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# A comparative perspective on brucellar, pyogenic, and tuberculous spondylodiscitis

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**Abstract. – OBJECTIVE: Non-specific features of spondylodiscitis lead to a delay and challenge in the diagnosis/differential diagnosis/treatment processes, and thus, serious complications may arise. This study aims to compare brucellar, pyogenic, and tuberculous types of spondylodiscitis, considering their demographic, clinical, and laboratory differences. This may provide more rapid management and good outcomes.**

**PATIENTS AND METHODS: A total of 131 patients with infectious spondylodiscitis were included in the study. The patients were divided into brucellar (n=63), pyogenic (n=53), and tuberculous (n=15) types of spondylodiscitis and compared for demographic, clinical, laboratory, and imaging features.**

**RESULTS: Tuberculous spondylodiscitis had higher scores for weight loss, painless palpation, thoracic spine involvement, and psoas abscess formation than other spondylodiscitis. Also, tuberculous spondylodiscitis had higher rates of neurologic deficit and lower rates of lumbar involvement than brucellar spondylodiscitis. Pyogenic spondylodiscitis is more likely to occur in patients who have a history of spine surgery compared to other forms of spondylodiscitis. Also, pyogenic spondylodiscitis had higher rates of fever, erythema, paraspinal abscess, white blood cell (WBC), and erythrocyte sedimentation rate (ESR) than brucellar spondylodiscitis. On the other hand, brucellar spondylodiscitis had higher rates of rural living and sweating than pyogenic spondylodiscitis.**

**CONCLUSIONS: Weight loss, painless palpation, involved thoracic spine, psoas abscess, and neurologic deficit are symptoms favoring tuberculous spondylodiscitis. History of spine surgery, high fever, skin erythema, and paraspinal abscess are findings in favor of pyogenic spondylodiscitis. Rural living, sweating, and involved lumbar spine are symptoms that indicate brucellar spondylodiscitis. These symptoms can be used to distinguish the types of spondylodiscitis.**

*Key Words:*
Spondylitis, Discitis, Brucellosis, Pyogenic, Tuberculous.

## Introduction

Infectious spondylodiscitis is a rare but serious spinal infection affecting the vertebral body and/or intervertebral disc and/or adjacent tissues. Clinically, infectious spondylodiscitis creates low specific manifestations such as pain, fever, sweating, and weight loss[1]. Men, older age, diabetes mellitus, hemodialysis, immunosuppressive drugs and conditions, intravenous drug abuse, injury or trauma, and invasive and surgical procedures are predisposing factors[1,2]. Diagnosis, differential diagnosis, and treatment processes include various difficulties arising from non-specific symptoms and findings[3,4]. For this reason, all demographic, clinical, laboratory, and imaging tools are used in the evaluation of infectious spondylodiscitis[5]. However, the disease requires urgent action due to its seriousness because its non-specific features can cause an underestimate of the disease, delayed diagnosis, and permanent complications[4].

It is necessary to distinguish between infectious and non-infectious spondylodiscitis, and the infectious agent needs to be determined[6,7]. Taking


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into account the features of the patient and the infection can enable more specific diagnostic approaches to be implemented[8]. In addition, it is important to evaluate the features of the patient to start the most appropriate empirical treatment until the causative agent is identified.

It is critical to identify responsible infectious agents as soon as possible to apply appropriate antibiotics in the management of infectious spondylodiscitis. A multidisciplinary approach, conservative treatment including antibiotherapy, spine bracing, and bed rest for all cases, and surgical treatment for cases with severe symptoms, spinal instability, abscess formation, and neurologic deficits are recommended[9,10].

This study aims to present a comparative perspective on brucellar, pyogenic, and tuberculous types of spondylodiscitis, considering their demographic, clinical, and laboratory differences from each other. In this way, it may be easier to predict the causative agent, and a more accurate empirical treatment preference can be provided. Additionally, knowing the differences between the types of spondylodiscitis can enable the implementation of more specific diagnostic approaches.

## Patients and Methods

This is a comparative retrospective cohort study. All data from 2010 to 2019 were extracted from our Hospital Information Systems. Ethics approval was obtained by the Institutional Ethics Committee of Yuzuncu Yil University, reference number 2020/3-45, date of approval 22 May 2020. The study was conducted in accordance with the tenets of the Declaration of Helsinki.

A total of 131 patients with infectious spondylodiscitis were included in the study. The patients were divided into three groups depending on the type of infectious spondylodiscitis. Accordingly, brucellar, pyogenic, and tuberculous types of spondylodiscitis were defined and compared in terms of demographic, clinical, laboratory, and imaging features.

### Brucellar Spondylodiscitis

In addition to clinical symptoms and findings, brucellar spondylodiscitis was diagnosed in cases whose serum brucella tube agglutination titer was found to be >1/160 or increased four-fold with an interval of two weeks and/or *brucella* spp. grew in blood culture.

### Pyogenic Spondylodiscitis

Patients who had pyogenic bacterial growth in the samples taken by interventional radiology or intraoperatively, or who responded to empirical antibiotic treatment despite not having a positive culture, or who had spondylodiscitis in the area where surgery was performed were considered to have pyogenic spondylodiscitis.

### Tuberculous Spondylodiscitis

Tuberculous spondylodiscitis was diagnosed in cases with acid-fast bacilli (Ziehl-Neelsen stain) and/or PCR positivity and/or mycobacterium tuberculosis growth in culture and/or caseating/chronic granulomatous inflammation detected histopathologically in samples obtained by interventional radiology or intraoperatively. In addition, in cases where a diagnostic sample can not be taken, patients having clinical, radiological, and laboratory features suggesting tuberculosis, positivity of tuberculin skin test and/or gamma interferon release test (quantiferon), and response to empirical antituberculosis treatment were accepted as tuberculous spondylodiscitis.

### Inclusion And Exclusion Criteria

Inclusion criteria were female or male patients diagnosed with infectious spondylodiscitis in the last 10 years and aged ≥18 years old. On the other hand, exclusion criteria were age <18 years and cases with missing information or without available imaging results. Also, patients with non-infectious spondylodiscitis were excluded from the study.

The groups were statistically compared in terms of demographic characteristics (age, gender, rural living, history of spine surgery, symptom duration), white blood cell (WBC), C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), most common symptoms (back pain, fever, sweating, weight loss), physical examination findings (fever, painful palpation, skin erythema, movement restriction, neurological deficit), involved spinal levels (cervical, thoracic, thoracolumbar, lumbar, lumbosacral), abscess formation, and localizations of abscesses (epidural, paraspinal, psoas, and gluteal).

### Statistical Analysis

Statistical analyses were performed with IBM SPSS version 20.0 (IBM Corp., Armonk, NY, USA). The Kolmogorov-Smirnov test was used to address whether continuous variables had a normal distribution. Since the continuous variables

in the groups had normal distribution (except the variables of symptom duration in the Brucellar spondylodiscitis group), the One-Way ANOVA Bonferroni post hoc test was used for their analyses. For the variables of symptom duration, the Mann-Whitney U test was used in the comparison between the brucellar spondylodiscitis group and other groups, and the Independent *t*-test was used to compare the pyogenic and tuberculous spondylodiscitis groups. The Fisher's Exact test was applied for the categorical variables. A *p*-value <0.05 was considered statistically significant.

## Results

When the demographic characteristics and laboratory values of spondylodiscitis were compared by infection type, the groups were statistically similar for age (the pyogenic spondylodiscitis group was older), sex, and CRP. For rural living, the only significant difference was a higher score of brucellar spondylodiscitis than pyogenic spondylodiscitis ($p$=0.022) (Table I). For individuals with a history of spine surgery, pyogenic spondylodiscitis had a significantly higher score than brucellar and tuberculous spondylodiscitis. For the symptom duration, the only significant difference was a higher score of tuberculous spondylodiscitis than brucellar spondylodiscitis ($p$=0.035). For the WBC and ESR, the only significant difference was a higher score of pyogenic spondylodiscitis than brucellar spondylodiscitis (Table I).

When comparing spondylodiscitis types, symptoms, and physical examination findings, the groups were statistically similar for back pain and fever. The most common symptom was back pain in all groups (~95%). For the sweating, the only significant difference was a higher score of brucellar spondylodiscitis than pyogenic spondylodiscitis ($p$=0.001). For weight loss, tuberculous spondylodiscitis had a significantly higher score than brucellar and pyogenic spondylodiscitis (Ta-

**Table I.** Demographic characteristics and WBC, CRP, and ESR values in the groups.

| | Brucellar spondylodiscitis (n=63) | Pyogenic spondylodiscitis (n=53) | Tuberculous spondylodiscitis (n=15) | p |
|---|---|---|---|---|
| Age, years | 47.7 ± 16.5 (18-79) | 54.8 ± 14.9 (19-84) | 47.7 ± 20.3 (18-80) | 0.066[a]<br>1.0[b]<br>0.434[c] |
| Gender (F/M) | 23/40 | 20/33 | 5/10 | 1.0[a]<br>1.0[b]<br>1.0[c] |
| Rural living | 51 (81) | 32 (60.4) | 10 (66.7) | 0.022[a]<br>0.297[b]<br>0.769[c] |
| History of spine surgery | 3 (4.8) | 26 (49.1) | 1 (6.7) | < 0.001[a]<br>1.0[b]<br>0.003[c] |
| Symptom duration, days | 59.5 ± 45.3 (10-210) | 79.6 ± 62.3 (6-360) | 105.3 ± 82.5 (10-300) | 0.057[a]<br>0.035[b]<br>0.194[c] |
| WBC, 109/L | 7.5 ± 2.4 (2.6-14.2) | 8.8 ± 3.1 (3.2-16.0) | 8.1 ± 3.2 (3.6-16.4) | 0.047[a]<br>1.0[b]<br>1.0[c] |
| CRP, mg/L | 35.0 ± 30.0 (3-123) | 53.0 ± 49.8 (3-170) | 61.1 ± 58.8 (10-242) | 0.075[a]<br>0.106[b]<br>1.0[c] |
| ESR, mm/h | 34.4 ± 19.8 (2-93) | 48.2 ± 27.7 (3-140) | 46.3 ± 23.4 (14-101) | 0.007[a]<br>0.244[b]<br>1.0[c] |

The data were given as mean±standard deviation or number (%). WBC: white blood cells, CRP: C-reactive protein, ESR: erythrocyte sedimentation rate, F: female, M: male. [a]: Comparison between brucellar and pyogenic spondylodiscitis groups. [b]: Comparison between brucellar and tuberculous spondylodiscitis groups. [c]: Comparison between pyogenic and tuberculous spondylodiscitis groups.

ble II). The groups were statistically similar for movement restriction. For the fever, the only significant difference was a higher score of pyogenic spondylodiscitis compared to brucellar spondylodiscitis ($p$=0.001). For the painful palpation, tuberculous spondylodiscitis had a significantly lower score than brucellar and pyogenic spondylodiscitis. For the skin erythema, the only significant difference was a higher score of pyogenic spondylodiscitis compared to brucellar spondylodiscitis ($p$=0.003). For the neurologic deficit, the only significant difference was a higher score of tuberculous spondylodiscitis compared to brucellar spondylodiscitis ($p$=0.009) (Table II).

When comparing the spinal involvement of the spondylodiscitis types, the groups were statistically similar at the cervical, thoracolumbar, and lumbosacral levels. For the involvement of the thoracic spine, tuberculous spondylodiscitis had a significantly higher score than brucellar and pyogenic spondylodiscitis. For the involvement of the lumbar spine, the only significant difference was a higher score of brucellar spondylodiscitis than tuberculous spondylodiscitis ($p$=0.020) (Table III).

When comparing the location of abscess formation by infection type, the groups were statistically similar in the frequency of epidural and gluteal abscesses. For the presence of an abscess, the only significant difference was a higher score of tuberculous spondylodiscitis compared to brucellar spondylodiscitis ($p$=0.003). For the paraspinal abscess, the only significant difference was the higher score of pyogenic spondylodiscitis than brucellar spondylodiscitis ($p$=0.006). For the psoas abscess, tuberculous spondylodiscitis had a significantly higher score than brucellar and pyogenic spondylodiscitis (Table IV).

## Discussion

In this comparative study, demographic characteristics and clinical, laboratory, and radiolog-

**Table II.** Common symptoms and physical examination findings in the groups.

| | Brucellar spondylodiscitis (n=63) | Pyogenic spondylodiscitis (n=53) | Tuberculous spondylodiscitis (n=15) | p |
|---|---|---|---|---|
| Back pain | 61 (96.8) | 50 (94.3) | 14 (93.3) | 0.659[a]<br>0.478[b]<br>1.0[c] |
| High fever (symptoms) | 40 (63.5) | 25 (47.2) | 8 (53.3) | 0.093[a]<br>0.559[b]<br>0.773[c] |
| Sweating | 36 (57.1) | 14 (26.4) | 7 (46.7) | 0.001[a]<br>0.567[b]<br>0.204[c] |
| Weight loss | 23 (36.5) | 18 (34) | 10 (66.7) | 0.846[a]<br>0.044[b]<br>0.036[c] |
| High fever (findings) | 0 (0) | 11 (20.8) | 0 (0) | < 0.001[a]<br>1.0[b]<br>0.105[c] |
| Painful palpation | 55 (87.3) | 47 (88.7) | 9 (60) | 1.0[a]<br>0.023[b]<br>0.019[c] |
| Skin erythema | 0 (0) | 7 (13.2) | 0 (0) | 0.003[a]<br>1.0[b]<br>0.334[c] |
| Movement restriction | 34 (54) | 38 (71.7) | 7 (46.77) | 0.057[a]<br>0.775[b]<br>0.120[c] |
| Neurologic deficit | 6 (9.5) | 12 (22.6) | 6 (40) | 0.071[a]<br>0.009[b]<br>0.198[c] |

The data were given as number (%). [a]: Comparison between brucellar and pyogenic spondylodiscitis groups. [b]: Comparison between brucellar and tuberculous spondylodiscitis groups. [c]: Comparison between pyogenic and tuberculous spondylodiscitis groups.

**Table III.** Localizations of spondylodiscitis.

| | Brucellar spondylodiscitis (n=63) | Pyogenic spondylodiscitis (n=53) | Tuberculous spondylodiscitis (n=15) | p |
|---|---|---|---|---|
| Cervical | 0 (0) | 2 (3.8) | 1 (6.7) | 0.207[a]<br>0.192[b]<br>0.533[c] |
| Thoracic | 7 (11.1) | 3 (5.7) | 5 (33.3) | 0.341[a]<br>0.047[b]<br>0.010[c] |
| Thoracolumbar | 3 (4.8) | 8 (15.1) | 2 (13.3) | 0.108[a]<br>0.244[b]<br>1.0[c] |
| Lumbar | 39 (61.9) | 28 (52.8) | 4 (26.7) | 0.351[a]<br>0.020[b]<br>0.087[c] |
| Lumbosacral | 14 (22.2) | 14 (26.4) | 4 (26.7) | 0.666[a]<br>0.739[b]<br>1.0[c] |

The data were given as number (%). [a]: Comparison between brucellar and pyogenic spondylodiscitis groups. [b]: Comparison between brucellar and tuberculous spondylodiscitis groups. [c]: Comparison between pyogenic and tuberculous spondylodiscitis groups.

ical features were investigated in patients with infectious spondylodiscitis. The results of statistical comparisons demonstrated that infectious spondylodiscitis types (brucellar, pyogenic, and tuberculous) have some critical differences from each other that need to be considered.

Considering the seriousness of the disease and the benefits of early diagnosis/differential diagnosis/treatment processes despite the challenges, the importance of rapid and effective intervention becomes evident[6,11,12]. Therefore, clinicians have an interest and efforts to improve the outcome of spondylodiscitis, focusing on early diagnosis/differential diagnosis/treatment processes[11-15]. Knowing the distinguishing features of the types of infectious spondylodiscitis can help to apply more specific diagnostic approaches and start the most appropriate empirical antibiotherapy. The present study was conducted with this important perspective and insight.

**Table IV.** Localizations of abscess formation.

| | Brucellar spondylodiscitis (n=63) | Pyogenic spondylodiscitis (n=53) | Tuberculous spondylodiscitis (n=15) | p |
|---|---|---|---|---|
| Presence of abscess | 26 (41.3) | 34 (64.2) | 13 (86.7) | 0.016[a]<br>0.003[b]<br>0.122[c] |
| Epidural abscess | 13 (20.6) | 6 (11.3) | 1 (6.7) | 0.214[a]<br>0.282[b]<br>1.0[c] |
| Paraspinal abscess | 10 (15.9) | 21 (39.6) | 5 (33.3) | 0.006[a]<br>0.150[b]<br>0.769[c] |
| Psoas abscess | 3 (4.8) | 6 (11.3) | 7 (46.7) | 0.297[a]<br>< 0.001[b]<br>0.005[c] |
| Gluteal abscess | 0 (0) | 1 (1.9) | 0 (0) | 0.457[a]<br>1.0[b]<br>1.0[c] |

The data were given as number (%). [a]: Comparison between brucellar and pyogenic spondylodiscitis groups. [b]: Comparison between brucellar and tuberculous spondylodiscitis groups. [c]: Comparison between pyogenic and tuberculous spondylodiscitis groups.

### Differences of Tuberculous From Both Brucellar and Pyogenic Spondylodiscitis

According to our results, tuberculous spondylodiscitis is more associated with long symptom duration, weight loss, painless palpation, thoracic spine, and psoas abscess compared to both brucellar and pyogenic spondylodiscitis. In agreement with our results, AlQahtani et al[16] reported that tuberculous spondylodiscitis exhibited longer symptom duration, higher thoracic spine involvement and psoas abscess formation than both brucellar and pyogenic spondylodiscitis. Similarly, Turunc et al[17] found higher thoracic spine involvement and psoas abscess formation in tuberculous than in both brucellar and pyogenic spondylodiscitis. In several studies[18,19], patients in the tuberculous spondylodiscitis group were more likely to have epidural and paraspinal abscesses and to have severe vertebral damage on magnetic resonance imaging. Also, Li et al[20] and Colmenero et al[21] detected that tuberculous spondylodiscitis had higher thoracic spine involvement in tuberculous than both brucellar and pyogenic spondylodiscitis. Thus, thanks to these common findings, it may be easier to carry out specific diagnostic and therapeutic processes for tuberculosis spondylodiscitis and to distinguish it from both brucellar and pyogenic spondylodiscitis. In addition, based on the fact that tuberculosis patients may develop secondary complications due to medication noncompliance[22], evaluation of patients with spondylodiscitis in this regard may also accelerate and facilitate diagnosis/differential diagnosis/treatment processes.

### Differences of Pyogenic From Both Brucellar and Tuberculous Spondylodiscitis

In the present study, we found that pyogenic spondylodiscitis is more associated with previous spine surgery than both brucellar spondylodiscitis and tuberculous spondylodiscitis. Similarly, Colmenero et al[21] have reported in 1997 that the rate of bone spine surgery was significantly higher in pyogenic spondylodiscitis with respect to both brucellar and tuberculous spondylodiscitis. So, this difference can be used to distinguish pyogenic spondylodiscitis from both brucellar and tuberculous spondylodiscitis. In addition, although there was no statistically significant difference in our study ($p$=0.066 and $p$=0.434), the patients in the pyogenic group were older than the other two groups. In their study, Liu et al[23] found that the pyogenic spondylodiscitis group was older than the tuberculous spondylodiscitis group ($p$=0.005).

### Other Differences Between Pyogenic and Brucellar Spondylodiscitis

In addition to those mentioned above, the present study revealed that there were higher rates of fever, skin erythema, paraspinal abscess, WBC, and ESR in pyogenic spondylodiscitis than in brucellar spondylodiscitis. On the other hand, patients with brucellar spondylodiscitis expressed higher rates of rural living and sweating with respect to pyogenic spondylodiscitis. Consistent with our results, AlQahtani et al[16] reported that pyogenic spondylodiscitis had higher rates of fever, paraspinal abscess, WBC, and ESR than brucellar spondylodiscitis. Similarly, Li et al[20] detected higher rates of paraspinal abscess and Colmenero et al[21] detected higher rates of fever, WBC, and ESR in pyogenic spondylodiscitis than in brucellar spondylodiscitis.

### Other Differences Between Brucellar and Tuberculous Spondylodiscitis

In addition to those mentioned above, we found that tuberculous spondylodiscitis had higher rates of neurological deficit and abscess formation, and lower rates of lumbar involvement compared to brucellar spondylodiscitis. These results are in agreement with the findings of previous studies by Hammami et al[24], and Erdem et al[25]. Additionally, more studies[16,20,26,27] have reported higher rates of abscess formation and lower rates of lumbar involvement in tuberculous spondylodiscitis than in brucellar spondylodiscitis.

### Limitations

On the other hand, the present study has some limitations that should be considered. Firstly, the study has disadvantages due to its retrospective analysis. Secondly, the study was conducted at a single center and included small samples. Thirdly, considering the etiological variability of spondylodiscitis in different geographical regions, the results may or may not generalize to other societies and geographies. Fourthly, this study focused on the differences between the types of infectious spondylodiscitis, and for this reason, potential important points may have been missed. Finally, due to limited literature on the subject, a sufficiently satisfactory and deep analysis and discussion could not be made.

## Conclusions

In conclusion, because patients with spondylodiscitis have non-specific symptoms and findings, a delay and challenge in the diagnosis/differential diagnosis/treatment processes, and thus serious complications may arise. Comparative analyses of the types of spondylodiscitis may provide information on early diagnosis/differential diagnosis/treatment processes and may result in improved outcomes. Considering the mentioned differences between the types of spondylodiscitis, it is seen that brucellar spondylodiscitis is relatively associated with rural living and sweating, pyogenic spondylodiscitis is specifically associated with fever and a history of spine surgery, and tuberculous spondylodiscitis is specifically associated with weight loss, thoracic spine involvement, and psoas abscess formation. Clinically, these differences can be used to distinguish the types of spondylodiscitis from each other.

### Conflict of Interest

The author declares that he has no conflict of interest.

### Ethics Approval

The study was approved by the Ethics Committee of the Medical Faculty of the Van Yüzüncü Yıl University and was performed in accordance with the Helsinki Declaration (Approval date: 22/05/2020, and number: 2020/3-45).

### Availability of Data and Materials

The data generated and analyzed during the study are available from the corresponding author. They are not publicly available.

### Informed Consent

Written informed consent was obtained from the study participants.

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