The Clinical Characteristics, Perioperative Management, and Treatment Outcomes of Spinal Tuberculosis Associated With Diabetes Mellitus

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Abstract

Background. Diabetes mellitus (DM) is a chronic systemic disorder that mainly damages small blood vessels and nerves. Previous studies indicate that DM is a major risk factor for perioperative complications of spine surgeries, such as wound infection, prolonged operative time, longer hospitalization, and higher nonunion rates. However, to the best of our knowledge, no study has compared differences between spinal tuberculosis associated with diabetes mellitus (DMSTB) and non-DMSTB in terms of clinical characteristics, perioperative management, radiographic outcomes and surgical complications.

Methods. We performed a retrospective study of 11 DMSTB patients who underwent surgical treatment between January 2014 and April 2018. We also reviewed 11 matching non-DMSTB patients. Matching characteristics included age, sex, and the range of bone destruction by spine tuberculosis. All patients underwent the same surgical procedure. For each patient, demographic information, including age, sex, residence, chief complaints, preoperative complications, the length of stay (LOS), and hospitalization expenses (USD), was reviewed. In addition, operation time, intraoperative blood loss, and postoperative complications were reviewed from digital medical records. Moreover, laboratory examination and radiographic assessments were conducted before operation and at 3-month follow-up/final follow-up (FFU).

Results. A total of 22 patients were divided into two groups: Group A (DMSTB) and Group B (non-DMSTB). All patients in Group A were newly diagnosed with spinal tuberculosis, while 4 were newly diagnosed with DM. The remaining 7 patients had been diagnosed with DM for an average of 6.15 ± 5.87 yrs. The lumbar and lumbosacral regions were the most affected regions for 6 patients. Significant differences in residence ($p=0.02$) and preoperative complications ($p=0.002$) were found between Groups A and B. There were no differences in operation times (292.72 ± 56.74 vs. 281.81 ± 46.28 min, $p=0.64$), intraoperative blood loss levels (627.27 ± 486.34 vs. 668.18 ± 350.50 ml, $p=0.83$), hospitalization expenses ($\$19713.13 \pm 5816.89$ vs. $\$16509.78 \pm 3170.89$, $p=0.14$), or LOS periods (25.54 ± 4.65 vs. 27.63 ± 10.79 days, $p=0.58$). There were no significant differences in erythrocyte sedimentation rate (ESR) or C-reactive protein (CRP) between Groups A and B at each time point: preoperation and at 3-month follow-up/FFU. The albumin level was lower than that in the normal stand in both groups preoperatively (35.82 ± 4.22 vs. 37.7 ± 2.57 g/L, $p=0.24$) and returned to normal at FFU (42.67 ± 2.91 vs. 43.26 ± 2.48 g/L, $p=0.63$). The imaging analysis shows no significant differences in vertebral body destruction between Group A and Group B (1.45 ± 0.75 vs. 1.31 ± 0.71 , $p=0.68$) with a similar fusion level (2.63 ± 1.43 vs. 2.81 ± 1.74 , $p=0.8$). The bone fusion times for Groups A and B were measured as 10.27 ± 3.01 months and 9.9 ± 2.11 months, respectively ($p=0.87$). There were no significant differences in postoperative complications between the DMSTB and non-DMSTB groups ($p=0.42$).

Conclusion. Our study demonstrates that DMSTB has a higher incidence of preoperative complications than non-DMSTB, which increases the difficulty of perioperative management for spinal tuberculosis. However, DMSTB does not significantly affect postoperative recovery as long as the glycemic level

remains well controlled, nutritional supplementation is adequate, and antituberculosis treatment is sufficient.

Background

According to the 2020 World Health Organization Global Tuberculosis Report, despite multiple efforts made to reduce the impact of tuberculosis, an estimated 10.0 million people are still newly diagnosed with tuberculosis (TB) each year globally. Diabetes mellitus (DM) is a strong risk factor for the development of TB, as up to 0.35 million cases are attributed to diabetes [1]. People with DM have a 2–3-fold greater chance of developing TB compared to nondiabetic controls [2, 3] because DM leads to impaired immunity, which causes latent TB infection to become active. Furthermore, DM has negative effects on TB patients' treatment responses, which may result in TB treatment failure, relapse after recovery, or even death [4, 5]. Moreover, treatment failure increases the odds of drug-resistant TB, which places a heavy burden on the global TB control program [1]. Considering this, a more powerful TB treatment strategy for patients with DM is needed.

Spinal tuberculosis (STB), as the most common type of extrapulmonary tuberculosis and a major cause of spinal kyphosis and neurological dysfunction, accounts for nearly half of osteoarticular tuberculosis cases [6]. Epidemiological surveys of spinal tuberculosis associated with diabetes (DMSTB) are lacking. To date, only a few studies have reported the incidence rate of spinal tuberculosis complicated with diabetes. A survey conducted in the United States from 2002–2011 shows that 11.6% of spinal tuberculosis patients have a comorbidity of diabetes [7]. Shi, T. et al. [8] reviewed 967 spinal tuberculosis patients in southwestern China for 1999–2013 and found 77 (8%) of the patients to have diabetes, and a review of 1378 spinal tuberculosis patients who received surgery from 2007 to 2016 in southcentral China found 63 of the patients (4.6%) to have a comorbidity of diabetes [9].

Previous studies have indicated that DM is a major risk factor for perioperative complications of spine surgery, such as wound infection, prolonged operative time, a longer hospitalization period, and a higher nonunion rate [10, 11]. However, to our knowledge, no study has compared differences between DMSTB and non-DMSTB in terms of clinical characteristics, perioperative management, radiographic outcomes and surgical complications. In studying 11 patients with DMSTB and comparing them to 11 non-DMSTB patients (matched by sex, age, the range of bone destruction by spine tuberculosis, and the surgical strategy adopted), we hope to contribute a better understanding of the clinical features, perioperative management, and treatment outcomes of DMSTB.

Methods

This study was approved by the ethics committee of our hospital, and written informed consent was obtained from all patients. We performed a retrospective study of 11 DMSTB patients who underwent surgical treatment between January 2014 and April 2018. We also reviewed 11 matching non-DMSTB patients, with matching characteristics including age, sex, and the range of bone destruction by spine

tuberculosis. All patients underwent one-stage anterior/posterior approach surgical treatment. For each patient, demographic data, including age (year), gender, residence, chief complaint, length of stay (day), and hospitalization expense (USD) information, were reviewed. Intraoperative blood loss (ml) and surgical complications were also reviewed from digital medical records.

Laboratory examination results

The laboratory examination measured the following: ESR), CRP, albumin, creatinine, uric acid, glycemic, glycosylated hemoglobin (4.0–6.1%). CRP and ESR levels at 3-month follow-up and final follow-up were also recorded. Levels of albumin, creatinine and uric acid at final follow-up were also reviewed.

Radiographic Measurement and Clinical Evaluation

The range of bone destruction was defined using the vertebral body as a reference from computed X-ray tomography (CT) scans, described as half/1/2... vertebral bodies. Each fusion of a disc is considered to form one fixation segment. Bone graft fusion was assessed using the radiologic criteria reported by Bridwell et al. [12].

Statistical Analysis

Data for the two groups were compared using independent *t*-tests, Fisher's exact tests, and chi-square tests depending on the parametric qualities of the data analyzed. Statistical analyses were performed using SPSS version 25.0 (IBM). The significance level was set at $p < 0.05$.

Results

A total of 22 patients were divided into two groups: Group A (DMSTB) and Group B (non-DMSTB). All of the patients in Group A had been diagnosed with spinal tuberculosis for the first time, and 4 patients had been diagnosed with DM for the first time. The remaining 7 patients had been diagnosed with DM for an average of 6.15 ± 5.87 yrs. The lumbosacral region was the most affected region, as it had been invaded in 6 of the patients: 2 in L5-S1, 2 in L4–5, 1 in L4-S1, and 1 in L1-L2. Four patients were affected in the thoracic region: 2 in T10–11, 1 in T8–9 and 1 in T8-T11. One patient was infected in the cervical region: C6–7. To compare the clinical characteristics and treatment outcomes of DMSTB and non-DMSTB, 11 patients matched by sex (both groups: 7 males/4 females), age (56.63 ± 9.66 vs. 52.81 ± 14.79 yrs., $p = 0.50$), and affected region were selected. There was a significant difference in residence between Groups A and B ($p = 0.02$); only 1 patient lived in an urban area in Group A, and 6 patients lived in urban areas in Group B. There were no significant differences in terms of operation time (292.72 ± 56.74 vs. 281.81 ± 46.28 min, $p = 0.64$), intraoperative blood loss levels (627.27 ± 486.34 vs. 668.18 ± 350.50 ml, $p = 0.83$), hospitalization expenses ($\$19713.13 \pm 5816.89$ vs. $\$16509.78 \pm 3170.89$ USD, $p = 0.14$), and LOS periods (25.54 ± 4.65 vs. 27.63 ± 10.79 days, $p = 0.58$) (Table 1).

Table 1

Demography and clinical data of STB patients with DM or without DM

	DMSTB(n=11)	NonDMSTB(n=11)	p Value
Age(yrs.)	56.63±9.66	52.81±14.79	0.5
Gender(male/female)	7/4	7/4	
Residence			0.02
Rural	10	5	
Urban	1	6	
Chief complaint			
Pain	10	10	
Numbness	4	3	
Weakness	1	1	
Limited activity	3	2	
Diabetes history(cases)			
Previous diagnosis	7	-	
New diagnosis	4	-	
Operation time(min)	292.72±56.74	281.81±46.28	0.64
Intraoperative blood loss(ml)	627.27±486.34	668.18±350.50	0.83
Hospitalization expenses (USD)	19713.13±5816.89	16509.78±3170.89	0.14
LOS (day)	25.54±4.65	27.63±10.79	0.58
Laboratory examination			
CRP	25.41±21.35	26.99±21.55	0.87
ESR	71.09±32.64	70.18±30.40	0.94
Albumin	35.82±4.22	37.7±2.57	0.24
Creatinine	127.34±174.02	72.93±14.50	0.33
Uric acid	429.37±194.84	405.29±176.25	0.77
Glycemic	7.68±4.13	-	
Glycosylated hemoglobin	6.9±1.45	-	
3M-CRP	9.01±5.56	6.11±3.38	0.17
3M-ESR	48.45±22.72	37.18±12.43	0.18

FFU-CRP	6.64±9.63	2.78±1.01	0.22
FFU-ESR	26.72±30.29	17.45±6.69	0.35
FFU-Albumin	42.67±2.91	43.26±2.48	0.63
FFU-Creatinine	116.57±145.00	68.18±17.93	0.3
FFU-Uric acid	321.8±141.07	342.81±82.91	0.68
Radiological assessments			
Cervical spine tuberculosis	1	1	
Thoracic spine tuberculosis	4	4	
Lumbar and lumbosacral spine tuberculosis	6	6	
Vertebral body destruction (Vertebrate)	1.45±0.75	1.31±0.71	0.68
Fusion segment	2.63±1.43	2.81±1.74	0.8
Bone fusion time(month)	10.27±3.01	9.9±2.11	0.87
Follow up time(month)	27.90±3.05	27.54±2.67	0.78
Abbreviation: LOS length of stay, CRP C-reactive protein, ESR erythrocyte sedimentation rate, FFU final follow-up,3M 3-month;			

Laboratory examination results and Radiological assessments

There were no significant differences in ESR and CRP levels between Groups A and B at any time point, including before operation, at 3-month follow-up, and at final follow-up (Table 1). The albumin level was lower than the normal standard in both groups preoperatively (35.82 ± 4.22 vs. 37.7 ± 2.57 g/L, $p = 0.24$) but returned to normal at final follow-up (42.67 ± 2.91 vs. 43.26 ± 2.48 g/L, $p = 0.63$). The examination of kidney function showed no significant differences before operation or at final follow-up. The imaging results show no significant differences in vertebral body destruction between Group A and Group B (1.45 ± 0.75 vs. 1.31 ± 0.71 , $p = 0.68$) under a similar fusion strategy (2.63 ± 1.43 vs. 2.81 ± 1.74 , $p = 0.8$). The bone fusion times for Groups A and B were measured as 10.27 ± 3.01 months and 9.9 ± 2.11 months, respectively ($p = 0.87$).

Preoperative and postoperative complications

There was a significant difference in preoperative complications between Groups A and B ($p = 0.002$), as a total of 40 preoperative complications were present in patients with DMSTB verses 11 preoperative

complications affecting non-DMSTB patients (Table 2). However, no significant differences in postoperative complications between DMSTB and non-DMSTB cases were found ($p = 0.42$) (Table 2).

Table 2
Preoperative and postoperative complications of STB patients with DM or without DM

	DMSTB(n = 11)	NonDMSTB(n = 11)	p Value
Preoperative complications(cases)			0.002
Pulmonary complications			
Asthma	1	0	
Bronchiectasia	1	0	
Obsolete Pulmonary Tuberculosis	2	3	
Cardiovascular complications			
Atrial fibrillation	1	0	
Arteriosclerosis	1	0	
Coronary heart disease	2	0	
Hypertension	8	1	
Uremic cardiomyopathy	1	0	
Hepatobiliary complications			
Chronic hepatitis B	1	0	
Cholecystolithiasis	1	0	
Fatty liver	1	0	
Urinary complications			
Prostatic nodule	1	0	
Adrenal nodule	1	0	
Chronic Renal Failure	1	0	
Diabetic glomerulopathy	1	0	
Renal calculus	3	2	
Anemia	2	0	
Incomplete paralysis	4	3	
Osteoporosis	3	0	
Hyperthyroidism	1	0	
Thyroid nodule	0	2	

	DMSTB(n = 11)	NonDMSTB(n = 11)	p Value
Endophthalmitis	1	0	
Brain tumors	1	0	
Colon cancer	1	0	
Total	40	11	
Postoperative complications(cases)			0.4226
Pulmonary infection	3	1	
LEDVT	1	1	
Total	4	2	
Abbreviations: LEDVT Lower extremity deep venous thrombosis;			

Discussion

The clinical characteristics of DMSTB

DM is a chronic, complex metabolic disorder that affects different organs and systems, leading to various subsequent complications, such as cardiovascular and microvascular accidents, nephropathy, retinopathy, etc. [13, 14] In our study, DMSTB patients experienced significantly more preoperative complications than non-DMSTB patients (40 vs. 11 $p = 0.002$), mainly including pulmonary, cardiovascular, hepatobiliary, and urinary complications, making treatment more difficult. Among these complications, hypertension was the most common (8/11). Two of the patients had coronary heart disease. Two DMSTB patients had symptoms of renal involvement. For other complications, osteoporosis was seen in 3 of the 11 DMSTB patients, while there were no cases of osteoporosis in the non-DMSTB group (Table 2). It is believed that osteoporosis may occur due to bone microstructure damage caused by diabetes [15]. Although no significant differences in serum albumin levels in DMSTB and non-DMSTB cases were seen, the level of serum albumin in DMSTB patients was lower than the standard ($35.82 \pm 4.22 < 40$ g/L), indicating that patients with DMSTB are often malnourished. Moreover, there were more patients who lived in rural areas ($p = 0.02$) in the DMSTB group, and 4 (40%) of them were newly diagnosed with DM, which may imply that patients living in rural areas have fewer financial resources less access to health care. In short, according to the above comparison, DMSTB patients are associated with a greater risk of experiencing preoperative complications and malnutrition and with having fewer financial resources.

Perioperative management of DMSTB

For DM patients who undergo spine surgery, glycemic control is essential. Previous studies have shown that patients with unsatisfactory glycemic control are associated with increased perioperative

complication rates and poorer surgical outcomes than those with better glycemic control [10, 16]. It has also been reported that poorly controlled DM has the strongest effects on TB susceptibility and on unfavorable TB outcomes [10]. Hence, to achieve better glycemic control for STB patients receiving surgical treatment, subcutaneous insulin injection should be used during the perioperative period for both those with newly and previously diagnosed diabetes. As a common practice, we prefer short-acting insulin before meals and long-acting insulin at 10 pm. Meanwhile, fasting and postprandial glycemic level should be monitored, and the use of insulin should be adjusted accordingly. As the American Diabetes Association recommends, glycated hemoglobin (HbA1c) levels of < 7% are an ideal target for patients with DM [17], and HbA1c levels of between 7% and 8% and random blood glucose levels of < 11.1 mmol/l are acceptable targets according to the American College of Physicians [18].

Currently, the recommended anti-TB treatment for combined TB and DM is similar as that for patients with TB only, and treatment principles of tuberculosis drugs include early, sufficient, whole course, and combined adoption [1]. However, caution should be exercised, as DM is known to be associated with several unfavorable antituberculosis outcomes (drug resistance, drug toxicity, treatment failure, and recurrence) [19]. Hence, antituberculosis treatment for DMSTB should be monitored more closely than that for non-DMSTB, and adjustments of drug doses and/or regimens should be made in accordance with the treatment response, with drug-drug interactions, and with drug side effects. At our center, HREZ4 treatment is adopted to treat DMSTB. For patients with liver and kidney dysfunction or drug-resistant tuberculosis, the use of tuberculosis drugs is adjusted according to the given situation. Recently, with the adaption of gene sequencing in clinics, patients have been recommended for the gene sequencing of tuberculosis samples for more individualized treatment [20]. In addition, since DMSTB patients usually have low albumin levels, it is necessary to provide adequate nutritional support during the perioperative period.

Treatment outcomes of DMSTB

By matching our DMSTB group by sex, age, infection sites, the range of bone destruction, and the surgical strategy adopted to our non-DMSTB group, we aimed to create equivalent conditions for comparison. Compared to non-DMSTB cases, although there was a significantly higher incidence of preoperative complications in DMSTB cases, we found no differences in terms of operation times, intraoperative blood loss, hospitalization expenses, LOS periods, fusion segments, bone fusion times or rates of postoperative complications. Echoing our studies, Yao, Y et al. [21] reviewed 237 thoracic STB patients who underwent surgery. A univariate analysis of prognostic factors for recovery after surgery showed no significant difference in median recovery times (12.0 vs. 8.0 months, $p = 0.095$) between DM and non-DM patients. From this result and those of our study it may be concluded that DMSTB does not significantly affect postoperative recovery as long as glycemic levels are well controlled, nutritional supplementation is adequate, and antituberculosis treatment is sufficient.

Study limitations

This study has two main limitations. First, as rates of DMSTB with surgery are low (4.6%) in our study area [9], the retrospective nature of our small sample study may be associated with bias. Second, our study did not consider intra- and interobserver differences associated with bias.

Conclusion

Our study demonstrates that DMSTB has a higher incidence of preoperative complications than non-DMSTB, complicating perioperative management for spinal tuberculosis. However, DMSTB does not significantly affect postoperative recovery as long as the glycemic level is well controlled, nutritional supplementation is adequate, and antituberculosis treatment is sufficient.

Abbreviations

DM: Diabetes mellitus; STB: Spinal tuberculosis; DMSTB: Spinal tuberculosis associated with diabetes mellitus; LOS: Length of stay; FFU: final follow-up; ESR: erythrocyte sedimentation rate; CRP: C-reactive protein

Declarations

Ethics approval and consent to participate

Our research was approved by the ethics department of Xiangya Hospital, Central South University, Changsha, China. We have consensus with all participants. We also followed the Declaration of Helsinki and relevant policies in China.

Consent for publication

Written informed consent was acquired from each of the patients or their parents and legal guardians to authorize treatment, imageology findings, and photographic documentation. The patients or their parents and legal guardians consented to the publication of their pictures as well as their anonymous and clustered data.

Availability of data and material

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

HZ designed the study. LX, MT and YS performed the data collection, statistical analysis and data interpretation. GY contributed to manuscript writing. GY and LX contributed to patient enrollment and follow-up. All authors read and approved the final manuscript.

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References

1. *Global Tuberculosis Report 2020* World Health Organization (WHO). 2020.
2. Alkabab, Y.M., H.M. Al-Abdely, and S.K. Heysell, *Diabetes-related tuberculosis in the Middle East: an urgent need for regional research*. *Int J Infect Dis*, 2015. **40**: p. 64-70.
3. Jeon, C.Y. and M.B. Murray, *Diabetes mellitus increases the risk of active tuberculosis: a systematic review of 13 observational studies*. *PLoS Med*, 2008. **5**(7): p. e152.
4. Lonroth, K., G. Roglic, and A.D. Harries, *Improving tuberculosis prevention and care through addressing the global diabetes epidemic: from evidence to policy and practice*. *Lancet Diabetes Endocrinol*, 2014. **2**(9): p. 730-9.
5. Baker, M.A., A.D. Harries, C.Y. Jeon, et al., *The impact of diabetes on tuberculosis treatment outcomes: a systematic review*. *BMC Med*, 2011. **9**: p. 81.
6. Jain, A.K., S. Rajasekaran, K.R. Jaggi, et al., *Tuberculosis of the Spine*. *J Bone Joint Surg Am*, 2020. **102**(7): p. 617-628.
7. *The epidemiology of spinal tuberculosis in the United States: an analysis of 2002-2011 data*. *J Neurosurg Spine*, 2017. **26**(4): p. 507-512.
8. Shi, T., Z. Zhang, F. Dai, et al., *Retrospective Study of 967 Patients With Spinal Tuberculosis*. *Orthopedics*, 2016. **39**(5): p. e838-43.
9. Liu, Z., J. Wang, G.Z. Chen, et al., *Clinical Characteristics of 1378 Inpatients with Spinal Tuberculosis in General Hospitals in South-Central China*. *Biomed Res Int*, 2019. **2019**: p. 9765253.
10. Guzman, J.Z., J.C. Iatridis, B. Skovrlj, et al., *Outcomes and complications of diabetes mellitus on patients undergoing degenerative lumbar spine surgery*. *Spine (Phila Pa 1976)*, 2014. **39**(19): p. 1596-604.
11. Zhuang, T., A.Y. Feng, L.M. Shapiro, et al., *Is Uncontrolled Diabetes Mellitus Associated with Incidence of Complications After Posterior Instrumented Lumbar Fusion? A National Claims Database*

Analysis. Clin Orthop Relat Res, 2021.

12. Bridwell, K.H., L.G. Lenke, K.W. McEnery, et al., *Anterior fresh frozen structural allografts in the thoracic and lumbar spine. Do they work if combined with posterior fusion and instrumentation in adult patients with kyphosis or anterior column defects?* Spine (Phila Pa 1976), 1995. **20**(12): p. 1410-8.
13. Cha, S.A., J.S. Yun, T.S. Lim, et al., *Diabetic Cardiovascular Autonomic Neuropathy Predicts Recurrent Cardiovascular Diseases in Patients with Type 2 Diabetes*. PLoS One, 2016. **11**(10): p. e0164807.
14. Nentwich, M.M. and M.W. Ulbig, *Diabetic retinopathy - ocular complications of diabetes mellitus*. World J Diabetes, 2015. **6**(3): p. 489-99.
15. Schacter, G.I. and W.D. Leslie, *Diabetes and Bone Disease*. Endocrinol Metab Clin North Am, 2017. **46**(1): p. 63-85.
16. Appaduray, S.P. and P. Lo, *Effects of diabetes and smoking on lumbar spinal surgery outcomes*. J Clin Neurosci, 2013. **20**(12): p. 1713-7.
17. Herman, W.H., M. Petersen, and R.R. Kalyani, *Response to Comment on American Diabetes Association. Standards of Medical Care in Diabetes-2017*. Diabetes Care 2017;40(Suppl. 1):S1-S135. Diabetes Care, 2017. **40**(7): p. e94-e95.
18. Qaseem, A., T.J. Wilt, D. Kansagara, et al., *Hemoglobin A1c Targets for Glycemic Control With Pharmacologic Therapy for Nonpregnant Adults With Type 2 Diabetes Mellitus: A Guidance Statement Update From the American College of Physicians*. Ann Intern Med, 2018. **168**(8): p. 569-576.
19. Tegegne, B.S., M.M. Mengesha, A.A. Teferra, et al., *Association between diabetes mellitus and multi-drug-resistant tuberculosis: evidence from a systematic review and meta-analysis*. Syst Rev, 2018. **7**(1): p. 161.
20. Sun, W.W., J. Gu, and L. Fan, *[Application value of metagenomic next-generation sequencing (mNGS) in the diagnosis of different types of tuberculosis]*. Zhonghua Jie He He Hu Xi Za Zhi, 2021. **44**(2): p. 96-100.
21. Yao, Y., H. Zhang, M. Liu, et al., *Prognostic Factors for Recovery of Patients After Surgery for Thoracic Spinal Tuberculosis*. World Neurosurg, 2017. **105**: p. 327-331.

Figures

Figure 1

A 42-year-old male was diagnosed as having DMSTB after an eight months history of severe back pain. A-E Pre-operative X-ray, MRI and CT showed that the lesion around the vertebral body of L5/S1 developed an abscess with marked bony destruction. The abscess involved in the spinal canal with cord compromise resulted in neurologic deficit. F-J Post-operative X-ray and CT showed complete resolution of epidural abscess and decompression of neural component. Interbody graft using titanium mesh cages

were placed satisfactorily. K-O 3-month follow-up radiographs showed there is no titanium mesh cages displacement. P-T Final follow-up radiographs showed there is good bone fusion.