Int J Clin Exp Pathol 2014;7(12):8875-8880
www.ijcep.com /ISSN:1936-2625/IJCEP0002839

Original Article

Study on different surgical approaches for acute Lumber disk protrusion combined with Cauda Equina Syndrome

Lianbing Shen[1*], Liangqin Fang[2*], Yihua Qiu[3], Shunming Xing[1], Dechun Chen[1], Xiang He[1], Jinxin Wang[1], Jing Lai[1], Guohua Shi[1], Jiefeng Zhang[1], Teng Liao[1], Junming Tan[1]

[1]Center of Trauma Repair and Reconstruction of Chinese PLA and Department of Orthopedics, The 98th Military Hospital, Huzhou 313000, Zhejiang Province, People's Republic of China; [2]Center of Trauma Repair and Reconstruction of Chinese PLA, The 98 Clinical Medical College of Medical University of Anhui, Huzhou 313000, Zhejiang Province, People's Republic of China; [3]Department of Cardiology, The 98th Military Hospital, Huzhou 313000, Zhejiang Province, People's Republic of China. [*]Equal contributors.

Received September 28, 2014; Accepted November 13, 2014; Epub December 1, 2014; Published December 15, 2014

Abstract: To compare the long and short term effectiveness and complications of different surgical approaches for Lumber disk protrusion combined with Cauda Equina Syndrome and find a better surgical method for the disease. In this study, follow up records of 144 patients received conventional laminectomy and minimally invasive decompression and fenestration 48 hours within acute injury of lumber disk protrusion combined with Cauda Equina Syndrome were analyzed. Surgical outcome immediately and 3, 6, 12, 36 months after the surgery were compared to evaluate the effectiveness two different approaches. The results indicated that there are no significant differences regarding age, sexual proportion, body mass index (BMI), visual analogue scale of pain (VAS) score as well as Frankel scores before the surgery, and significant differences VAS score as well as Frankel scores immediately after the surgery. In conclusion, minimally invasive decompression and fenestration can be of the same effectiveness and less complications comparing with the conventional laminectomy.

Keywords: Cauda Equina Syndrome, decompression and fenestration, laminectomy, lumber disk protrusion

Introduction

Lumber disk protrusion (LDH) combined with Cauda Equina Syndrome is not seen often in clinical practice [1, 2]. Most of LDH followed by Cauda Equina Syndrome (CES) happens at levels L4~5, L5~S1, L3~4 [3]. It can always be seen by CT scan that huge intervertebral disk medulla enters the spinal canal, which occupies one third of the latter. On occasions small hernia may lead to CES if there exists spinal stenosis. The symptoms of CES include serious back pain, bi- or unilateral sciatica, numbness in the saddle area, disfunction of sphincter, urinary incontinence as well as impotence in male patients. CES is a serious complication that needs immediate surgical intervention. Although it has been widely accepted that a surgical intervention is a gold standard for CES [4], there is not a standard procedure for the intervention. Most the surgeries were performed according to the type of the hernia and experience of the surgeon.

In this paper, we have retrospectively analyzed 144 patients who underwent surgical treatment within 48 hours at the occurrence of CES between 2005.9 and 2010.07 in our ortrhopedic center.

Materials and methods

Patents and methods

Inclusion criteria of the CES patients in our study include: ① have significant pain of lower limbs that induced by the CES; ② compression of nerve root can be identified by imaging techniques; ③ have no lumber spinal instability. Exclusion criteria include: ① have hernia in multiple levels; ② recurrence after a similar

Table 1. Basci characacteristics of patients in two groups

	Conventional (n=66)	Minimal (n=78)	P
Age	39.1±5.9	38.6±6.8	0.32
Female (%)	21 (31.8)	25 (32.1)	0.21
BMI	27.4	27.6	0.15
VAS	6.9	6.7	0.36
ODI	15.4	15.7	0.81
JOA	17.6	16.9	0.63
Frankel score	2.1	2.0	0.27

Table 2. Clinical results of patients in two groups

Group	Evaluation after the surgery				
	Excellent	Fine	OK	Unsatisfactory	P
Conventional (n=66)	54	16	8	7	>0.05
Minimal (n=78)	60	21	12	8	

surgery; ③ have fracture, infection or tumor on vertebral body.

Surgical methods

All the patients used continuous epidural anesthesia. Bend hip and knee to the operating table, put the abdomen on overhanging position as much as possible. Choose the posterior median line of lumber vertebrae, use tomographic photo of C arm to localize the articular process of the surgery. Decide the surgical incision according to the position of free intervertebral disk after precise localization. In both groups, a 3-6 cm incision was taken at posterior median incision site, following by blunt dissection of spinous process. Laminectomy tractor was used to expose the vertebral plate interval. Transection, minimal incisional fenestration laminectomy or traditional laminectomy was performed on both sides of the vertebral plate. Drains were placed after complete hemostasis and washing.

Frankel score grading: Patients were graded for four grades according to the pain, numbness, mobility of the lower limbs and functionality of the sphincter. Frankel grade 0: complete numbness and loss of mobility; Frankel grade 1: hypoesthesia of the lower limbs, has muscle strength of 0-2 degrees and with significant functional disability of sphincter; Frankel grade 2: have significant loss of sensation, muscle strength of 3 degrees, functional disability of sphincter; Frankel grade 3: have slight loss of sensation, muscle strength of 4-5 degrees, have no functional disability of sphincter; Frankel grade 4: have normal pain, sensation, mobility as well as function of sphincter.

Among all the patients, there are 5 patients of Frankel grade 0, 97 patients with Frankel grade 1-2, 57 patients with Frankel grade 3-4. Preoperational lumber VAS pain score is a mean of 6.9, mean ODI score is 15.4. After the surgery, the VAS score decreased to 1.5, ODI score decreased to 3.8.

Nakano N standard [5]: excellent: have no pain and numbness, normal sphincter function, have no difficulty in normal life and work. Fine: have no pain and numbness, significant recovery of sphincter function, can have basically normal life and work. OK: have significant release of pain and numbness, partial recovery of sphincter and lower limb function, still have difficulty in walking and gait abnormality, can take care of oneself. Worse: symptoms not changed even worsened comparing to pre-operation.

All patients received surgical treatment 48 hours within the appearance of CES. Antibiotics were used routinely for 5 days after the surgery, the drainage pipe was extracted 48 hours after the surgery.

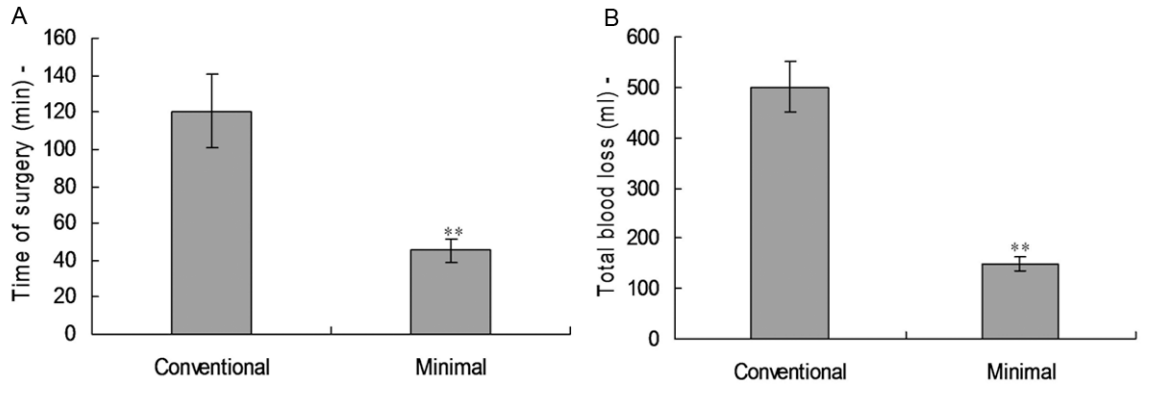
Statistical analysis

We used SPSS 19.0 for windows (SPSS Inc, Chicago, Illinois) for statistical analysis. All data were presented as mean±standard deviation (SD) or frequency. Logistic Regression correlates different parameters, VAS, ODI, JOA scores. All tests were set as two sides and a *P* value of <0.05 was considered statistical significant.

Results

Basic data of patients

Clinical manifestations: among 144 patients, 86 were male, 58 were female, has an average age of 39 (20-65), 122 patients complained of severe back pain, 78 reported pain on a lower limb, 46 reported pain on both lower limbs. 96 reported numbness in saddle area, 16 reported functional disability of sphincter, decrease



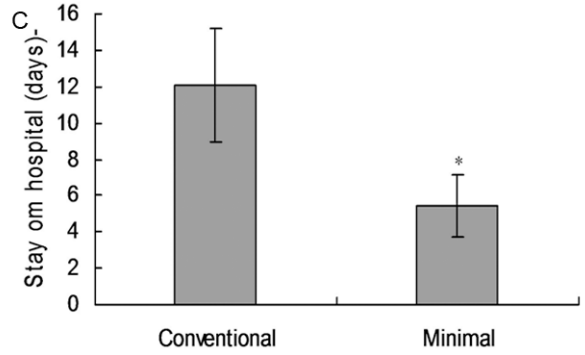


Figure 1. Distribution of time of surgery, blood loss and stay time in hospital in the conventional group and minimal group. A. Time of surgery; B. Blood loss amounts; C. Stay time in hospital. *P<0.05 and **P<0.01 represent index in minimal group compared to index in conventional group.

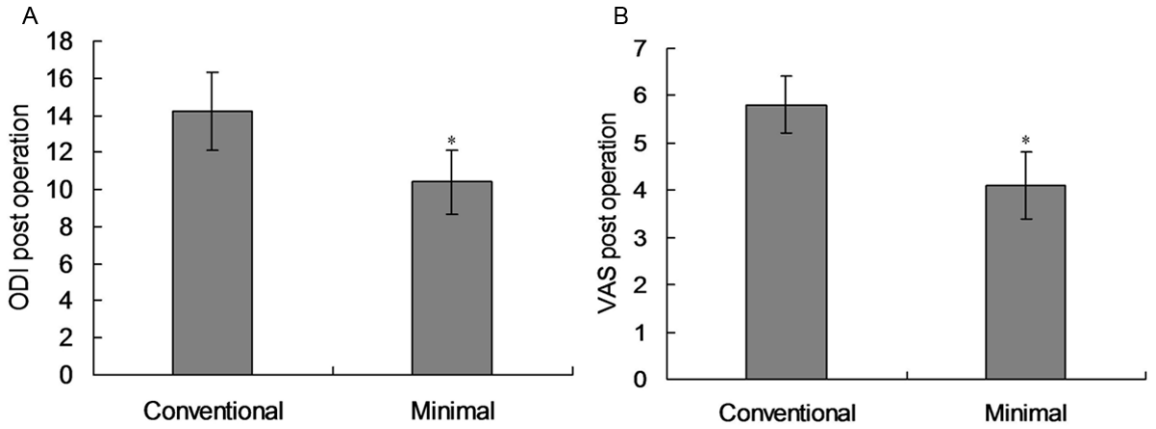


Figure 2. ODI and VAS scoring for the conventional group and minimal group. A. ODI scoring; B. VAS scoring. *P<0.05 represents ODI socres or VAS scores in minimal group compared to scores in conventional group.

in sensation and muscle strength of both lower limbs in 74 patients, decrease in sensation and muscle strength of one lower limb in 28 patients. Lasegue syndrome is positive in all patients.

Clinical characteristics of patients

Tomographic examination showed obvious hernia of intervertebral disk in all 144 patients, including hernia of L4-5 disk in 7 patients, L4-5 in 52 patients, L_5S_1 in 85 patients. Central type in 121 patients and partial central type in 33 patients.

66 patients underwent traditional laminectomy and 78 underwent minimal incisional fenestration laminectomy. There is no significant difference between two groups regarding age, sexual proportion, body mass index (BMI), visual analogue scale of pain (VAS), JOA score as well as Frankel scores (**Table 1**).

Table 3. Comparison of time of surgery total blood loss ODI and VAS scores between two groups

		Conventional (n=66)	Minimal (n=78)	P
Time of surgery		120.6±20.1	45.2±6.4	<0.01
Total blood loss		500.7±150.4	150.4±13.5	<0.01
Stay in the hospital		12.1±3.1	5.4±1.7	0.02
ODI index	Post operation	14.2	10.4	0.04
	3 months	3.8	3.4	0.7
	6 months	3.1	3.2	0.14
	12 months	2.5	2.6	0.21
	36 months	2.4	2.7	0.17
VAS score	Post operation	5.8	4.1	0.05
	3 months	1.5	1.6	0.37
	6 months	1.4	1.2	0.62
	12 months	1.2	0.8	0.34
	36 months	0.7	0.7	0.51

Table 4. Intraoperational complications in two groups

Intraoperational complications	Conventional (n=66)	Minimal (n=78)	P
Rupture of spinal dura mater	6	7	>0.05
Leakage of cerebrospinal fluid	2	2	>0.05
Incision infection or discitis	3	2	>0.05
Contusions of nerve root	1	1	>0.05

Outcomes

According to the Nakano N evaluation system, after the surgery, we found that 114 patients gained excellent recovery, 37 gained fine recovery, 20 gained OK recovery, 15 gained unsatisfactory recovery. The proportion of patients who gained excellent and fine recovery is 81.1% (**Table 2**).

Blood loss, operative time, hospital time and scores

Different time points after the surgery, there are significant differences between the two groups regarding time of surgery (**Figure 1A**), total blood loss during the surgery (**Figure 1B**), total time for stay in the hospital (**Figure 1C**). Significant differences were demonstrated regarding NDI index, ODI scores (**Figure 2A**), VAS score (**Figure 2B**) as well as Frankel grading immediately after the surgery, and 3, 6, 12, 36 months postoperatively (**Table 3**).

Intraoperational complications post operation

There are significant differences regarding intraoperational complications such as rupture of spinal dura mater, leakage of cerebrospinal fluid, incision infection or discitis, contusions of nerve root, Cauda Equina Syndrome between the two groups in the surgery (**Table 4**).

Discussion

Patients progress fast several hours after the incidence of CES, clinical manifestations include sensational loss in the saddle area, functional loss of sphincter as well as severe sciatica. Most patients can be easily diagnosed by combined analysis of patient history, body check up and tomographic observations.

Mechanism of CES: LDH is a common malady. However, LDH followed by CES is a rare symptom. Herniated intervertebral lumber disk may compress dural sac and cause injury to the cauda equine [1, 6, 7]. As there is no neurilemma like peripheral nerve system in the spinal nerve, spinal nerve is especially sensitive to compression. Compression may cause venous blood congestion on nerve root, and metabolic products may conjugate around the nerve tissue and cause pain. Moreover, LDH can affect the circulation of cerebrospinal fluid, which causes conjugation of blood in cauda equina, which subsequently cause regional edema. External trauma, traction with heavy weight, inappropriate manipulation can be the cause of CES. Central intervertebral herniation is most likely the cause of CES. Nerve axonal injury may occur several hours after the compression of cauda equina. At the case of acute LDH, the shock of lumbar intervertebral hernia to the cauda equina causes congestion and edema at the injury site and subsequently hinder the circulation of cerebral fluid, which deprives the trophic support of nerve roots, and causes more severe symptoms. Even if the patient is nurtured in fine bed rest and immediate conservative treatment is provided, poor functional outcome is bent to happen. Thus it is utterly important to have early surgical intervention after CES [8, 9].

The clinical outcome of CES is decided by three main factors [10]. First: how serious CES is: at the incidence of acute CES, once the lesion take place, followed by edema and adhesion of

surrounding tissues, cerebral fluid circulation can no be restored soon even after early surgical intervention [11, 12]. Second, time of surgical intervention: there are reports that surgical intervention 48 hours after CES can significantly preserve the function of nerve and urinary system. However, any delay in surgical intervention may result in catastrophic outcomes. In our study we have underwent surgical treatment 48 hours after the occurrence of CES, and gained satisfactory results in most patients. Third, the method of surgical intervention: although it has been accepted widely that early surgical intervention is necessary in the treatment of CES, there is still not a standardized method [13]. The type of surgical approach is decided by the experience of the surgeon and the type of the injury. In this paper, we have compared outcomes of two different surgical approaches on patients with similar basic qualities. And found that minimal invasive half laminectomy has significantly better results with regards to VAS, ODI, Frankel scores than conventional laminectomy. It may be assumed that minimal invasive laminectomy can not only relieve the pressure on the nerve root, but also preserve the normal anatomical construction at the site of injury and can promote the stability of lumbosacral region [14-16].

Conventionally, total laminectomy was performed in cases of LDH followed by CES. Although it is easy to perform, can prevent excessive traction and prevent further damage to the nerves, but it may cause damage to the posterior column of lumber vertebral body and ligamenta flava and may result in vertebral body instability, coarctation of dural sac and even detachment of lumbar vertebrae. In the decompression by fenestration with minimally invasive approach can preserve supraspinal and interspinal ligament, which can not only gain full decompression at the injury site, but also preserve the stability of vertebra and prevent from long term complications.

Acknowledgements

This study was financially supported by grants from the Medical Scientific Fund and Intensive Research of Nanjing Military Area Command of Chinese PLA (No. Nan 2007-13 and Nan 08Z003), and the Medical Scientific Fund and Research of Chinese PLA during the 12th Plan (No. CWS11J260).

Disclosure of conflict of interest

None.

Address correspondence to: Dr. Junming Tan, Department of Orthopedics, The 98th Military Hospital, No. 9 Station Road, Huzhou 313000, Zhejiang, China. Tel: +86-0572-3269680; Fax: +86-0572-3269680; E-mail: tanjunmingdr@yeah.net

References

[1] Tan JM, Wu J, Shi JG, Shi GD, Liu YL, Liu XH, Wan CY, Chen DC, Xing SM, Shen LB, Jia LS, Ye XJ, Li JS. Brain-derived neurotrophic factor is up-regulated in severe acute cauda equine syndrome dog model. Int J Clin Exp Med 2013; 6: 431-7.

[2] Ackeman WE, Andrews PJ, Juneja MM, Rigor BM. Cauda equine syndrome: a consequence of lumbar disk protrusion or continuous subarachnoid analgesia? Anesth Analg 1993; 76: 898-901.

[3] Archer R, Sissener T, Connery N and Spotswood T. Asymmetric lumbosacral transitional vertebra and subsequent disc protrusion in a cocker spaniel. Can Vet J 2010; 51: 301-4.

[4] Chau AM, Xu LL, Pelzer NR and Gragnaniello C. Timing of surgical intervention in cauda equine syndrome: a systematic critical review. World Neurosurg 2014; 81: 640-50.

[5] Nakano N and Nakano T. Surgical technique of anterior extroperitoneal Lumber disc hermiation. Oeration 1987; 41: 1.

[6] Augustijn P, Vanneste J and Davies G. Chronic Spinal arachnoiditis follow-ing intracranial subarachnoid haemorrhage. Clin Neurol Neurosurg 1987; 9: 347-350.

[7] Yuan C, Zhu H, Song D, Wei W, Zhu R, Mei X, Zou J and Yang H. Impact and clinical significance of pedicle length on spinal canal and intervertebral foramen area. Int J Clin Exp Med 2014; 7: 163-169.

[8] Nakanishi K, Uchiyama T, Nakano N, Fukawa N, Yamada K, Yabuuchi T and Kato A. Spinal syringomyelia following subarachnoid hemorrhage. J Clin Neurosci 2012; 19: 594-597.

[9] Balasar M, Dogan M, Kandemir A, Taskapu HH, Cicekci F, Toy H and Gurbuz R. Investigation of granulomatous prostatitis incidence following intravesical BCG therapy. Int J Clin Exp Med 2014; 7: 1554-1557.

[10] Tamburrelli FC, Genitiempo M, Bochicchio M, Donisi L and Ratto C. Cauda equina syndrome: evaluation of the clinical outcome. Eur Rev Med Pharmacol Sci 2014; 18: 1098-1105.

[11] Tumialan L, Cawley M and Barrow D. Arachnoid cyst with associated arachnoiditis developing after subarachnoid hemorrhage. J Neurosurg 2005; 103: 1088-1091.

[12] Thines L, Khalil C, Fichten A and Lejeune J. Spinal arachnoid cyst related to nonaneursymal perimesencephalic subarachnoid hemorrhage: case report. Neurosurgery 2005; 5: 817.
[13] Silva N, Januel AC, Sabatier J, Demonet JF, Tall P and Cognard C. Delayed medullar syndrome after aneurysmal subarachnoid haemorrhage: A case of cystic arachnoiditis. Int Neuroradiol 2007; 13: 201-204.
[14] Eneling J, Bostrom S and Rossitti S. Subarachnoid hemorrhage-associated arachnoiditis and syringomyelia. Clin Neuroradiol 2012; 22: 169-173.
[15] Sajanti J and Majamaa K. Detection of meningeal fibrosis after subarach-noid haemorrhage by assaying procollagen propeptides in cerebrospi-nal fluid. J Neurol Neurosurg Psychiatry 1999; 67: 185-188.
[16] Huang YL, Lin HG, Yang JW, Jiang FQ, Zhang T, Yang HM, Li CL and Cui Y. Laparoscopy-assisted versus open gastrectomy with D2 lymph node dissection for advanced gastric cancer: meta-analysis. Int J Clin Exp Med 2014; 7: 1490-1499.