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Clinical analysis of intervertebral space infections

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Abstract

Intervertebral space infections are a serious group of diseases caused by various microorganisms. These infections present various pathological processes with neurological deficit due to pain, deformity, instability and spinal cord compression, and lead to high morbidity and mortality. For this reason, our aim in this study was to contribute to the discussions in the literature by comparing etiologically different disc infections, by revealing different aspects of them, and by assessing them in terms of timing of surgical treatment retrospectively in the light of the literature. In this study, 59 patients with spinal infection were retrospectively evaluated between 2010 and 2015 at Inonu University Department of Neurosurgery. The patients were divided into groups based on age, gender, complaints, duration of complaints, preoperative and postoperative findings, and microorganism sites and compared in terms of sites, malformation, instability, and surgical procedures. Tissue samples taken from the histopathological and bacteriological (culture and cultural sensitivity) patients were examined. Lastly, the effects of each parameter on morbidity and mortality were investigated. It was concluded that early diagnosis and treatment decreases morbidity.

Keywords: Spondylodiscitis, pyogenic, paraspinal abscess, instability

Introduction

Pyogenic Spinal Infections (PSI): *S. aureus* active in 60% of the infections, while gram-positive and gram-negative bacteria such as streptococcus and pneumococcus are active in the rest [1]. Diabetes mellitus, immunosuppression, advanced age, intravenous medication usage, sharp object injuries, and postoperative spondylodiscitis (POS) are causes that increase the inclination toward spinal infections [2-5]. *Spinal Tuberculosis (TB)* is among the most frequently observed infections [6]. *M. tuberculosis, M. bovis, M. microti, and M. africanum* are among other factors. The presence of mm3>100,000 bacteria is accepted as ARB (+). In contrast to pyogenic infections, spinal TB infections are often seen not only in advanced age but in all ages as well and in the thoracic region [7]. *Spinal Brucellosis (SB): B. melitensis* is caught from sheep and goats, *B. abortus* from cattle, *B. suis* from swine, and *B. canis* from dogs. Infectious milk and dairy products and generally cheese consumption play an active role [8]. In brucellosis, it is possible to observe tremor, high fever, sweating, headache, weakness, weight loss, and backache and arthralgia. *B. melitensis* is the most pathogenic and frequently observed microorganism [9]. Tube agglutination test (TAT) is frequently used in the diagnosis of the disease and 1/160 is accepted to be +. *Parasitic Infections of the Spine:* Echinococcus granulosus, which causes cyst hydatid, is a parasitic infection that most frequently settles on the spine. Its spread on the spine is enabled with proto-vertebral shunts [10]. *Fungal Infections of the Spine:* They are transmitted through inhalation or cutaneously and form infections on the organs through blood. They are generally observed in immunodeficient patients. Fungi such as blastomycosis, coccidioidomycosis, cryptococcosis, aspergillosis, actinomycosis, and candidiasis cause granulomatous infection and can be mixed with tuberculosis radiologically and pathologically. The surgical planning was carried out based on that of White and Panjabi [11]. According to White and Panjabi, *spinal stability* means that the spinal arrangement is not disrupted under normal weight and there is no unbearable pain or motor deficit, while *spinal instability* means that the spinal arrangement is disrupted under normal weight as

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a result of which motor deficit and chronic pain occur. In the instability evaluation of White and Panjabi, anterior colon is scored as 2 points, posterior colon 2 points, dislocation during rest 2 points, angulation during rest 2 points, listhesis in dynamic graphics 2 points, nerve injury 3 points, narrowing of the discs in the infectious region 1 point, and overload 1 point; while a score of up to 4 points is assessed to be limited instability, and 5 points or more clinical instability. Spinal infections are a group of high-level morbidity and mortality diseases that cause different deformities and motor losses through different microorganisms [12,13]. The advancement of radiological diagnostic tools has led to an increase in the number of spinal surgeries, antibiotic-resistant microorganisms, and the diagnosis of spinal infections [12-15]. Therefore, it was intended in this study to compare etiologically varying disc infections, reveal their original aspects, and contribute to these discussions by examining surgical treatment indications and timings retrospectively. .

Materials and Methods

A total of 23170 patients, applying to Inonu University Turgut Özal Medical Center Neurosurgery Clinic with back, neck, and lower back pain complaints between January 2010 and October 2015, were examined retrospectively. From among those patients, 59 patients diagnosed with spinal infection were divided into groups based on age, gender, complaints on application, duration of these complaints, preoperative and postoperative findings, active microorganisms, and the infectious site and region. The background and neurological treatment findings, routine blood parameters, culture test results, erythrocytes sedimentation rate, and C-reactive protein (CRP) levels of the patients were evaluated and compared. All the patients were assessed with a tuberculosis skin test (Purified Protein Derivative, PPD), serological tests, and radiological examinations. Surgical intervention was implemented on each patient based on their deformity and instability levels. Before the operation, the instability criteria of the patients were classified based on a 5-point system created by White and Panjabi and stabilized using the modification of this system conducted by Benzel. Histopathological, cultural, and culture antibiogram analyses of the tissue samples taken from the lesion region were performed. Within 24 hours after the surgery, scoliosis graphics and the amount of recovery in neural decompression and deformity were assessed with CT scans during the early period. The effects of each parameter on morbidity and mortality in each patient were investigated.

Results

Spondylodiscitis was observed in 59 out of 23170 patients who applied to Inonu University Turgut Özal Medical Center Neurosurgery Clinic between January 2010 and October 2015 with complaints of back, neck, and lower back pain. Pyogenic spinal infection was found in 19 out of these 59 patients. Of these patients, 6 were female (31.6%) while 13 were male (68.4%) (Table 1).

Table 1. Gender distribution

Group	Gender	N	Percent	Cumulative Percent
	Male	4	25.0	
Brucella	Female	12	75.0	25.0 100.0
	Total	16	100.0	
	Male	1	25.0	
Tuberculosis	Female	3	75.0	25.0 100.0
	Total	4	100.0	
	Male	13	68.4	
Pyogenic spinal infection	Female	6	31.6	68.4 100.0
	Total	19	100.0	
	Male	11	55.0	
Postoperative spondylodiscitis	Female	9	45.0	55.0 100.0
		20	100.0	

The average age of the patients with PSI was found to be 55.32 (min 31, max 77, SD 12.26). The primary risk factors in the patients were, in order, diabetes mellitus (44%), extraspinal infection (33%), long-term steroid medication use (24%), and malignancy (17%), followed by immunodeficiency syndrome and chemotherapy. In the present study, undergone operation or biopsy ranked first in 20 cases (33%), while extraspinal infections and diabetes mellitus were observed in 6 (30%) and 4 (6%) patients respectively. The starting time of the symptoms (Table 2) were found to be 19.69 days (min 14, max 30, SD 5.16) for SB, 49.5 days (min 30, max 60, SD 13.69) for spinal TB, 24.74 days (min 15, max 40, SD 6.74) for PSI, and 36.35 days (min 20, max 90, SD 16.74) for POS. Erythrocytes sedimentation rates (Table 2) were determined to be 29.75 (min 2, max 67, SD 20.16) for SB, 67.75 (min 56, max 82, SD 10.71) for spinal TB, 36.87 (min 4, max 103, SD 28.53) for PSI, and 32.8 (min 4, max 120, SD 30.77) for POS. CRP levels were determined to be 5.86 (min 0.33, max 30, SD 7.4) for SB, 6.58 (min 0.67, max 15.26, SD 14) for spinal TB, 21.27 (min 28, max 176, SD 41.38) for PSI, and 10.69 (min 0.22, max 80, SD 22.64) for POS. WBC was calculated to be 7.6 (min 4.3, max 12, SD 1.74) for SB, 7.85 (min 3.5, max 12.4, SD 3.73) for spinal TB, 16.65 (min 3.2, max 86i SD 19.58) for PSI, and 11.71 (min 5.1, max 82, SD 16.63) POS. Out of cases with previous surgery, 2 (8%) patients had TB; the number of cases that could not reveal an active agent was 26 (76%); staphylococcus aureus was observed in 3 cases (13%), aspergillosis in 1 (4%), candida in 2 (8%), and eikenella in 1 (4%).

All of 59 patients had discitis (Table 3), while 1 had kyphotic deformity. Epidural abscess was present in 4 patients with SB (25%), 4 patients with spinal TB (100%), 4 patients with PSI (21.1%), and 17 patients with POS (85%); psoas abscess was observed in 1 patient with SB (6.3%), 4 patients with spinal TB (100%), and 3 patients with PSI (15.8%). In terms of lesion regions, they were observed in cervical area in 3 patients (18.8%), thoracic area in 1 patient (6.3%), and lumbar area in 12 patients

(75%) among the patients with SB; in thoracic area in 1 patient (25%) and lumbar area in 3 patients (75%) among the patients with spinal TB; in cervical area in 3 patients (15.8%), thoracic area in 4 patients (21.1%), and lumbar area in 12 patients (63.2%) among the patients with PSI; and in lumbar area in 20 patients (100%) among the patients with POS. The Brucella agglutination test, Coombs, produced + results (81.3%) in 13 of the SB patients with a history of fresh cheese consumption. In patients with spinal TB, the PPD>15 value produced positive results in 2 out of 4 patients (Table 4).

Table 2. Age, blood parameters and duration of hospitalization

Group		Age	WBC	CRP	ESR	Clinical time
SB	Valid N	16	16	16	16	16
	Missing N	0	0	0	0	0
	Mean	58.00	7.606	5.8688	29.250	19.69
	Median	58.00	7.800	3.8600	25.000	19.00
	Std. Deviation	18.900	1.7403	7.40874	20.1610	5.160
	Range	72	5.9	29.67	65.0	16
	Minimum	25	4.3	.33	2.0	14
	Maximum	97	10.2	30.00	67.0	30
Spinal TB	Valid N	4	4	4	4	4
	Missing N	0	0	0	0	0
	Mean	60.25	7.850	6.5350	67.750	49.50
	Median	58.50	7.750	5.1350	66.500	54.00
	Std. Deviation	10.210	3.7350	6.14890	10.7199	13.699
	Range	24	8.9	14.53	26.0	30
	Minimum	50	3.5	.67	56.0	30
	Maximum	74	12.4	15.20	82.0	60
PSI	Valid N	19	19	19	19	19
	Missing N	0	0	0	0	0
	Mean	55.32	16.653	21.2763	36.874	24.74
	Median	59.00	9.600	3.2800	38.000	23.00
	Std. Deviation	12.266	19.5875	41.38401	28.5391	6.740
	Range	46	82.8	175.72	99.0	25
	Minimum	31	3.2	.28	4.0	15
	Maximum	77	86.0	176.00	103.0	40
POS	Valid N	20	20	20	20	20
	Missing N	0	0	0	0	0
	Mean	49.30	11.715	10.6910	32.800	36.35
	Median	45.50	7.900	1.5350	20.500	30.00
	Std. Deviation	11.323	16.6336	22.64278	30.7770	16.747
	Range	43	76.9	79.80	116.0	70
	Minimum	31	5.1	.20	4.0	20
	Maximum	74	82.0	80.00	120.0	90

Table 3. Contrast-enhanced and unenhanced MRI findings of the patients

	Discitis	Epidural abscess	Psoas abscess	Vertebra fracture
Brucella	16 (100 percent)	4 (25 percent)	1 (6.3 percent)	-
Tuberculosis	4 (100 percent)	4 (100 percent)	4 (100 percent)	1 (25 percent)
Pyogenic	19 (100 percent)	4 (21.1 percent)	3 (15.8 percent)	-
Postoperative	20 (100 percent)	17 (85 percent)	-	-

Table 4. Demographical and epidemiological distribution of the patients

	SB N=16	SPINAL TB N=4	PSI N=19	POS N=20
Fresh Cheese Consumption	13 (81.3 percent)	-	-	-
Spinal Surgery History	2	-	3	20
Diabetes Mellitus	-	2 (50 percent)	1 (5.3 percent)	1 (5 percent)
Fever	5 (31.3 percent)	4 (100 percent)	3 (15.8 percent)	3 (15 percent)
Weight Loss	2 (12.5 percent)	2 (50 percent)	1 (5.2 percent)	1 (5 percent)
Cough	-	3 (75 percent)	-	-
Cladicatio	5(31.3 percent)	4 (100 percent)	3 (15.8 percent)	6 (30 percent)
Brucella Agglutination Coombs	13 (81.3 percent)	-	-	-
PPD >15	-	2 (50 percent)	-	-

Intensity change in end-plates accordant with spondylodiscitis, limited only by the disc space and adjacent to the disc in MRI examinations was seen in 18 cases; single vertebral segment involvement was observed in 5 cases, and two-segment involvement was found in 7 cases. In one case, only L5 vertebral body involvement was present. There was a contrast enhancement in L2-3 corpus vertebrae, contrast medium enhancement accordant with L2-3 discitis, and a lesion accordant with prevertebral and paravertebral multiloculated abscess; in another patient, there were contrast medium enhancement, epidural abscess, and accompanying cord compression in the C4-5 disc space, contrast medium enhancement in the C5-6 and C7-T1 disc spaces, lesion cord compression accordant with the abscess in the C4-T1 epidural space, contrast medium enhancement and lesion cord compression accordant with C4-5 epidural abscess in the C4-5 disc space, contrast medium enhancement and lesion accordant with paraspinal abscess in the T8-9 disc space, contrast medium enhancement and lesion accordant with L1-5 epidural abscess in the L2-3 disc space, contrast medium enhancement, epidural abscess, and cord compression in the C5-6 disc space, contrast medium enhancement and Pott abscess in the T6-7 disc space, and contrast medium enhancement, psoas abscess, and MRI findings accordant with TB in the L1-2 disc space. Whole-body scintigraphy of the patients was demanded concerning differential diagnoses. It was concluded that there was an activity change related to the infection in the L2-3 disc space. Materials taken from 19 patients were sent to pathology with respect to pathological differential diagnosis. The conclusions were that 5 patients had necrotizing granulomatous inflammation tuberculosis, 4 patients had acute inflammation, 1 patient had neutrophils formation, 1 patient had suppurating inflammation (the species candida growth), 1 patient had granulation tissue rich in macrophage (aspergillus growth), 1 patient had inflammatory granulation (viridans streptococci + eikenella growth, undergone surgery 11 times), 5 patients had related to non-specific infection, and no results were able to be obtained from 1 patient.

Fever was observed in 5 out of 16 SB patients (31%), 4 out of 4 spinal TB patients (100%), and 6 out of 39 PSI patients (15%). Weight loss was seen in 2 people among SB patients (12%), 2 people among spinal TB patients (50%), and 2 people among PSI patients (5%). Cough showed positive results only in spinal TB patients. Cladicatio was observed in 5 people among SB patients (31%), 4 people among spinal TB patients (100%), and 23% of PSI patients.

Out of patients to whom instrumentation was applied, 6 were assessed to score more than 5 points and accordingly have clinical instability based on the White and Panjabi classification modified by Benzel (Table 5).

Table 5. The case results of the White and Panjabi classification modified by Benzel

case	score	case	score	case	score	case	score	case
1	2	6	9	11	4	16	5	21
2	2	7	7	12	7	17	7	22
3	5	8	7	13	5	18	4	23
4	7	9	5	14	9	19	3	
5	5	10	4	15	5	20	3	

Discussion

Of 59 patients participating in this study, 29 were female (49%) and 30 were male (51%), which means there was no significant difference. According to the literature, the F/M ratio is 1.5:3 [16-19]. Spondylodiscitis is generally seen in old people (aged 60 and above). The average age in the present study was found to be 55.7 [17,20]. The average ages in two other recent studies were found to be lower than 60, similar to the present study [19,21,22]. PSI is most commonly observed in the sixth and seventh decades. Although the female/male ratio is specified to be 1.5:3, there are studies in which there is no statistically significant difference regarding this ratio [19,23]. Of PSI patients in the present study, 6 were female (31.6%) and 13 were male (68.4%), assessed to be in accordance with the literature. The average of PSI patients was 55.32 (min 31, max 77, SD 12.26) which is lower compared to the averages seen in the literature. It is believed that early diagnoses made possible by the increase in diagnosis methods affected the decrease seen in the average age in this study.

Sole risk factor plays a role in 77% of spinal infections, while multiple risk factors have a role in 53% [22,24,25]. In this study, sole risk factor was detected in 41 patients (68%) and multiple risk factors in 7 patients (11.6%) out of 59. Primary risk factors were diabetes mellitus (44%), extraspinal infection (33%), long-term steroid medication use (24%), and malignancy (17%), as well as immunodeficiency syndrome and chemotherapy [26]. In the present study, undergone operation or biopsy ranked first in 20 cases (33%), while extraspinal infections and diabetes mellitus were observed in 6 (30%) and 4 (6%) patients respectively and diabetes mellitus was determined to be the third most frequently observed cause. This should be resulting from the increase in the number of spinal operations and having taken diabetes mellitus under control.

The starting time was found to be 19.69 days for SB (min 14, max 30, SD 5.16). The cases have been classified as acute (< 8 weeks), subacute (8-52 weeks), and chronic (> 1 year) based on the duration of findings; the acute stage was at the forefront in the present study [27]. For spinal TB, the symptoms started to appear after 49.5 days (min 30, max, 60, SD 13.69) in the present study; this duration is reported to be between 4 and 10 weeks in the literature [11]. The duration for PSI, which varies in the literature, was 24.74 days (min 15, max 40, SD 6.74). In patients with POS, wound site drainage appears within 1-4 weeks [4,24, 8]. The duration for POS in the present study was detected to be 36.35 days (min 20, max 90, SD 16.74) which coincides with the literature. In PSI cases, acute phase reactants are high. The erythrocyte sedimentation rate was calculated to be 29.25 (min 2, max 67, SD 20.16) for SB, 67.75 (min 56, max 82, SD 10.71) for spinal TB, 36.87 (min 4, max 103, SD 28.53) for PSI, and 32.8 (min 4, max 120, SD 30.77) for POS. CRP was determined to be 5.86 (min 0.33, max 30, SD 7.4) for SB, 6.58 (min 0.67, max 15.26, SD 14) for spinal TB, 21.27 (min 28, max 176, SD 41.38) for PSI, and 10.69 (min 0.2, max 80, SD 22.64) for POS. WBC was found to be 7.6 (min 4.3, max 10.2, SD 1.74) for SB, 7.85 (min 3.5, max 12.4, SD 3.73) for spinal TB, 16.65 (min 3.2, max 86, SD 19.58) for PSI, and 11.71 (min 5.1, max 82, SD 16.63) for POS. In the present study, the leucocyte, C-reactive protein, and ESR values were found to be generally higher compared to the SB and spinal TB cases, similar to the values found in the literature [5,29]. Total recovery from the infection is assessed by whether the sedimentation rate and CRP values have reached normal levels in the postoperative period. A decrease in the sedimentation rate and CRP values is observed in the second week of the treatment and within a few following days respectively. Sedimentation and CRP reach normal levels within 3-5 weeks and 1-2 weeks respectively [21]. Although conservative treatment was applied to adult PSI patients, no sedimentation decline was observed in half of these patients. A decline in sedimentation rate by half or more is assessed to be an indicator that the infection has been cured in numerous articles [30].

Among the operated patients, staphylococcus aureus growth was seen in 1 (13%), aspergillosis in 1 (4%), candida in 2 (8%), and eikenella in 1 (4%). The most frequently observed factor in the literature is staphylococcus aureus, which supports the results of the present study [21,22,31]. Out of these patients, 2 belonged to the spinal TB patient group which amounted to 50% within this group. This percentage was found to be 41% and 59.3% in two other studies respectively [21,22]. The number of cases which did not produce any factors is 26 (60%). It has been reported that thoracic vertebrae are affected the most in spinal TB cases [32-34]. SB generally shows lumbar region involvement [35]. In a study examining 20 PSI patients, lumbar involvement was found in 17 (80%) of the cases [34,36]. Soft tissue changes are more commonly observed in spinal TB cases compared to other spondylodiscitis cases [20,33]. Paraspinal abscess is seen by 50% or more in spinal TB [34,37]. However, abscess and soft tissue involvement are observed less commonly in SB cases [38,39].

Epidural abscess is a dangerous complication seen in 4-38% of spinal infections [24,40]. Of 59 patients in this study, all had discitis; 1 had kyphotic deformity; epidural abscess was observed in 4 SB patients (25%), 4 spinal TB patients (100%), 4 PSI patients (21.1%), and 17 POS patients (85%); patients with canal obliteration had also neurologic deficit and abscess drainage and decompression indication manifested in these patients; psoas abscess was seen in 1 SB patient (6.3%), 4 spinal TB patients (100%), and 3 PSI patients (15.8%). Even though it is seen in other spondylodiscitis cases, psoas abscess can be a guide with regard to TB diagnosis [34, 40]. In terms of lesion regions, they were observed in cervical area in 3 patients (18.8%), thoracic area in 1 patient (6.3%), and lumbar area in 12 patients (75%) among the patients with SB; in thoracic area in 1 patient (25%) and lumbar area in 3 patients (75%) among the patients with spinal TB; in cervical area in 3 patients (15.8%), thoracic area in 4 patients (21.1%), and lumbar area in 12 patients (63.2%) among the patients with PSI; and in lumbar area in 20 patients (100%) among the patients with POS; all these rates coincided with the literature [4, 5].

Of the patients with Brucella consuming fresh cheese, 13 yielded positive results from the Brucella agglutination test (81.3%), which is a slightly higher rate than seen in the literature [41]. It is thought that this was caused by the abundance of Brucella geographically and low consumption of pasteurized milk and dairy products in this study. Of 4 patients with spinal TB, The PPD>15 value was positive in 2.

Based on the White and Panjabi classification system modified by Benzel, 13 patients scored 5 or more and stabilization + fusion was applied to only 4 patients. In a study carried out by Max C. Lee et al., 12 out of 30 patients in total had paraplegia [42], while there were 7 patients with paraplegia in the present study. In spinal infections, paraplegia growth without any acute phenomenon should be resulting from inefficiency in diagnosis, patient monitoring, and treatment if the patient has not applied late. In the present study, 2 patients among the paraplegic cases applied late; significant neuromotor improvement was observed in the remaining 5 paraplegic patients. Of the cases, 90% suffered from axial pain, while radicular pain was observed in 70%.

The most important aim of treatment is the maximum protection of neurologic functions. For this, aggressive decompression of neural tissue, parenteral antibiotic therapy, and spinal stabilization may be necessary. Another important aim of surgical treatment is the prevention of a possible sepsis growth with aggressive debridement. Viridans streptococci + eikenella growth was observed in a patient that had undergone surgery 11 times due to spondylodiscitis; it must always be taken into account that multiple organisms can grow in patients having undergone multiple surgeries [43].

Fever is frequently seen in SB and PSI and less commonly in spinal TB [32,35,44]. It was observed more in SB and spinal TB and less in PSI in the present study, which does not coincide with the literature. It is highly likely that this is caused by the fact that SB and spinal TB patients had taken a long time before applying to our clinical center. Of the patients, 2 underwent laminectomy and decompression; instability developed in these patients later. This finding reveals how important it is to detect instability during the application of surgical treatment.

Conclusion

The increase seen in diagnosis methods in this study has an effect on the diagnosis of spinal infections and the decline seen in the average age. Changes seen in risk factors and microbial strains result in increased spinal surgeries and diabetes mellitus taken under control. It is highly likely that in spinal infections, paraplegia growth without any acute phenomenon results from inefficiency in diagnosis, patient monitoring, and treatment if the patient has not applied late. Fever is frequently seen in SB and PSI and less commonly in spinal TB, but it was seen more in SB and spinal TB and less in PSI in the present study. The reason for this is thought to be the fact that SB and spinal TB patients had taken a long time before applying to our clinical center. It must always be taken into consideration that multiple organisms can grow in patients having undergone multiple surgeries.

Competing interests
The authors declare that they have no competing interest.

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Ethical approval
Ethics committee approval is not required in retrospective studies.

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