaired *t*-test and, if not applicable, Fisher's exact probability test was used to determine the statistical significance of differences (significant at $P < 0.05$).

All patients were given 0.5 mg atropine sulphate and 50 mg hydroxyzine intramuscularly before induction. Anaesthesia was induced with intravenous thiopental sodium (5 mg/kg) and vecuronium bromide (0.1 mg/kg). After intubation, anaesthesia was maintained with 70% nitrous oxide and 30% oxygen supplemented with isoflurane (0.5–1.5%) and intravenous pancuronium bromide. At the end of anaesthesia, the pancuronium blockade was reversed with 2.5 mg neostigmine and 1.0 mg of atropine sulphate.

Results

There were no significant differences between the study and control groups for each operation for gender, age, weight, height and operating time (Tables 1 and 2). There was no motor weakness in the legs of any patient who received caudal epidural blockade. In the first 12 h after operation the patients in the study group showed a significantly reduced need for additional analgesics (Tables 3 and 4) and had lower visual analogue scores compared to those in the control group for each

Table 1. Details of patients who underwent lumbar laminotomy

	Patients with caudal blockade (study group)						Patients without blockade (control)
	With decrease in blood pressure after caudal injection			Without decrease in blood pressure after caudal injection		Both groups	
Number of patients	18			12		30	28
Gender (men: women)	(10:8) NS			(4:8) NS		(14:16) NS	(17:11)
Age (years)	61.9 ± 11.0 NS			55.2 ± 13.8 NS		59.0 ± 12.5 NS	57.1 ± 14.1
Height (cm)	161.5 ± 11.2 NS			155.2 ± 7.2 NS		159.1 ± 10.2 NS	158.7 ± 11.0
Weight (kg)	61.6 ± 9.1 NS			54.0 ± 9.4 NS		58.7 ± 9.8 NS	59.9 ± 12.0
Operation time (min)	152.1 ± 32.8 NS			156.3 ± 38.4 NS		153.8 ± 34.5 NS	174.7 ± 46.3
Number of patients who had undergone previous posterior lumbar surgery	0			5		5	4

Values indicated as $X \pm Y$ are means and standard deviations. Level of significance is indicated as difference from control. NS: not significant

Table 2. Details of patients who underwent posterior lumbar interbody fusion

	Patients with caudal blockade (study group)						Patients without blockade (control)
	With decrease in blood pressure after caudal injection		Without decrease in blood pressure after caudal injection		Both groups		
Number of patients	18		6		24		23
Gender (men: women)	(8: 10)	NS	(2: 4)	NS	(10: 14)	NS	(12: 11)
Age (years)	61.6 ± 15.5	NS	48.3 ± 5.1	NS	58.3 ± 14.7	NS	53.2 ± 13.9
Height (cm)	153.6 ± 9.5	<i>P</i> < 0.005	166.8 ± 9.2	NS	156.9 ± 10.9	NS	162.9 ± 10.0
Weight (kg)	53.8 ± 9.7	NS	64.5 ± 15.7	NS	56.5 ± 11.9	NS	59.0 ± 8.2
Operation time (min)	231.2 ± 57.4	NS	221.0 ± 74.4	NS	228.7 ± 59.5	NS	259.0 ± 74.2
Number of patients who had undergone previous posterior lumbar surgery	0		3		3		3

Values indicated as $X \pm Y$ are means and standard deviations. Level of significance is indicated as difference from control. NS: not significant

Table 3. Postoperative pain in patients who underwent lumbar laminotomy

	Patients with caudal blockade (study group)						Patients without blockade (control)				
	With decrease in blood pressure after caudal injection		Without decrease in blood pressure after caudal injection		Both groups						
Period until the pain had gone (days)	5.2	±2.6	NS	6.3	±2.9	NS	5.6	±2.7	NS	6.3	±1.9
Duration of analgesic administration (days)	1.50	±1.76	<i>P</i> <0.01	3.00	±2.13	NS	2.10	±2.02	NS	3.00	±1.78
Number of patients receiving pentazocine	0		NS	1		NS	1		NS	2	
Frequency of administration of diclofenac and pentazocine											
total	1.17	±1.38	<i>P</i> <0.00005	3.38	±1.90	NS	2.05	±1.92	<i>P</i> <0.01	3.59	±2.11
in the first 12 h	0.17	±0.38	<i>P</i> <0.000000002	0.83	±0.72	NS	0.43	±0.63	<i>P</i> <0.000005	1.22	±0.55
in and after the second 24 h	0.78	±1.07	<i>P</i> <0.01	1.88	±1.32	NS	1.22	±1.28	NS	2.03	±1.96

Values indicated as $X \pm Y$ are means and standard deviations. Level of significance is indicated as difference from control. NS: not significant.

Table 4. Postoperative pain in patients who underwent posterior lumbar interbody fusion

	Patients with caudal blockade (study group)						Patients without blockade (control)
	With decrease in blood pressure after caudal injection		Without decrease in blood pressure after caudal injection		Both groups		
Period until the pain had gone (days)	7.4 ±1.9	NS	6.8 ±4.3	NS	7.2 ±2.6	NS	7.7 ±2.0
Duration of analgesic administration (days)	2.6 ±1.1	NS	4.3 ±3.2	NS	3.0 ±1.8	NS	3.4 ±2.1
Number of patients receiving pentazocine	0	<i>P</i> <0.01	0	NS	0	<i>P</i> <0.002	8
Frequency of administration of diclofenac and pentazocine total	1.50±1.00	<i>P</i> <0.0005	2.25±2.22	NS	1.69±1.35	<i>P</i> <0.001	4.07±2.77
in the first 12 h	0.42±0.51	<i>P</i> <0.0005	0	N/A ^a	0.31±0.48	<i>P</i> <0.0001	1.43±1.08
in and after the second 24 h	0.92±0.90	<i>P</i> <0.02	2.00±2.16	NS	1.19±1.33	<i>P</i> <0.05	2.24±2.11
Number of patients receiving diclofenac and pentazocine in the first 12 h	5	<i>P</i> <0.002	0	<i>P</i> <0.001 ^a	5	<i>P</i> <0.0001	18

Values indicated as $X \pm Y$ are means and standard deviations. Level of significance is indicated as difference from control

^a Fisher's exact probability test was used because unpaired t-test was not applicable. NS: not significant. N/A: not applicable

operation (Fig. 1). Those in the PLIF study group required no pentazocaine, unlike the PLIF control group (Table 4).

In the study groups undergoing laminotomy and PLIF, 5 and 3 patients respectively had previous posterior lumbar operations. None of these had a decrease in blood pressure of 10 mm or more within 30 min of the caudal injection. Of those who had not had previous lumbar operations, 18 of 25 with a laminotomy and 18 of 21 with PLIF had a decrease in blood pressure after the caudal injection (Tables 1 and 2).

In, and after, the second 24 h after each operation during which the direct analgesic action of the blockade would have already disappeared, those with hypotension needed additional analgesics significantly less frequently than without blockade. There was no significant difference in frequency of analgesic administration (Tables 3 and 4), or in the visual analogue scores, between patients who did not have hypotension after caudal injection and those without blockade (Fig. 1). Those with hypotension after injection had significantly lower visual analogue scales than those without blockade in, and after, the second 24 h, but not in the third 24 h or later, following PLIF (Fig. 1).

Discussion

Pain after operation serves as an early warning system for detecting postoperative complications, such as epidural haematoma and infection. Continuous postoperative epidural infusion of anaes-

thetics or opioids may make patients completely free of pain and impair their normal pain mechanisms. It also involves a risk of unexpected and unnecessary blockade, such as respiratory depression or arrest, and increases the risk of wound infection.

The best pain relief after spinal operations is to reduce discomfort, while leaving normal pain mechanisms intact without increasing the risk of complications. This can be achieved by preventing pain hypersensitivity which can arise from two phases of sensory input from tissue damage, namely from stimuli directly from tissue damage or else associated with the inflammatory reaction to tissue damage occurring at hours or days after operation. Pre-emptive analgesia should eliminate both these phases of afferent input [1, 8, 9, 12, 15].

A concentration of 0.25% epidural bupivacaine is adequate to block sensory fibres [13], and provides analgesia for 2 to 4 h without motor blockade [6]. Epidural opioids are long acting and block dull pain from inflammation, but they have a slow onset and do not abolish the sharp pain from an incision [5]. Thus the bupivacaine provides analgesia for several hours and buprenorphine for rather longer, so that they block the operative pain and pain from the early inflammatory reaction. In our patients, 0.25% bupivacaine did not produce motor blockade.

Sympathetic vasoconstrictor fibres run from T1 to L2 segmental levels and neural blockade up to L2 or higher produces a sympathetic block [4]. Hypotension after epidural injection indicates that

the segmental spread is up to the upper lumbar or lower thoracic level. The absence of hypotension may indicate neural blockade at the lower 3 lumbar and sacral segments only, which will not produce analgesia in the whole operative area.

Early postoperative pain relief may be produced by preventing an established state of pain hypersensitivity and by direct action of the blockade and the agents absorbed into the blood stream. Pain relief in the second 24 h or later may be produced only by reducing pain hypersensitivity. In the patients who had laminotomy or PLIF, those who had hypotension required additional analgesics less frequently than those without blockade, both in the first 24 h, and later, and they had significantly lower visual analogue scores than those without blockade. This indicates that, when sufficient analgesia is achieved in the wound during operation, postoperative pain is relieved early and late.

In the patients who developed hypotension, caudal blockade in PLIF was less effective in reducing the score in the third 24 h and later than in laminotomy, suggesting a different degree of invasiveness between the two procedures. More severe inflammatory reaction may last longer than the analgesic effect and may have partly contributed to the development of pain hypersensitivity in PLIF.

When the epidural space is intact, caudal injection of 20 ml of the anaesthetic solution over 1 min induces analgesia up to the upper lumbar or lower thoracic level [10]. In some patients the injection is less effective in inducing analgesia up to the operative site compared with lumbar or upper thoracic epidural injection because of the distance between the two sites and spread through the stenotic space. This is likely to occur in those who have previous lumbar operations, and none of them developed hypotension. When the blood pressure does not decrease, a lumbar epidural injection of a smaller volume of solution through the interlaminar space above the stenosis should be done when the laminae are exposed and before the canal is opened. Another solution is rapid injection of a large volume of anaesthetic solution, but this increases cerebrospinal fluid pressure and might cause a cerebrovascular accident or spinal cord ischaemia [4].

Pre-incisional epidural blockade by caudal injection of bupivacaine and buprenorphine is a simple and effective way of relieving postoperative wound pain after operations on the lumbar spine performed under general anaesthesia, and allows

normal pain mechanisms to remain intact. In patients with hypotension 30 minutes after the blockade, effective pain relief continues after the direct analgesic action has disappeared.

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