

Original Article

Comparison of the effect of local anesthesia and general anesthesia on prognosis of decompression for thoracic spinal stenosis

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Abstract: To compare the effect of local anesthesia and general anesthesia on prognosis of decompression for thoracic spinal stenosis. From June 2005 to March 2011, 100 patients with thoracic spinal stenosis receiving decompression at our hospital were analyzed retrospectively. The technique used was the removal of posterior wall of the spinal canal via cap uncovering. The anesthesiologist divided the patients equally into observation group (local anesthesia) and control group (general anesthesia) based on the patients' serial number. The parameters measured were operation time, intraoperative bleeding, time of hospital stay, operation cost, postoperative Frankel grade recovery and postoperative JOA scores. All patients were followed up for 12-48 months either in outpatient clinic or at home. The operation time, intraoperative bleeding and time of hospital stay were obviously reduced in the observation group than in the control group; the hospitalization cost of the former was also lower ($P < 0.05$). Before surgery, the observation group had 11 patients of Frankel grade B, 18 patients of Frankel grade C and 21 patients of Frankel grade D. During the last follow-up, there were 8 patients of Frankel grade C, 11 patients of Frankel grade D and 31 patients of Frankel grade D. In the control group before surgery, there were 13 patients of Frankel grade B, 17 patients of Frankel grade C and 20 patients of Frankel grade D. For the last follow-up, there were 1 patient of Frankel grade B, 11 patients of Frankel grade C, 14 patients of Frankel grade D and 24 patients of Frankel grade E. JOA scores and response rate of the observation group were significantly higher than those of the control group 6 months after surgery and in the last follow-up ($P < 0.05$). Local anesthesia allows for intraoperative observation of neurological functions for decompression of thoracic spinal stenosis, thereby reducing the risks of spinal cord damage and other complications. This is particularly suitable for elderly patients who cannot tolerate general anesthesia. Moreover, local anesthesia has lower cost and causes less economic burden to the patients.

Keywords: Thoracic spinal stenosis, local anesthesia, general anesthesia

Introduction

Thoracic spinal stenosis (TSS) has a high clinical incidence [1]. Compression of the thoracic spinal segments can lead to numbness of lower limbs, walking instability, paralysis and urinary and fecal incontinence [2, 3]. These irreversible pathological changes severely affect the life of patients. Surgical treatment is the major way to treat TSS, but some researchers believe that the mode of anesthesia has a certain influence on the prognosis of surgery [4]. Thus we adopted cortical somatosensory evoked potentials (CSEP) monitoring of local anesthesia and general anesthesia for decompression of TSS. The prognosis was compared between patients re-

ceiving local anesthesia and general anesthesia.

Materials and methods

Baseline data

Inclusion criteria: ① TSS confirmed by imaging examinations and clinical diagnosis; ② ossification of ligamentum flava and posterior longitudinal ligament and intervertebral joint hyperplasia on CT and MRI; ③ aclassified as ASA grade I and II; ④ receiving decompression by the removal of posterior wall of the spinal canal via cap uncovering; ⑤ clinically manifesting abnormal gait, walking difficulty, numbness below the

compressed thoracic segments, probably accompanied by girdle-band sensation, spasms in lower limbs, sphincter of Oddi dysfunction and urinary and fecal dysfunction. Exclusion criteria: ① spinal fracture and tumors that require surgery; ② infections or diseases of respiratory system, immune system and endocrine system; ③ heart, brain, liver and kidney dysfunctions; ④ having been medicated with analgesics or hormone drugs two months before surgery; ⑤ sensorimotor dysfunction of the limbs and preoperative motor evoked potential abnormalities; ⑥ mental disorders.

From June 2005 to March 2011, 100 patients with TSS receiving decompression at our hospital were analyzed retrospectively. The technique used was the removal of posterior wall of the spinal canal via cap uncovering. The anesthesiologist divided the patients equally into observation group (local anesthesia) and control group (general anesthesia) based on the patients' serial number. The observation group had 27 males and 23 females aged 22-69 years (42.17 ± 5.83 years). The disease course was 5-66 months (23.93 ± 4.38 months); 22 patients were classified as ASA grade I and 28 patients as ASA grade II; 11 patients were of Frankel grade B, 18 patients Frankel grade C, and 21 patients Frankel grade D; the preoperative JOA score was 4.31 ± 1.58 . The control group had 32 males and 18 females aged 23-68 years (43.62 ± 3.62 years). The disease course was 4-65 months (22.86 ± 5.38 months); 26 patients were classified as ASA grade I and 24 patients as ASA grade II; 13 patients were of Frankel grade B, 17 patients Frankel grade C, and 20 patients Frankel grade D; the preoperative JOA score was 4.29 ± 1.67 .

The two groups did not differ significantly in baseline information, including gender, age, disease course, ASA grade, Frankel grade and preoperative JOA scores ($P > 0.05$). The experiment was approved by the Ethics Committee in the hospital and the informed consent was obtained from all patients.

Anesthesia and surgery

Local anesthesia was performed under CSEP monitoring. The patients took prone position with chest and abdomen propped up. The thoracic segments to be operated were determined by vital signs, X-ray scan, CT or MRI, fol-

lowed by imaging with C-arm X-ray device. Anesthesia was performed by infiltration through different layers with enhanced anesthesia. First 0.5% lidocaine (single injection < 8 mg) and 0.3 mg epinephrine were injected after excluding hypertension and heart diseases. The first layer infiltrated was the incised skin and the subcutaneous tissue. The next layer was erector spinae with a width of about 4 cm. Then the anesthetic was injected to the root along the lateral spinous process. The needle was turned towards the vertebral lamina, and the anesthetic was injected when approaching the bone. The anterolateral articular process was supposed to be completely infiltrated by the anesthetic. Analgesics such as 50 mg pethidine and 25 mg promethazine may be used additionally.

General anesthesia was performed for the control group. Before surgery, 10 mg luminal and 0.5 mg atropine was injected intramuscularly. The venous access was established after the patient was sent to the operation room. Before anesthesia, 8 ml of Ringer's lactate solution was infused. Anesthesia was induced using 0.1 mg midazole diazepam, 2.5 μ g sufentanil, 0.5 mg atracurium besylate and 1 mg propofol. Intubation was performed after oxygen therapy. Sufentanil was injected intravenously for maintenance of anesthesia; 0.1 mg vecuronium bromide was injected selectively, and 2% isoflurane was inhaled. Depending on the condition of the patient, 1 mg propofol was injected intravenously. Anesthesia with isoflurane was terminated 15 min before the surgery was over, and the pump delivery of sufentanil was completely stopped 5 min before the surgery was over.

Observation indicators

The two groups were compared with respect to operation time, intraoperative bleeding, time of hospital stay, operation cost, postoperative Frankel grade recovery and postoperative JOA scores. The response rate evaluated by JOA was calculated as (postoperative JOA score-preoperative JOA score)/11-preoperative JOA score $\times 100\%$.

Statistical analysis

The database was established and the statistical analyses were performed using SPSS18.0 software. The measured data were reported as

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Table 1. Comparison of operation time, intraoperative bleeding, time of hospital stay and hospitalization cost between the two groups

Group	Case	Operation time	Intraoperative bleeding	Time of hospital stay	Hospitalization cost
Observation group	50	172.49 ± 31.56	307.49 ± 52.64	8.67 ± 2.25	3.26 ± 0.79
Control group	50	213.76 ± 29.18	412.31 ± 46.19	11.34 ± 1.78	3.92 ± 0.68
T value		4.8387	6.1729	3.0915	1.0124
P		< 0.05	< 0.05	< 0.05	< 0.05

Table 2. Comparison of Frankel grades before surgery, 1 month after surgery and during the last follow-up between the two groups

Group	Preoperative Frankel grade	Case	Frankel grade 1 month after surgery				Frankel grade during the last follow-up			
			B	C	D	E	B	C	D	E
Observation group	B	11	1	7	3	0	0	6	2	3
Control group		13	3	8	2	0	1	7	4	1
Observation group	C	18		4	10	4		2	9	7
Control group		17		5	9	3		4	9	4
Observation group	D	21				21				21
Control group		20			2	18			1	19

Table 3. Comparison of JOA scores and response rate between the two groups before surgery, 6 months after surgery and during the last follow-up

Group	Case	Preoperative JOA score	JOA score 6 months after surgery	JOA score during the last follow-up	Response rate
Observation group	50	4.31 ± 1.58	7.55 ± 2.64	7.84 ± 2.41	(48.94 ± 22.67)%
Control group	50	4.29 ± 1.67	6.91 ± 1.86	7.11 ± 1.92	(40.33 ± 21.52)%
T/X ² value		0.9726	3.1184	2.6593	2.3517
P		> 0.05	< 0.05	< 0.05	< 0.05

$\bar{X} \pm s$ and compared by t-test. The count data were expressed as percentages and analyzed by using χ^2 test. $P < 0.05$ was considered statistically significant.

Results

The operation time, intraoperative bleeding and time of hospital stay in the observation group were significantly lower compared with the control group; the hospitalization cost of the former was also reduced ($P < 0.05$) (**Table 1**). The patients were followed up for 12-48 months either in outpatient clinic or at home. The patients of the observation group had better Frankel grades 1 month after surgery and during the last follow-up as compared with the control group (**Table 2**). JOA scores and response rate of the observation group were significantly higher than those of the control

group 6 months after surgery and during the last follow-up ($P < 0.05$) (**Table 3**). All patients achieved complete bony fusion during the follow-up period without loosening and fracture of implants and surgical site infection.

Discussion

The pathogenesis of TSS is still unclear, and many researchers attribute it to degenerative factors. According to the related report, TSS in 81% of patients is due to long-term physical labor [5]. The pathological characteristics of TSS are divided into two categories [6, 7]: (1) Degeneration and fibrosis and ossification of ligamentum flava, which leads to stenosis and degenerative changes. There will be hyperplasia and hypertrophy of articular process, thickening and gathering of articular capsule. TSS is more common in lower thoracic vertebrae, but much less common in upper and middle tho-

racic vertebrae; (2) Osteophytes, cartilaginous nodes and ossification of the posterior longitudinal ligament (OPLL) at the posterior margin of thoracic vertebrae, all of which can lead to TSS and spinal cord compression. OPLL is more common in the neck and the thoracic vertebrae. Posterior decompression can radically eliminate the anterior lesions with complete spinal cord decompression. TSS can result in impaired mobility of the thoracic spine and poor blood supply [8]. The aggravation of spinal cord damage is hard to detect in surgery under general anesthesia. This may cause paralysis or even irreversible nerve damage after surgery. CSEP is proved reliable for the monitoring of neurological functions under anesthesia and provides warning of ischemia and mechanical damage of the spinal cord [9]. But this technique is not fully popularized. Moreover, CSEP can only monitor the dorsal column but not the ventral column of the spinal cord [10].

Gunnarsson et al. reported that the sensitivity of SET monitoring was only 23.7% [11]. That is, only 23.7% of patients later showing spinal cord damage were found to be abnormal on SEP. These findings indicate that the SEP monitoring is far from perfect. SEP monitoring is not widely applied at grass-root hospitals in China. Chinese researchers reported that posterior laminectomy decompression under local anesthesia achieved satisfactory effect in treating ossification of the ligamentum flavum; the excellent and good rate was 81.3%, and the overall response rate was 93.8% [12]. This proves the effectiveness and superiority of local anesthesia. The aggravation of spinal cord damage is greatly reduced with less interference to the human body as compared with general anesthesia.

The preoperative communication was enhanced in the present study, and the patients were instructed to take exercises in prone position before surgery. Decompression was performed under local anesthesia with CSEP monitoring. It was found that the operation time, intraoperative bleeding and time of hospital stay in the observation group were significantly lower compared with the control group; the hospitalization cost of the former was also reduced ($P < 0.05$). Before surgery, the observation group had 11 patients of Frankel grade B, 18 patients of Frankel grade C and 21 patients of Frankel grade D. During the last follow-up, there were 8

patients of Frankel grade C, 11 patients of Frankel grade D and 31 patients of Frankel grade D. In the control group before surgery, there were 13 patients of Frankel grade B, 17 patients of Frankel grade C and 20 patients of Frankel grade D. For the last follow-up, there were 1 patient of Frankel grade B, 11 patients of Frankel grade C, 14 patients of Frankel grade D and 24 patients of Frankel grade E. This confirmed that local anesthesia was more favorable for the spinal cord damage recovery in TSS. The average JOA score was 7.84 ± 2.41 and the response rate was $48.94 \pm 22.67\%$ for the observation group in the last follow-up; for the control group, the result was 7.11 ± 1.92 and $40.33 \pm 21.52\%$, respectively. Thus local anesthesia was superior to general anesthesia in surgical decompression of TSS.

To conclude, local anesthesia for decompression of TSS allows for the observation of neurological functions during surgery, thereby reducing the risk of spinal cord damage. The complications or adverse events associated with general anesthesia can be avoided, including headache, blood pressure changes, urinary retention, respiratory and circulation dysfunction. Local anesthesia is recommended for elderly patients who cannot tolerate general anesthesia. Besides, local anesthesia has the extra benefits of lower cost.

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Disclosure of conflict of interest

None.

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