



Research article

# Frequency of various forms of spondylodiscitis on spinal column segments

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## Abstract

**Introduction:** The term spinal infections or spinal column infections usually include processes localized in various parts of spinal column, parts of vertebrae as well as in intervertebral disc. There are three main types of spondylodiscitis. Bacterial spondylodiscitis (vertebral osteomyelitis) is inflammatory process usually involving two (neighboring) vertebrae and intervertebral disc causing the space for the disc between the vertebrae to be narrowed down. The aim of this paper is to present the frequency of various forms of spondylodiscitis on spinal column segments following laboratory, microbiological and radiological diagnostic procedures.

**Patients and methods:** Descriptive research method was used in the work, as it was deemed appropriate for this type of research analysis. Diagnostic procedures used include: laboratory tests, microbiological analysis, MRI scans of cervical spine, MRI scans of thoracic spine, MRI scans of L/S spinal column.

**Results:** Out of 307 patients included in the research, in 109 occurrences spondylodiscitis was verified on various parts of spinal column. Brucellosis spondylodiscitis represents the most frequent form (in 86% of patients), and the majority of occurrences was localized at lumbosacral part of spinal column. During the research, quite unusually, there was also one occurrence of spondylodiscitis with paravertebral abscess on cervical part of spinal column. It is also a type of brucellosis spondylodiscitis. The use of magnetic resonance imaging appears to be gold standard in diagnostics of spondylodiscitis, especially following the application of contrast agent and the use of T1 FS (fat saturation) sequences along with standard tomograms in times T1 and T2. The majority, up to 262 (85.3%) of Elisa tests were related to brucellosis. In 245 out of 307 cases, the result was positive, that is in direct relation to the fact that various forms of brucellosis are present in the areas being examined.

**Conclusion:** Research results indicated that spondylodiscitis was diagnosed in all segments of spinal column. The most frequent occurrences are on L/S part of spinal column and the most frequent form of brucellosis is spondylodiscitis.

**Keywords:** Spondylodiscitis, localization, infection, spinal column, diagnostic procedures

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## Introduction

The term spinal infections or spinal column infections usually include processes localized in various parts of spinal column, parts of vertebrae as well as in intervertebral disc. Accordingly, they may infect vertebrae, intervertebral discs, spinal canal, as well as paravertebral structures. One of the most frequent spinal column infections is spondylodiscitis.

Spondylodiscitis may also be defined as a primary infection accompanied by the destruction of the intervertebral disc. This, in fact, represents the aforementioned discitis with the secondary vertebrae infections. Spondylodiscitis frequently occurs in persons with weakened immune system caused by cancer, numerous radiotherapy treatments and by the use of immunosuppressive medication used in organ transplant.

Spondylodiscitis, as any other spinal column infection, may be caused by bacteria, fungi and parasitic microorganisms (1). In respect of bacteria, *Staphylococcus aureus* is considered to be the most frequent cause. However, it may be caused by *Escherichia coli*, *Proteus sp.*, *Pseudomonas aeruginosa* and *Klebsiella sp.*, as well (2). *Mycobacterium sp.* and *Brucella sp.* are also among the important causes of specific spondylodiscitis (3). The cause of spondylodiscitis, although rarely, may also be fungi, out of which the most frequent are *Candida albicans* and *Aspergillus fumigatus* (4). However, in 39.2% of occurrences, the major risk factors resulting in spondylodiscitis are previous surgical procedures on spinal column or clinical procedures related to the aforementioned surgical procedure (5).

There are three main types of spondylodiscitis. Bacterial spondylodiscitis (vertebral osteomyelitis) is inflammatory process usually involving two (neighboring) vertebrae and intervertebral disc causing the space for the disc between the vertebrae to be narrowed down. In more than 50% of the cases in Europe, it is usually the case of monobacterial infection by *Staphylococcus aureus*, whereas in 11 to 25 % of the cases the cause of this infection are gram-negative pathogens like *Escherichia coli* (6). Although magnetic resonance imaging is considered as a golden standard for radiological representation and interpretation of this disease due to 92% sensitivity and 96% specificity, there are also many other diagnostic procedures including radiological, laboratory and microbiological procedures, which should be implemented in order to obtain the complete image and the confirmation of the disease itself (7).

### Patients and methods

Descriptive method was used in the research, in order to prepare thorough description of the occurrences of spondylodiscitis on various segments of spinal column. All common diagnostic procedures were used in obtaining this scientific result:

- Laboratory procedures - C reactive protein, sedimentation,
- Microbiological procedures - sputum for BK, quantiferon test, Rose Bengal test, blood culture test, Elisa test for brucellosis,

Elisa test for *Coxiella burnetii*, Elisa test for Q fever,

- Radiological procedures - Magnetic resonance imaging.

### Research sample

The research included 307 confirmed cases of patients with brucellosis. Out of the total number, spondylodiscitis was confirmed in 109 patients, as follows: one case on cervical spine, 14 cases on thoracic and 94 cases on L/S part of the spinal column.

Out of the total number of patients, there were 218 male or 71%, while the remaining 89 cases were female patients (29%). In respect of the area that the patients were coming from, all patients were from Central Bosnia and Zenica-Doboj canton, the areas known for animal husbandry thus also for the occurrences of brucellosis.

Somewhat larger number of patients came from Zenica-Doboj Canton, 201 patients or 65.5% of the total number, while the research also included 106 patients from Central Bosnia canton (34.5%).

In respect to hospital treatment of the patients, the least number of occurrences was registered in 2015 and 2016 with about 20 patients per year (6.5% each), while in 2019 there were 94 patients undergoing hospital treatment (30.6%).

According to the age, the patients were divided into three age groups:

- 0 to 18 years old - 38 patients (12.4%),
- 19 to 40 years old - 80 patients (26.1 %),
- 41-year-old and over - 189 patients (61.6 %).

### Research procedure

The research was conducted in Cantonal hospital in Zenica during the period of 6 years (1.1.2015 - 31.12.2020) at the Department for Infectious diseases. The research encompassed all patients with referral diagnosis of spondylodiscitis retrospective study.

Medical history and discharge summary were thoroughly analyzed for all of the patients included in the research.

The most important parameters for the selected research problem were singled out from the performed diagnostic procedures. The obtained data were inserted into quantitative analysis statistical software - IBM Statistics SPSS.



## Results

### Laboratory tests results

Laboratory tests, such as sedimentation and C reactive protein have an important role in the warning about the existence of inflammation processes in the organism, especially in the case of the elevated values. Their importance is reflected in the number of tests performed during the research. Sedimentation test was done for 291 out of 307 patients or 94.8 % of the total number. Having in mind that C reactive protein is the most frequently tested plasma protein which is used as an inflammation marker and very important indicator of inflammation process (8), it was tested in significant number of patients, 276 or 89.9% of the cases. Obtained results in both tests (sedimentation and C reactive protein) show greater number of negative results in comparison to those with elevated values.

**TABLE 1 Laboratory procedures results**

Procedure:	Status	N.	%	Values	N	%
Sedimentation	Not analyzed	16	5.2	normal	186	60.6
	analyzed	291	94.8	elevated	121	39.4
CRP	Not analyzed	31	10.1	In order	176	57.3
	analyzed	276	89.9	elevated	131	42.7

### Microbiological analysis results

During the research greater number of microbiological analyses provided significant results: Sputum for BK, Quantiferon test, Rose Bengal test, Blood culture test. Table representing the obtained results from the aforementioned analyses is as follows:

**TABLE 2 Results of microbiological procedures**

Procedure:	Status	N.	%	Values	N.	%
Blood culture test	Not analyzed	79	25.7	normal	207	67.4
	analyzed	228	74.3	elevated	100	32.6
Rose Bengal test	Not analyzed	119	38.8	normal	133	43.3
	analyzed	188	61.2	elevated	174	56.7
Sputum for BK	Not analyzed	297	96.7	normal	305	99.3
	analyzed	10	3.3	elevated	2	0.7
Quantiferon test	Not analyzed	298	97.1	normal	302	98.4
	analyzed	9	2.9	elevated	5	1.6

Obtained results indicate that blood culture test is a primary diagnostic procedure for isolating large number of microorganisms that may be present in the blood (9). The test was performed in 228 patients (74.3%). Having in mind the fact that patients were coming from the region that is connected with frequent occurrences of brucellosis, the highest number of positive or elevated values were obtained from Rose Bengal test (56.7%) as it is considered as more accurate and reliable method than some other tests for brucellosis (10).

As a part of microbiological procedures Elisa test was performed as well:

- Elisa test for brucellosis,
- Elisa test for Coxiella burnetti,
- Elisa test for Q fever.

Statistically, the aforementioned tests provide the following results:

**TABLE 3 Elisa test results**

Procedure:	Status	N.	%	Values	N	%
Elisa test for brucellosis	Not analyzed	45	14.7	normal	62	20.2
	analyzed	262	85.3	elevated	245	79.8
Elisa test for Coxiella burnetti	Not analyzed	231	75.2	normal	270	87.9
	analyzed	76	24.8	elevated	37	12.1
Elisa test for Q fever	Not analyzed	291	94.8	normal	293	95.4
	analyzed	16	5.2	elevated	14	4.6

The majority, up to 262 (85.3%) of Elisa tests were related to brucellosis. In 245 out of 307 cases, the result was positive, what is in direct relation to the fact that various forms of brucellosis are present in the areas being examined.

### Radiological analysis results

Diagnosis is confirmed by MRI, digital radiological procedure based on electromagnetic radio waves using powerful magnetic field to depict various anatomic regions of the human organism (11). The aforementioned procedure is golden standard for radiological representation and interpretation of the diseases with 92% sensitivity and 96% specificity. Naturally, it requires obligatory use of contrast agent.

Magnetic resonance imaging was used to scan all segments of the spinal column. T1 and T2 tomograms in three plains (coronal, sagittal and axial plain) were done for all patients. If it was necessary, contrast agent was also used. Post contrast sequences with obligatory T1FS (fat saturation) sagittal sequence were also performed.

**TABLE 4 Magnetic resonance imaging results**

Procedure:	Status	N.	%
MRI of cervical spine	Not analyzed	304	99.0
	analyzed	3	1.0
MRI of thoracic spine	Not analyzed	297	96.7
	analyzed	10	3.3
MRI of thoracic and lumbosacral spine	Not analyzed	300	97.7
	analyzed	7	2.3
MRI of lumbosacral spine	Not analyzed	150	48.9
	analyzed	157	51.1

The largest number of MRI scans was related to lumbosacral part of spinal column, in 157 out of 307 subjects or 51.1%. Magnetic resonance imaging of thoracic part of spine was done in 10 patients (3.3%), while in 7 cases this type of examination included combination - thoracic and lumbosacral spine (2.3%). The least number of scans, as expected, was performed on cervical part of spinal column, only 3 (1%). However, it is important to note that there was very rare occurrence of spondylodiscitis in its brucellosis form on this segment, only one occurrence.

**TABLE 5 Occurrences of spondylodiscitis on spinal column segments**

Localization	Status	N.	%	Localization	Status	N.	%
Spondylodiscitis at C6/C7 level	negative	306	99.7	Spondylodiscitis at C6/Th12 level	negative	305	99.3
	positive	1	0.3		positive	2	0.7
Spondylodiscitis at Th6 level	negative	306	99.7	Spondylodiscitis at L1/L2 level	negative	297	96.7
	positive	1	0.3		positive	10	3.3
Spondylodiscitis at Th7 level	negative	305	99.3	Spondylodiscitis at L2/L3 level	negative	296	96.4
	positive	2	0.7		positive	11	3.6
Spondylodiscitis at Th9 level	negative	304	99.0	Spondylodiscitis at L3/L4 level	negative	290	94.5
	positive	3	1.0		positive	17	5.5
Spondylodiscitis at Th10 level	negative	303	98.7	Spondylodiscitis at L4/L5 level	negative	276	89.9
	positive	4	1.3		positive	31	10.1
Spondylodiscitis at Th11 level	negative	305	99.3	Spondylodiscitis at L5/S1 level	negative	282	91.9
	positive	2	0.7		positive	25	8.1

Table 5. shows results of spondylodiscitis occurrences for every segment of spinal column individually. Majority of cases, 94, were related to lumbosacral segment of spinal column (L4/L5 segment being the most frequent). Spondylodiscitis on thoracic part of spinal column was recorded in 14 patients, while there was only one case in cervical part of spinal column.

We have also statistically analyzed various forms of spondylodiscitis and obtained the following data.

**TABLE 6 Frequency of various forms of spondylodiscitis**

Procedure:	Status	N.	%
Tuberculosis spondylodiscitis	negative	304	99.0
	positive	3	1.0
Bacterial spondylodiscitis	negative	302	98.4
	positive	5	1.6
Brucellosis spondylodiscitis	negative	221	72.0
	positive	86	28.0

Brucellosis spondylodiscitis was the most frequent form. It was registered in 86 patients (28% of the cases) which is quite unusual result for the world scale data, however, this is quite expected for the region which was included in the research. Bacterial spondylodiscitis was registered in 6 patients (6.1%), and the least represented was tuberculosis spondylodiscitis in only 1% of the cases (3 patients).



## Discussion

Research conducted from 1992 to 2000 at the Aarhus University hospital in Austria included 163 patients with diagnosed spondylodiscitis. Localizations in relation to individual parts of spine included: in 13 cases, or 8% of total number of infections, the infection was located on cervical spine, in 62 patients the infection occurred on thoracic part of the spine column and in 88 cases infection was located at L/S part of spine (12). If percentage results are compared to our research, there is a greater percentage of infections on cervical and thoracic part of the spinal column. Spondylodiscitis on lumbosacral part of the spinal column in our research is registered in 86% of the cases compared to 54% of the cases in the research conducted in Austria.

A rare case of spontaneous spondylodiscitis in cervical part of the spinal column was recorded in Korea in 2008. Neurological examination determined paresthesia of upper extremities which served as an indication for magnetic resonance imaging of cervical part of the spinal column.

As in our case, in T1 sequence, vertebrae bodies indicated hypo signal and after contrast agent was applied, significant hyper signal. However, there is a difference in localization. In this case epidural abscess is located at the level C5/C6 (in our case level C6/C7), and the cause of infection is completely different, bacteria *Klebsiella pneumonia* (13).

The research conducted at the University hospital in Cairo, from January 2012 to October 2017, included 44 patients (Ghada W et al., 2019). If gender is taken into account, it is noticeable that spondylodiscitis is diagnosed in 59,1% of males, matching the results of our research (79% of diagnosed patients are males) and the fact that men are more frequently diagnosed with this disease than women. The feature which is not common is the information that *Mycobacterium tuberculosis* is the most frequent cause of spondylodiscitis compared to *Brucella* which is in our research defined as the most frequent cause of spondylodiscitis.

## Conclusion

As the discussion suggests, although the causes of infection are different, there are a series of common characteristics related to the occurrence of spondylodiscitis at individual segments of the spinal column. Laboratory analyses confirm that the

aforementioned diagnosis is also characterized by the elevated results, from sedimentation to CRP. However, in more than 50% of patients, the results of our research showed normal values of sedimentation and CRP.

Rose Bengal test and Elisa test for brucellosis, according to the results obtained, are the most important microbiological procedures in this research. Rose Bengal test showed elevated valued in 56.7% cases, while Elisa test for brucellosis resulted positive in as much as 79.8% of patients.

Localization of spondylodiscitis, as expected, was the most frequent on lumbosacral part, in 86% of the cases, on thoracic part in 13% of the cases, while only one case (1%) was recorded on cervical part of the spinal column.

Despite the fact that, statistically, tuberculosis is the most frequent cause of spondylodiscitis around the world, what is even confirmed by the results of the research in Cairo, the highest percentage of spondylodiscitis in our research is caused by brucellosis (86% of the verified number of spondylodiscitis occurrences), including the rare occurrence of spondylodiscitis with paravertebral abscess on the cervical part of the spinal column. These data are based on the fact that large number of persons are employed in animal husbandry in two cantons in particular, Zenica-Doboj and Central Bosnia Canton. This area gravitates towards Cantonal hospital in Zenica which is responsible for the treatment of the patients from these cantons.

MRI scanning, as golden standard in spondylodiscitis diagnostics, was done in 57.7% of the patients on all segments of the spinal column. Somewhat smaller number of MRI scans can be related to the limitations of this research i.e. the fact that certain number of patients self-willingly abandoned treatment process and thus complete analysis covering entire research sample could not be performed.

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