Genij Ortopedii. 2021. Vol. 27, no. 6. P. 750-757.

Original article

https://doi.org/10.18019/1028-4427-2021-27-6-750-757

Risk factors for perioperative complications and recurrences in hematogenous pyogenic vertebral osteomyelitis: analysis of a monocentric cohort

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Abstract

Study design Retrospective analysis of a single-center cohort of patients with pyogenic vertebral osteomyelitis. The purpose of the study was to review risk factors for perioperative complications and recurrences in patients diagnosed with hematogenous pyogenic vertebral osteomyelitis. **Material and methods** 141 inpatient records of hematogenous pyogenic vertebral osteomyelitis were reviewed at the Regional Clinical Hospital No. 2, Tyumen. Patients who developed complications, neurological deficits and recurrences were assigned to A group (n = 66), and those who did not included in B group (n = 75). **Results** Perioperative complications, recurrences, risk factors and neurological disorders that could develop with different treatment methods were explored. There was a greater risk of recurrences and a lower rate of neurological complications seen in chronic cases and drug addicts. There was a lower risk of intra- and postoperative complications seen in thoracic spine involvement, a greater risk of neurological deficit with involved cervical spine and a lower risk in the lumbar spine involvement. There was a lower risk of neurological disorders in type A and type B disorders, and a greater risk in type C disorders as categorized by E. Pola. There were no differences in recurrence rates among different types of involvement. HIV did not increase the risk of complications and relapses. Surgical site infection developed in 8.1 % cases of transpedicular fixation and in 6.9 % following ventral interventions. No correlation was observed between the recurrence and complication rate and the surgical methods used. Overall, recovery or stable remission was achieved in 88.6 % of cases after treatment of relapses. **Conclusion** Recurrences and complications were primarily caused by delayed diagnosis, co-morbidities and neurological deficits. No correlation was observed between the recurrence and complication rate and the surgical methods used. There was a greater risk of recurrences and a lower rate of neurological complications seen in chronic cases and drug addicts. Neurological disorders are common for cervical spine disorders. The risk of complications was dependent on the type of involvement as categorized by E. Pola. There was a lower risk of neurological disorders in type A and B disorders and a statistically greater risk in type C disorders.

Keywords: spine, hematogenous pyogenic vertebral osteomyelitis, spondylodiscitis, spondylitis, risk factors, recurrence, complication, neurological disorder

For citation: Bazarov A.Yu., Sergeev K.S., Lebedev I.A., Paskov R.V., Tsvetkova A.K. Risk factors for perioperative complications and recurrences in hematogenous pyogenic vertebral osteomyelitis: analysis of a monocentric cohort. *Genij Ortopedii*, 2021, vol. 27, no 6, pp. 750-757. https://doi.org/10.18019/1028-4427-2021-27-6-750-757.

INTRODUCTION

Hematogenous osteomyelitis of the spine (HOS) is a disease that requires a multidisciplinary approach at all stages of treatment, from diagnosis to rehabilitation of patients. The rare and severe pathology is associated with perioperative risk factors of recurrences and complications. This is supported by a number of factors. Late diagnosis is common for vertebral inflammatory involvement [1]. Algorithmization and classifications have been offered for infectious lesions of the spine [2-5] but they are mostly used in researches and have not been widely applied in practical healthcare. The mean time of diagnosis ranges between 2 and 4 months [6-8]. Diagnosis is based on radiological findings, physical examination, laboratory and microbiological data [9]. Neurological deficiency occurs in 18.5-75 % with the risk of the complication being higher with involvement in the cervical spine and with a disease caused by Staphylococcus aureus [5, 10, 11]. Overall, complications depend on many factors and can be as high as 12.5 %. One of the reasons is "soft" fixation systems used for the treatment of degenerative spinal lesions [12]. The complication rate is twice as high in patients older than 65 years after surgical treatment being 40.6 % including long-term results and mortality, and 21.9 % after conservative therapy. Complication rate of inpatients operated on amounted to 28.1 % and was reported to be 16.6 % among those treated conservatively [13]. Conservative treatment is a safe and effective for patients with early diagnosis, absence of significant bone destruction and neurological deficit and can be the method of choice for patients with decompensated concomitant pathology [14].

Surgical treatment of spondylodiscitis is accompanied by a risk of recurrence with implantation of stabilizing constructs, in particular [15]. Although recurrence rate in conservative and surgical treatment is comparable the risk is higher with antibacterial therapy of less than 6 weeks [16-18]. The recurrence rate ranges from 1 to 22 % [19] with the main risk factors being lumbosacral involvement, HIV, treatment of unidentified pathogen,

resistant microflora and polymicrobial involvement. Recurrence usually develops 4 months after stabilizing operations and extremely rarely after a year and over [15, 20] and repeated diagnostic algorithm would be required to include laboratory, imaging and microbiological examination to be followed by antibacterial therapy and surgical treatment in some cases [21].

There are publications ranking the risks of reoperations in pyogenic complications of spinal surgery [22] describing indications for surgical treatment of spondylodiscitis [16]. Six predictors identified by the authors included distant site infection, medical comorbidities, the immunocompromised patient, MRI findings of destruction and abscesses, lumbosacral location, neurological deficit [16]. The risk of revision interventions is associated with polymicrobial involvement or methicillin-resistant Staphylococcus aureus (MRSA), implanted spinal systems, use of bone-plastic materials (synthetic, in particular) [22].

The purpose of the study was to review risk factors for perioperative complications and recurrences in patients diagnosed with hematogenous osteomyelitis of the spine.

MATERIAL AND METHODS

141 inpatient records of hematogenous osteomyelitis of the spine were reviewed at the Regional Clinical Hospital No. 2, Tyumen. Patients underwent surgical treatment. Patients who developed intra- and postoperative complications, neurological deficits and recurrences were assigned to A group and those who did not included in B group. Detailed information is presented in the flowchart (Fig. 1). Exclusion criteria were absence of a catamnesis during the year, the specific nature of the inflammation, postoperative osteomyelitis, conservative treatment. The paper reports clinical material collected in 2006-2017 with use of inpatient charts, CT and/or MRI findings, CBC, ESR, CRP, questionnaires filled out not earlier than a year after the patient's discharge. The length of inpatient treatment, timing of diagnosis, pattern of the disease and the type of lesion as classified by E. Pola, the presence of risk factors for intra- and postoperative complications and ways to correct them were statistically analyzed.

All patients were divided into groups depending on the presence of complications, neurological deficits and recurrences. Group A (n = 66) included patients who developed no recurrences and had uncomplicated course of the disease, group B (n = 75) consisted of patients with a complicated course of the disease (Fig. 1). There were 71.6 % (n = 101) male and 28.4 % (n = 40) female patients with ratio of 2.5:1. The mean age was 48.0 ± 14.3 years. The patients were divided according to the localization of the infection developed in cervical (7.1 %, n = 10), thoracic (36.2 %, n = 51), lumbar (48.2 %, n = 68) spine, multilevel (3.5 %, n = 5) and polysegmental 5.0 % (n = 7) involvement. Polysegmental lesions were localized in the cervical (n = 4), thoracic (n = 1) and lumbar (n = 2) spine. Multilevel inflammations were characterized by combined involvement of the cervical and lumbar spine (n = 2), thoracic spine (n = 2) and thoracic and lumbar spine (n = 1). Of the five patients with multilevel involvement, two had neurological deficit and involved cervical spine. Overall, the cervical spine was affected in 16 patients, neurological disorders of different severity were noted in 81.3 % (n = 13). Patients with acute and subacute forms of the disease accounted for 50.4 % (n = 71) and there were 49.6 % (n = 70) chronic cases. The distribution of patients by types of surgical interventions is shown in Figure 2.

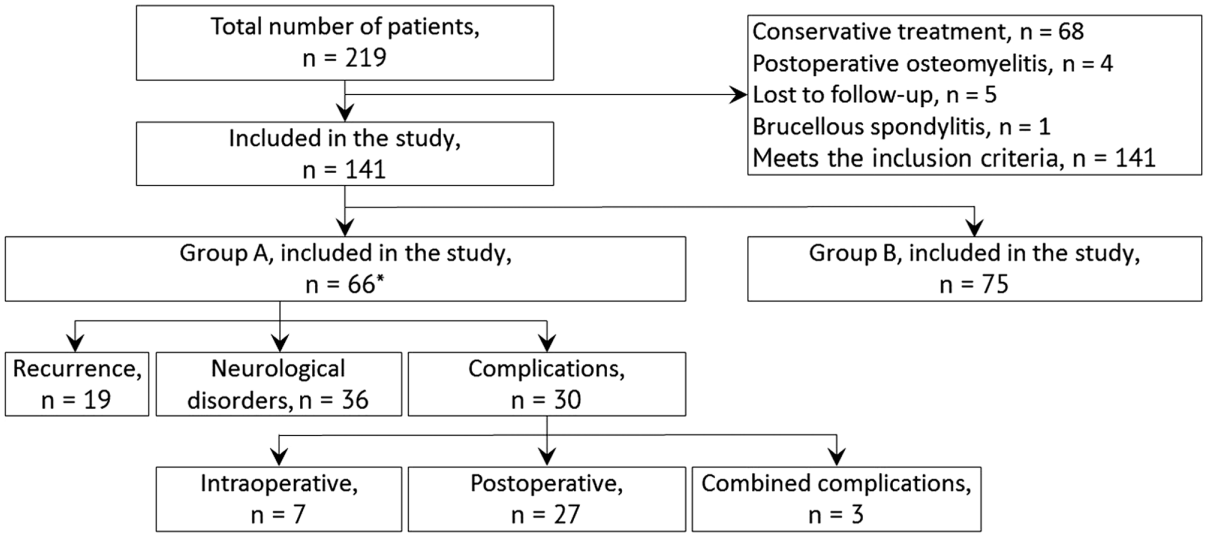

Fig. 1 Diagram showing study design

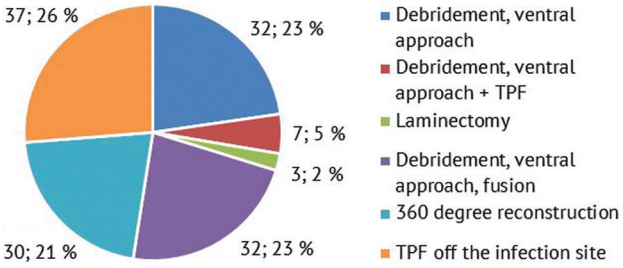

Fig. 2 Distribution of patients by types of surgical interventions

Statistical analysis was performed using IBM SPSS Statistics 21.0 and Statistica 6.0 software. Quantitative data were presented in the form of mean and standard deviation of mean (M ± SD) or in the form of median and interquartile range of Me [25–75 %]. The Kolmogorov-Smirnov test was used to identify the distribution of quantitative parameters. The data were compared with the normal distribution using the Student's t-test for independent samples, and the Mann-Whitney U test was used to compare differences between two independent groups. The χ-square test and the exact Fisher criterion were used to identify the differences between the qualitative parameters. A value of $P < 0.05$ was considered statistically significant.

RESULTS

The mean bed/day in groups A and B was 31.0 ± 15.2 and 35.4 ± 22, respectively, and was determined by the volume of surgical intervention and by the timing of antibacterial therapy. There were no significant differences in the risk of recurrence and complications depending on the type of surgical intervention. The mean time of diagnosis was 2.1 ± 2.2 months for group A and 3.3 ± 2.7 months for group B. The risk of recurrences was significantly higher ($p = 0.042$) in chronic cases with a simultaneous decrease in neurological complications ($p < 0.001$). Localization of the process was also decisive for complications: the risk of intra- and postoperative complications ($p = 0.069$) was less for the thoracic spine involvement with a significantly increased risk of neurological deficit with cervical spine involvement and the decreased risk in the lumbar spine ($p < 0.001$).

Patterns of pyogenic lesions of the spine as classified by E. Pola [5] included a decreased risk of neurological disorders in type A ($p = 0.003$) and type B lesions ($p < 0.001$) with significantly increased risk in type C lesions ($p < 0.001$). Osteomyelitic subtypes revealed lower rate of recurrences ($p = 0.031$) and intra- and postoperative complications ($p = 0.038$) for lesions A.3. Other subtypes demonstrated highly significant risk of neurological deficiency for type C lesions, C.3 and C.4 ($p < 0.001$) with lower risk for types A, A.3 ($p = 0.021$), type B, B.1 ($p < 0.001$) and B.2 ($p = 0.011$). There were no specific patterns in the development of recurrences in patients differentiated by main types of lesions. Immunodeficiency in HIV patients did not increase the risk of complications and recurrences and drug-dependent patients had higher rate of recurrences ($p = 0.072$) and lower rate of neurological complications ($p = 0.083$). There was a significant decrease in intra- and postoperative complications ($p = 0.041$) and neurological disorders ($p = 0.008$) in patients with a history of spinal injury.

Four patients were not grouped with classification system developed by E. Pola: three cases were diagnosed with a monovertebral lesion located posteriorly in the vertebrae without involving bodies and intervertebral discs, and one patients had involved CI-CII segment, and one of the main classification criteria being spondylodiscitis, a lesion of the vertebral motion segment (VMS). The presence of concomitant diabetes mellitus did not affect recurrences and complications, no significant differences were found in the Charlson Comorbidity Index (CCI).

Different risk factors were identified in 78 patients (55.3 % of the total number of patients), 32 (22.7 %) had combined risk factors, for example, HIV + viral hepatitis + drug addiction observed in 18 (12.8 %) cases. Parenteral use of synthetic psychedelic drug (surfactants) with subsequent development of spinal osteomyelitis within 1-3 weeks was noted in several patients (chemical and toxicological examination was not conducted). Diabetes mellitus affected 11 patients (7.8 %); cirrhosis of the liver noted in 2 (1.4 %); oncological diseases was in the history of 1 case (0.7 %); systemic hormone therapy was administered in 2 (1.4 %); spinal surgery in the history in 4 (2.8 %); alcoholism, in 2 (1.4 %); treatment in the intensive care unit and abdominal surgery in 6 (4.3 %); spinal anesthesia was performed for two (1.4 %) patients. Urinary surgery, periprosthetic hip joint infection, prolonged use of the peripheral venous catheter, spinal cord injury in the history, bacterial endocarditis were noted once in 0.7 % each. Paravertebral scars and adhesions that inevitably involved vessels (n = 6) were the reason for the majority of intraoperative complications. There was a traction injury to the descending colon during removal of the migrated interbody implant (n = 1) with resultant colonic fistula that closed due to conservative treatment. Postoperative complications developed in 28 patients with combined adverse events noted in one case. Some of the complications were surgery related events and the rest were associated with underlying or concomitant disease. Types and number of postoperative complications are presented in Table 2.

Table 1

Frequency and percentage of recurrences and complications, neurological deficits in groups of patients depending on risk factors

Risk factor	Recurrence (absence/presence)		Complications including neurological (absence/presence)		Intra-, postoperative complications (except neurological) (absence/presence)		Neurological deficiency (absence/presence)		Group A (absence/presence)	
	n (%)	P	n (%)	P	n (%)	P	g (%)	P	n (%)	P
Acute/subacute type	115 (61.2) / 8 (38.1)	0.042	84 (56.8) / 39 (63.9)	< 0.001	108 (60.7) / 15 (48.4)	> 0.1	91 (53.2) / 32 (84.2)	< 0.001	79 (57.2) / 44 (62.0)	0.015
Chronic type	73 (38.8) / 13 (61.9)		64 (43.2) / 22 (36.1)		70 (39.3) / 16 (51.6)		80 (46.8) / 6 (15.8)		59 (42.8) / 27 (38.0)	
Cervical spine	13 (10.7) / 1 (5.3)	> 0.1	3 (3.6) / 11 (19.0)	0.004	11 (9.9) / 3 (10.0)	0.069	3 (2.9) / 11 (30.6)	< 0.001	2 (2.7) / 12 (18.2)	0.002
Thoracic spine	46 (37.7) / 7 (36.8)		32 (38.6) / 21 (36.2)		46 (41.4) / 7 (23.3)		36 (34.3) / 17 (47.2)		30 (40.0) / 23 (34.9)	
Lumbar spine	58 (47.5) / 11 (57.9)		45 (54.2) / 24 (41.4)		50 (45.1) / 19 (63.4)		63 (59.9) / 6 (16.6)		40 (53.3) / 29 (43.9)	
Multilevel, polysegmental	5 (4.1) / 0		3 (3.6) / 2 (3.4)		4 (3.6) / 1 (3.3)		3 (2.9) / 2 (5.6)		3 (4.0) / 2 (3.0)	
Involvement type* A	21 (17.5) / 5 (26.3)	> 0.1	19 (23.5) / 7 (12.1)	< 0.001	20 (18.3) / 6 (20.0)	> 0.1	25 (24.3) / 1 (2.8)	0.003 < 0.001 < 0.001	16 (21.9) / 10 (15.2)	< 0.001
Involvement type B	66 (55.0) / 10 (52.6)		55 (67.9) / 21 (36.2)		60 (55.1) / 16 (53.3)		70 (67.9) / 6 (16.7)		51 (69.9) / 25 (37.8)	
Involvement type C	33 (27.5) / 4 (21.1)		7 (8.6) / 30 (51.7)		29 (26.6) / 8 (26.7)		8 (7.8) / 29 (80.5)		6 (8.2) / 31 (47.0)	
Involvement type A.2	13 (10.8) / 1 (5.3)	> 0.1	14 (17.3) / 0	< 0.001	14 (12.8) / 0	0.04	14 (13.6) / 0	0.021	13 (17.8) / 1 (1.5)	0.001
Involvement type A.3	6 (5.0) / 4 (21.1)	0.031	4 (4.9) / 6 (10.3)	> 0.1	5 (4.6) / 5 (16.7)	0.038	9 (8.7) / 1 (2.8)	> 0.1	2 (2.7) / 8 (12.1)	0.045
Involvement type A.4	2 (1.7) / 0	> 0.1	1 (1.2) / 1 (1.7)	> 0.1	1 (0.9) / 1 (3.3)	> 0.1	2 (1.9) / 0	> 0.1	1 (1.4) / 1 (1.5)	> 0.1
Involvement type B.1	30 (25.0) / 4 (21.1)	> 0.1	27 (33.4) / 7 (12.1)	0.005	27 (24.8) / 7 (23.3)	> 0.1	34 (33.0) / 0	< 0.001	25 (34.2) / 9 (13.6)	0.006
Involvement type B.2	25 (20.8) / 3 (15.8)	> 0.1	21 (25.9) / 7 (12.1)	0.045	22 (20.2) / 6 (20.0)	> 0.1	26 (25.3) / 2 (5.6)	0.011	20 (27.4) / 8 (12.1)	0.034
Involvement type B.3.1	11 (9.2) / 3 (15.8)	> 0.1	7 (8.7) / 7 (12.1)	> 0.1	11 (10.1) / 3 (10.0)	> 0.1	10 (9.7) / 4 (11.1)	> 0.1	6 (8.2) / 8 (12.1)	> 0.1
Involvement type C.2	8 (6.7) / 0	> 0.1	6 (7.4) / 2 (3.4)	> 0.1	7 (6.4) / 1 (3.3)	> 0.1	7 (6.8) / 1 (2.8)	> 0.1	6 (8.2) / 2 (3.0)	> 0.1
Involvement type C.3	9 (7.5) / 1 (5.3)	> 0.1	0 / 10 (17.2)	< 0.001	7 (6.4) / 3 (10.0)	> 0.1	0 / 10 (27.7)	< 0.001	0 / 10 (15.2)	< 0.001
Involvement type C.4	16 (13.3) / 3 (15.8)	> 0.1	1 (1.2) / 18 (31.1)	< 0.001	15 (13.8) / 4 (13.3)	> 0.1	1 (1.0) / 18 (50.0)	< 0.001	0 / 19 (28.8)	< 0.001
HIV	16 (13.1) / 6 (31.6)	> 0.1	12 (14.5) / 10 (17.2)	> 0.1	16 (14.4) / 6 (20.0)	> 0.1	17 (16.2) / 5 (13.9)	> 0.1	10 (13.3) / 12 (18.2)	> 0.1
Drug addict	23 (19.3) / 7 (38.9)	0.072	20 (24.4) / 10.(18.2)	> 0.1	23 (21.1) / 7 (25.0)	> 0.1	26 (25.5) / 4 (11.4)	0.083	17 (23.0) / 13 (20.6)	> 0.1
Spinal injury	14 (11.5) / 0	> 0.1	6 (7.2) / 8 (13.8)	> 0.1	14 (12.6) / 0	0.041	6 (5.7) / 8 (22.2)	0.008	6 (8.0) / 8 (12.1)	> 0.1
Diabetes mellitus	10 (8.2) / 1 (5.3)	> 0.1	7 (8.4) / 4 (6.9)	> 0.1	7 (6.3) / 4 (13.3)	> 0.1	9 (8.6) / 2 (5.6)	> 0.1	7 (9.3) / 4 (6.1)	> 0.1

* – Involvement type as classified by E. Pola, 2017.

Table 2

Types and number of postoperative complications and the percentages

#	Complication	Number	%
1	Infection developed at the site of TPF device	6	21.4
2	Unstable interbody implant	4	14.3
3	Totally infected wound	3	10.7
4	Multiple organ failure syndrome (MOFS)	3	10.7
5	Damaged transpedicular fixator	3	10.7
6	Pneumonia	2	7.1
7	Ascending spinal cord swelling	2	7.1
8	Psoasabscess	1	3.6
9	Ligature fistula	1	3.6
10	Upper paraparesis	1	3.6
11	Kyphosis at the level of anterior reconstruction and fusion	1	3.6
12	Coagulated hemothorax	1	3.6
13	Pyogenic coxitis	1	3.6
14	Massive bleeding from postoperative wound	1	3.6
Total:		30*	

* – 30 complications presented was observed in 28 patients (one patients had combined complications including № 1, 2, 13).

Surgical site infection (SSI) developed in 8.1 % out of 73 patients due to TPF and in 6.9 % of 101 patients due to anterior fixations. Postoperative complications required 27 reoperations in 25 cases including removal of TPF with fusion formed (n = 8, 29.6 %); repeated debridement, (n = 5, 18.5 %); revision TPF (n = 3, 11.1 %); revision of the postoperative wound (n = 3, 11.1 %); primary TPF (n = 2, 7.4 %); removal of the interbody implant (n = 2, 7.4 %); resection of the femoral head, spacer placement, (n = 2, 7.4 %); necrectomy of pressure ulcers (n = 1, 3.7 %); tracheostomy (n = 1, 3.7 %). Recurrence was observed in 19 patients (13.5 %) with the distribution depending on the type of surgical intervention shown in Figure 3.

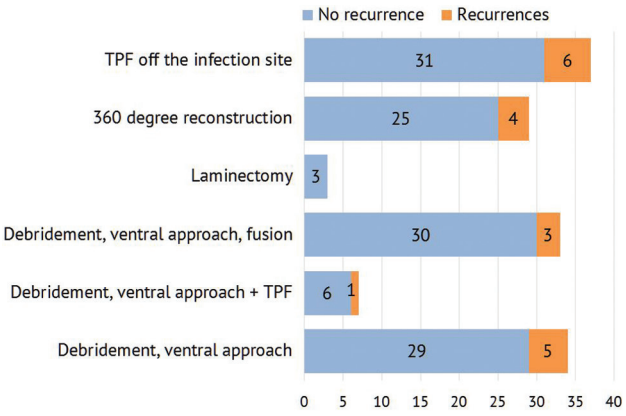

Fig. 3 Distribution of patients depending on type of surgery performed

The main causes of complications included localization and type of lesion, prolonged parenteral use of synthetic surfactants, non-compliance. No risk factors for recurrences were seen in six patients. Recurrences developed within the year were noted in 13 (6.2 %) cases and six (3.3 %) patients had recurrences between 15 months to 7 years. No correlation was observed between the number of patients with recurrences and complications and the method of surgical treatment used. All patients received complex treatment for recurrences, 17 of them were re-operated, stable remission was achieved in nine for the period of 1.5 to 13 years. Good results were obtained in most cases. Recovery was assessed as the absence of recurrence within a year with the supporting and motor functions of the spine regained and acute phase parameters normalized in blood tests. Recovery or persistent remission was achieved in 88.6 % (n = 125) of cases after treatment of recurrences.

DISCUSSION

Inflammatory lesions of the spine are normally treated at tertiary hospitals where patients can receive care from experienced professionals. The level of diagnosis and treatment of spondylodiscitis in the general medical network is quite low, and there is a significant number of patients with untimely diagnosis or complications. Septic destruction in the spine detected accidentally with MRI is not uncommon. Identification of risk factors is essential for HOS patients with the maximum prognostic value noted in the presence of distant site infection, concomitant diseases (diabetes mellitus, in particular), immunodeficiency, MRI findings, anatomical location (lumbar spine) and neurological deficit [16]. Recurrences after surgical interventions are more likely seen with parenteral drug addiction, polymicrobial and resistant microflora and implanted constructs [18, 22, 23]. Tumor lesions, liver and kidney diseases, and an unidentified pathogen are also important risk factors. The maximum risk of recurrence persists for the first six months after surgery with the rate of 9.9–18.8 % [1, 15, 19, 24]. Polymicrobial involvement combined with highly virulent pathogen, diabetes mellitus or immunodeficiency significantly aggravates the course of the disease and increases the risk of complications or treatment failures [17]. A targeted study of HIV patients showed no increased complication or recurrence rates among patients who underwent surgical treatment [25]. Based on the results of randomized clinical trials antibacterial therapy is recommended for at least 6 weeks. An increase in antibiotic therapy for more than 6 weeks does not lead to a decrease in mortality and poor treatment results [18]. The duration of antibiotic

treatment of 8 weeks or more can be advocated for patients with MRSA, non-drained paravertebral abscesses and patients receiving chronodialysis [26]. Long-term treatment results are better with anterior approaches for patients with indications to surgical treatment [27]. Anterior fixation is associated with a high risk of injury to segmental and major vessels at the maximum level of the lumbosacral spine. Our series showed pyogenic SSI rate being comparable with that seen with anterior and posterior fixation of the spine. Recurrences were observed in 13.5 % (n = 19) of surgical cases and in 4.4 % (n = 3) of cases treated conservatively. Several similar complications can be arrested either conservatively or with extensive revision interventions. We reviewed intra- and postoperative complications using the grading system offered by Dindo-Clavien (2004) [28, 29, 30] and found that similar complications could be assigned to different groups depending on the measures required for their correction: surgical blood loss replenished by transfusion of blood products, different degrees of transpedicular screw malposition [31], migration of the interbody implant. Group V included 9 in-hospital deaths, (mortality rate was not included in the review).

Conservative treatment provided better results than those seen with surgical treatment and required strict indications for the use (uncomplicated course with no extended abscesses, septic instability and neurological symptoms) and parameters determining the disparity of groups. The majority of complications and recurrences were observed in the patients who underwent surgical treatment and associated with the duration of the disease, general condition of the patient and concomitant pathologies. Ultimately, the choice of treatment method and the results largely depend on timely diagnosis and concomitant pathology.

Table 3

Types and number of postoperative complications distributed according to the grading system offered by Dindo-Clavien (2004)

Group*	Type of complication	Number (%)
I	Kyphosis at the level of anterior reconstruction and fusion	1 (0.7)
II	Migration of interbody implant	1 (0.7)
	Upper paraparesis	1 (0.7)
	Pneumonia	1 (0.7)
	Colon fistula	1 (0.7)
	Malpositioned transpedicular screw Rao type 1-2	2 (1.4)
	Blood loss of greater than 500 mL and hemotransfusion	35 (24.8)
III-a	Ligature fistula	1 (0.7)
	SSI (totally infected postoperative wound)	1 (0.7)
III-b	SSI at the site of TPF secondary to fusion	4 (2.8)
	SSI at the site of TPF with no fusion	1 (0.7)
	Pyogenic coxitis	2 (1.4)
	Damaged transpedicular fixator secondary to fusion	3 (2.1)
	Psoasabscess	1 (0.7)
	Unstable interbody implant	1 (0.7)
	Coagulated hemothorax	1 (0.7)
	SSI (totally infected postoperative wound)	2 (1.4)
	Migration of interbody implant	2 (1.4)
	Massive bleeding from postoperative wound	1 (0.7)
	Screw malposition type 3	2 (1.4)
V	Ascending spinal cord swelling	2 (1.4)
	Pneumonia	2 (1.4)
	Uncontrollable sepsis	2 (1.4)
	Multiple organ failure syndrome	3 (2.1)

* – The table includes findings of 47 (33.3 %) patients taking into account the combined complications (n = 1) as classifed by Dindo-Clavien

CONCLUSION

Untimely diagnosis, concomitant pathology, neurological deficiency were shown to be major causes of recurrences and complications. There was no correlation between recurrence and complication rate and method of surgical treatment used. The risk of recurrences was higher ($p = 0.042$) in chronic cases with a simultaneous decrease in neurological complications ($p < 0.001$) as well as in drug-dependent patients showing an increased recurrence rate ($p = 0.072$) and decrease in neurological complications ($p = 0.083$). Neurological disorders were common for cervical spine involvement ($p < 0.001$). There was a correlation between the risk

of complications and the type of lesion as classified by E. Pola with a decreased risk of neurological disorders in type A ($p = 0.003$) and type B lesions ($p < 0.001$) with significantly increased risk in type C lesions ($p < 0.001$). Recovery or persistent emission was achieved in 88.6 % (n = 125) of cases after treatment of recurrences.

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The article was submitted 30.04.2021; approved after reviewing 25.08.2021; accepted for publication 19.10.2021.

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Declaration of Conflicting Interests *The authors declared no potential conflicts of interest with respect to the authorship and/or publication of this article.*

Funding *The authors received no financial support for the research and/or authorship of this article.*