Biomedical Research 2018; 29 (4): 667-670 *ISSN 0970-938X*
www.biomedres.info

The effects of surgical methods and hemorrhage amount on postoperative spinal function after thoracolumbar debridement.

Zhenbin Wang[1], Tuerhugjan Turdi[2], Kahaer Aikenmu[1], Wenfei Gu[1], Laiyong Tu[1], Enfeng Zhang[1], Jiang Zhao[1*]

[1]Department of Spine Surgery, Traditional Chinese Hospital Affiliated to Xinjiang Medical University, PR China

[2]Department of Spine Surgery, Kuche People's Hospital of Xinjiang Autonomous Region, PR China

Abstract

Purpose: This study aims to analyse 63 patients in our hospital during 2015-2017 treated by Thoracolumbar Debridement (TD), and elucidate any significant factors in operation process influencing the spinal recovery.

Methods: Different TD surgeries were performed using four surgical methods: Fenestration Discectomy (FD), Percutaneous Screw Fixation (PSF), Percutaneous Transforaminal Endoscopic Discectomy (PTED) and Percutaneous Interlaminar Endoscopic Discectomy (PIED). The spinal function was evaluated by the Japanese Orthopaedic Association (JOA) scores at three time points: the admission day, discharge day and three months after discharge.

Results: At the discharge time, the following functions were found significantly influenced by the surgical methods: daily activity limitation, standing function, setting posture, and heave function. In particular, for the standing function, the PIED had a significantly higher score than PTED. Three months later, the PSF group showed a better performance in various items regarding to the spinal function, compared to PTED. The hemorrhage volume, which was influenced by the surgical method, showed a correlation with the scores of pace, standing function, setting posture, and daily activity that more blood loss linked to poorer recovery in a short term.

Conclusions: Together, surgical methods, hemorrhage amounts and the spinal function (at the discharge time and three months later) had correlations mutually. The PSF method could still be an optimal choice for the spinal function, despite its disadvantages in the blood loss volume, compared to PTED. Hemorrhage largely influenced the spinal function recovery in the short term after operation and was strongly decided by surgical techniques during TD operation.

Keywords: Thoracolumbar debridement, Hemorrhage, Spinal function, JOA score.

Accepted on November 15, 2017

Introduction

Thoracolumbar Debridement (TD) is a necessary and useful treatment for a serial of thoracic and lumbar diseases, such as lumbar vertebral compression fractures, lumbar disc herniation, lumbar spinal stenosis, lumbar tuberculosis, etc. [1-3]. China is one country with a high incidence of thoracic/lumbar diseases and wide application of TD surgeries [2,4-6]. However, it has been noticed that patients might developed spinal degeneration disorders, osteoporosis, and other secondary hazards, after thoracolumbar debridement [4,7,8]. Therefore, we here aim to probe the major factors which may influence the prognosis especially in spinal function during the operation. For example, surgical strategies could lead to distinct outcomes; and the blood loss is also a potential hazard to the postoperative recovery. We analysed 63 patients in our hospital during 2015-2017 treated by TD, and assessed the spinal function using the Japanese Orthopaedic Association (JOA) scores [9,10], when they discharged and three months later. We carried out this analysis to elucidate any significant factors in operation process influencing the spinal recovery.

Methods

Basic information

Written informed consent was acquired from each patient. The follow-up survey was approved by the Hospital Ethics Committee. After screening from 2015 to 2017, 63 patients averaged 72.27 ± 4.65 y old (25 males and 38 females) with different thoracic or lumbar probability who had received thoracolumbar debridement were enrolled in this study. Those with severe thoracic or lumbar problems or died in six months were excluded out of the cohort. Moreover, the patients failed to complete the JOA survey three months later were also screened out.

Surgical treatment and the follow-up

Patients received different surgery according to the corresponding diagnosis. Taken altogether, following surgeries were performed: posterior lumbar incision and internal fixation, posterior lumbar spinal canal decompression, bone graft fusion and percutaneous reduction and internal fixation, laminectomy, etc. According to the surgical methods, patients could be divided into four groups: Fenestration Discectomy (FD), Percutaneous Screw Fixation (PSF), percutaneous transforaminal endoscopic discectomy (PTED) and Percutaneous Interlaminar Endoscopic Discectomy (PIED). No significant differences were found among groups before surgery. The spinal function was evaluated by the JOA questionnaire at three time points: on the admission day, the discharge day and three months after discharge. Each item was scored from zero to three by self-assessment or with the help of follow-up researchers. This survey was performed both on the discharging date or three months after discharge. Those patients who refused to complete this questionnaire after three months or died in six months were excluded. In detail, the following indexes were investigated: leg pain/tingling, pace, clinical sign, sensory disturbance, dyskinesia, daily activity limitation, standing function, wash function, flexion function, setting posture, heave function, locomotor activity, bladder function, etc.

Statistical analysis

The statistical analysis was performed using SPSS. The Pearson correlation coefficient was tested for revealing the correlation between the factors during operation and the postoperative spinal functions indexes. To compare the differences between subgroups, some results were presented as the mean ± SE and analysis was performed with repeated-measure ANOVA. Statistical significance level was set as $p<0.05$.

Results

The surgical methods influence spinal function indexes at the discharge time and 3 months later

To analyse the correlation between surgical methods and spinal functions, Pearson correlation coefficient was applied. We found no differences among surgical method groups in each JOA item at the admission date. The following indexes in the JOA questionnaire were found significantly influenced by the surgical methods: daily activity limitation, standing function, setting posture, and heave function. As shown in Table 1, the standing function and setting posture exhibited a highly significant correlation with surgical methods. In particular for the standing function, the PIED had a significantly higher score than PTED (1.83 ± 0.17 *vs.* 1.25 ± 0.13, $P<0.05$). While, 3 months later, no significant correlation was observed between different surgical methods. However, using multiple comparisons, there existed differences between different groups. For example, the PSF group had a significantly higher score for sensory function compared to the PTED group (0.833 score higher, $P<0.01$), and the former also exhibited a higher score in locomotor activity than the latter (0.833 score higher, $P<0.01$) three months after discharge. Moreover, three months after discharge, the standing function of the PSF patients showed a significantly better performance compared to the PTED ones (0.667 score higher, $P<0.05$). Similarly, the former had a benefit in wash function (0.833 score higher, $P<0.01$) and flexion function (0.750 score higher, $P<0.01$) than the latter. These findings suggested that surgical methods are important factors that decide the later recovery of the spinal, and the PSF method could be an optimal choice for the spinal function.

The hemorrhage amount influences spinal function indexes at the discharge time and 3 months later

Another crucial factor that influenced the spinal function was the hemorrhage amount. At the discharge date (Table 2), it showed a significant correlation with the scores of pace ($p<0.05$), standing function ($p<0.05$), setting posture ($P<0.01$), and daily activity limitation ($P<0.05$). As expected, for all these assessment, a larger hemorrhage amount linked to poorer prognosis. Again, it did not influence the JOA scores three months later. The above result indicates that hemorrhage during operation may largely impact the recovery effects of hospitalization.

The correlation between surgical methods and hemorrhage amounts

The hemorrhage amounts were distinct among different surgical groups. The open operation resulted in the highest hemorrhage volume (221.74 ± 31.36 ml). The PSF group took the second place (117.50 ± 18.39 ml). Comparatively, PTED and PIED were minimal invasive and controlled the hemorrhage under a very low level (6.50 ± 1.07 ml and 12.00 ± 2.55 ml). There exited a highly significant correlation between surgical methods and hemorrhage amounts ($P<0.01$, Table 3).

Table 1. *The correlation between surgical methods and JOA indexes at the discharge time.*

Indexes	Pearson correlation coefficient	p
Daily activity limitation	0.295	0.019
Standing function	0.709	<0.001
Setting posture	0.583	<0.001
Heave function	0.284	0.024

Table 2. *The correlation between hemorrhage amounts and JOA indexes at the discharge time.*

Indexes	Pearson correlation coefficient	p
Pace	-0.295	0.036
Standing function	-0.334	0.018
Setting posture	-0.392	0.005

Daily activity limitation	-0.46	0.001

Table 3. *The hemorrhage amounts of different surgical methods.*

Methods	Hemorrhage amounts (Mean ± SE)	N	P (*vs.* FD)
FD	221.74 ± 31.36	33	
PSF	117.50 ± 18.39	12	0.01
PTED	6.50 ± 1.07	12	<0.001
PIED	12.00 ± 2.55	6	<0.001

Discussions

In the present study, three major findings are demonstrated. First, the JOA scores including daily activity, standing function, setting posture and heave function are correlates with the surgical method at the discharge time, and three months later the PSF group showed a significantly better performance in the spinal function compared to the PTED group. Second, hemorrhage largely influenced the pace, standing function, setting posture, daily activity limitation in the short term after operation. Finally, surgical methods strongly decided the hemorrhage results during TD surgery.

Overall, we did not observe any case of infection in the 63 patients, and the improvements were satisfactory according to follow-up survey. It has been seldom compared the consequences on the spinal functions among different surgical methods. However, large amounts of publications have claimed that those microinvasive approaches, like PTED and PIED, were most beneficial for the postoperative recovery [11,12]. PTED has been recognized as one of the best minimally invasive surgical methods, with such advantages: low trauma and blood loss level, quick recovery, protective for the spinal stability. It allows easy removal of foraminal/extraforaminal discs and recurrent discs, [13-15] thus offers both reduced invasiveness and good clinical results without sacrificing reliability [10,16]. Inconsistently, the outcome of our analysis implied that, despite the low hemorrhage amount and invasive level, PTED had a relatively poorer prognosis for the spinal function assessed by the JOA scores. It caused poorer standing function compared with PIED at the discharge date, and more notable, lower scores in sensory function, locomotor activity, standing function, wash function and flexion function, compared to the PSF method. This may be due to a relatively higher relapse ratio of the PTED technique [17-20]. Besides, PTED for high-migrated discs was regarded challenging [12]. More exact reasons need to be further studied.

It is interesting that, on one hand, our findings suggest that a higher hemorrhage during TD may lead to a poorer recovery, which even indicated that hemorrhage volume could be a potential index for spinal function forecast; on the other hand, the better approach for the spinal function (PSF) had definitely higher blood loss compared to the poorer one (PTED). Here are some possible reasons. First, hemorrhage strongly decided the recovery in the short term (especially before discharge) in our study and according to previous publication [13,21,22]. But the superiority of PSF compared to PTED significantly appeared only at 3 months after discharge. Second, given a high proportion of the traditional FD in our entire cohort, the conclusion that serious hemorrhage leads to worse recovery still makes sense when it is recognized towards the FD group [14,23].

Collectively, our study demonstrated the correlations between surgical methods, hemorrhage amounts and the spinal function (at the discharge time and three months after discharge). The spinal function assessed by the JOA scores in the PSF patients were better than PTED ones. Hemorrhage largely influenced the spinal function recovery in the short term after operation and was strongly decided by surgical techniques during TD operation. The PSF method could still be an optimal choice for the spinal function, despite its disadvantages in the blood loss volume.

Competing Interests

The authors declare that they have no competing of interests.

References

1. Fayazi AH, Ludwig SC, Dabbah M, Bryan Butler R, Gelb DE. Preliminary results of staged anterior debridement and reconstruction using titanium mesh cages in the treatment of thoracolumbar vertebral osteomyelitis. Spine J 2004; 4: 388-395.
2. Jin W, Wang Q, Wang Z, Geng G. Complete debridement for treatment of thoracolumbar spinal tuberculosis: a clinical curative effect observation. Spine J 2014; 14: 964-970.
3. Dobran M, Iacoangeli M, Nasi D, Nocchi N, Di Rienzo A, di Somma L, Colasanti R, Vaira C, Benigni R, Liverotti V, Scerrati M. Posterior titanium screw fixation without debridement of infected tissue for the treatment of thoracolumbar spontaneous pyogenic spondylodiscitis. Asian Spine J 2016; 10: 465-471.
4. Zhang P, Peng W, Wang X, Luo C, Xu Z, Zeng H, Liu Z, Zhang Y, Ge L. Minimum 5-year follow-up outcomes for single-stage transpedicular debridement, posterior instrumentation and fusion in the management of thoracic and thoracolumbar spinal tuberculosis in adults. Br J Neurosurg 2016; 30: 666-671.
5. Wang YX, Zhang HQ, Tang MX, Guo CF, Deng A, Wu JH, Liu JY, Deng Z, Chen J. One-stage posterior focus debridement, interbody grafts, and posterior instrumentation and fusion in the surgical treatment of thoracolumbar spinal tuberculosis with kyphosis in children: a preliminary report. Childs Nerv Sys 2016; 32: 1495-1502.
6. Xu YG, Yang YD, Liu SL. Effect of surgical treatment for thoracolumbar spinal tuberculosis by anterior radical debridement with bone graft fusion and posterior pedicle

screw-rods system fixation. Zhongguo Gu Shang 2009; 22: 938-940.

7. Lai Z, Shi SY, Fei J, Wei W, Hang GH, Hu SP. Mid-term outcome of surgical operation for thoracolumbar tuberculosis. Zhongguo Gu Shang 2016; 29: 157-161.
8. Schuchert MJ, McCormick KN, Abbas G, Pennathur A, Landreneau JP, Landreneau JR, Pitanga A, Gomes J, Franca F, El-Kadi M, Peitzman AB, Ferson PF, Luketich JD, Landreneau RJ. Anterior thoracic surgical approaches in the treatment of spinal infections and neoplasms. Ann Thorac Surg 2014; 97: 1750-1757.
9. Liu C, Zhou Y. Percutaneous endoscopic lumbar diskectomy and minimally invasive transforaminal lumbar interbody fusion for recurrent lumbar disk herniation. World Neurosurg 2017; 98: 14-20.
10. Yoshimoto M, Iwase T, Takebayashi T, Ida K, Yamashita T. Microendoscopic discectomy for far lateral lumbar disk herniation: less surgical invasiveness and minimum 2-year follow-up results. J Spinal Disord Tech 2014; 27: 1-7.
11. Li J, Ma C, Li Y, Liu G, Wang D, Dai W, Tian J. A comparison of results between percutaneous transforaminal endoscopic discectomy and fenestration discectomy for lumbar disc herniation in the adolscents. Zhonghua Yi Xue Za Zhi 2015; 95: 3852-3855.
12. Choi KC, Kim JS, Ryu KS, Kang BU, Ahn Y, Lee SH. Percutaneous endoscopic lumbar discectomy for L5-S1 disc herniation: transforaminal versus interlaminar approach. Pain Physician 2013; 16: 547-556.
13. Li X, Hu Z, Cui J, Han Y, Pan J, Yang M, Tan J, Sun G, Li L. Percutaneous endoscopic lumbar discectomy for recurrent lumbar disc herniation. Int J Surg 2016; 27: 8-16.
14. Chen HC, Lee CH, Wei L, Lui TN, Lin TJ. Comparison of percutaneous endoscopic lumbar discectomy and open lumbar surgery for adjacent segment degeneration and recurrent disc herniation. Neurol Res Int 2015; 2015: 791943.
15. Ahn Y, Lee SH, Park WM, Lee HY, Shin SW, Kang HY. Percutaneous endoscopic lumbar discectomy for recurrent disc herniation: surgical technique, outcome, and prognostic factors of 43 consecutive cases. Spine (Phila Pa 1976) 2004; 29: 326-332.
16. Nomura K, Yoshida M, Kawai M, Okada M, Nakao S. A novel microendoscopically assisted approach for the treatment of recurrent lumbar disc herniation: transosseous discectomy surgery. J Neurol Surg A Cent Eur Neurosurg 2014; 75: 183-188.
17. Wen BT, Zhang XF, Wang Y, Xiao SH, Liu ZS, Liu BW, Zhang YG, Song J, Zhong YX, Sun JH. Complication and treatment of the lumbar intervertebral disc herniation using percutaneous endoscopic lumbar discectomy. Zhonghua Wai Ke Za Zhi 2011; 49: 1091-1095.
18. Yamashita K, Higashino K, Sakai T, Takata Y, Abe M, Morimoto M, Nagamachi A, Sairyo K. Revision percutaneous endoscopic lumbar discectomy under the local anesthesia for the recurrent lumbar herniated nucleus pulposus in a high class athlete: A case Report. J Med Invest 2016; 63: 135-139.
19. Li ZZ, Hou SX, Shang WL, Cao Z, Zhao HL. Percutaneous lumbar foraminoplasty and percutaneous endoscopic lumbar decompression for lateral recess stenosis through transforaminal approach: Technique notes and 2 years follow-up. Clin Neurol Neurosurg 2016; 143: 90-94.
20. Ahn SS, Kim SH, Kim DW, Lee BH. Comparison of outcomes of percutaneous endoscopic lumbar discectomy and open lumbar microdiscectomy for young Adults: a retrospective matched cohort study. World Neurosurg 2016; 86: 250-258.
21. Chao CM, Wu CD, Sung KC, Lin WT, Lee KK, Lai CC. Right iliac aortic aneurysmal hemorrhage as a complication of lumbar discectomy. World Neurosurg 2013; 80: 901 907-908.
22. Li X, Han Y, Di Z, Cui J, Pan J, Yang M, Sun G, Tan J, Li L. Percutaneous endoscopic lumbar discectomy for lumbar disc herniation. J Clin Neurosci 2016; 33: 19-27.
23. Hirano Y, Mizuno J, Takeda M, Itoh Y, Matsuoka H, Watanabe K. Percutaneous endoscopic lumbar discectomy-early clinical experience. Neurol Med Chir (Tokyo) 2012; 52: 625-630.

*Correspondence to

Jiang Zhao

Department of Spine Surgery

Traditional Chinese Hospital Affiliated to Xinjiang Medical University

PR China