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BACTERIAL PROFILE IN SPONDYLODISCITIS: COMPARING BIOPSY, BLOOD CULTURE AND UROCULTURE

PERFIL BACTERIANO NAS ESPONDILODISCITES: COMPARANDO BIÓPSIA, HEMOCULTURA E UROCULTURA

PERFIL BACTERIANO EN ESPONDILODISCITIS: COMPARANDO BIOPSIA, HEMOCULTIVO Y UROCULTIVO

MORGANA MARQUES MELLO VIEIRA[1], FERNANDA ANDREA MINUTTI NAVARRO[1], RODRIGO YUITI NAKAO[1], LUIZ CLAUDIO LACERDA RODRIGUES[2,3]

1. Santa Marcelina Hospital, Spine Pathology Group, São Paulo, SP, Brazil.
2. Faculdade Santa Marcelina, São Paulo, SP, Brazil.
3. Instituto Vita, São Paulo, SP, Brazil.

ABSTRACT

Objetive: To evaluate and correlate the bacterial profile identified in blood cultures, urine cultures and vertebral biopsies in patients at Hospital Santa Marcelina in São Paulo – SP. Methods: Cross-sectional study of 20 patients affected by spondylodiscitis. Blood culture, urine culture, and spinal biopsy results were evaluated, in addition to sex and age. Results: The sample consisted of 20 patients, between 32 and 79 years old, predominantly male, diagnosed with spondylodiscitis. Most blood culture and urine culture results were negative, 80% and 65%, respectively. Among the spinal biopsy samples, 60% identified pathogens. When correlating the samples, 50% of the blood culture and biopsy cases presented the same result; however, between urine culture and biopsy, none identified the same germ between the samples. Conclusion: It is concluded that results from blood cultures, urine cultures, and spinal biopsies may frequently differ, making biopsy essential in diagnosing and treating spondylodiscitis. ***Level of Evidence IV; Cross-Sectional Study.***

Keywords: Spine; Bone Diseases, Infectious; Diagnosis; Biopsy.

RESUMO

Objetivo: Avaliar e correlacionar o perfil bacteriano identificado em hemoculturas, uroculturas e biópsias da coluna vertebral em pacientes do Hospital Santa Marcelina em São Paulo – SP. Métodos: Estudo transversal de 20 pacientes acometidos por espondilodiscite. Avaliados resultados de hemocultura, urocultura e biopsia vertebral, além de sexo e idade. Resultados: A amostra foi constituída de 20 pacientes, entre 32 e 79 anos, com prevalência do sexo masculino, diagnosticados com espondilodiscite. A maioria dos resultados de hemocultura e urocultura se apresentaram negativos, 80% e 65% respectivamente. Dentre as amostras de biopsia vertebral, 60% identificaram patógenos. Ao se correlacionar as amostras, 50% dos casos de hemocultura e biópsia apresentaram o mesmo resultado, porém entre urocultura e biópsia, nenhum dos casos identificou o mesmo germe entre as amostras. Conclusão: Conclui-se que resultados de hemoculturas, uroculturas e biopsia da coluna vertebral podem divergir com frequência nos resultados, tornando a biopsia essencial no diagnóstico e tratamento da espondilodiscite. ***Nível de Evidência IV; Estudo Transversal.***

Descritores: *Coluna Vertebral; Doenças Ósseas Infecciosas; Diagnóstico; Biópsia.*

RESUMEN

Objetivos: Evaluar y correlacionar el perfil bacteriano identificado en hemocultivos, urocultivos y biopsias de columna en pacientes del Hospital Santa Marcelina de São Paulo – SP. Métodos: Estudio transversal de 20 pacientes afectados de espondilodiscitis. Se evaluaron los resultados de hemocultivo, urocultivo y biopsia vertebral, además del sexo y la edad. Resultados: La muestra estuvo compuesta por 20 pacientes, entre 32 y 79 años, predominantemente masculinos, diagnosticados con espondilodiscitis. La mayoría de los resultados de hemocultivos y urocultivos fueron negativos, 80% y 65% respectivamente. Entre las muestras de biopsia de columna, el 60% identificó patógenos. Al correlacionar las muestras, el 50% de los casos de hemocultivo y biopsia presentaron el mismo resultado, sin embargo, entre urocultivo y biopsia, en ninguno de los casos se identificó el mismo germen entre las muestras. Conclusión: Se concluye que los resultados de los hemocultivos, los urocultivos y la biopsia de columna a menudo pueden diferir en los resultados, lo que hace que la biopsia sea esencial en el diagnóstico y tratamiento de la espondilodiscitis. ***Nivel de Evidencia IV; Estudio Transversal.***

Descriptores: *Columna Vertebral; Enfermedades Óseas Infecciosas; Diagnóstico; Biopsia.*

Study conducted by the Hospital Santa Marcelina, Spine Pathology Group, São Paulo, Santa Marcelina, 177, Vila Carmosina, São Paulo, SP, Brazil. 08270-070.
Correspondence: Luiz Claudio Lacerda Rodrigues. 43/cj 1102, Coronel Irineu de Castro Street, Jd Analia Franco, São Paulo, SP, Brazil. 03333-050. luizclrodrigues@yahoo.com.br

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INTRODUCTION

Spondylodiscitis refers to the concomitant infection of the intervertebral disc and the vertebral body,[1,2] and is one of the main causes of back pain today.[3,4] Although vertebral osteomyelitis is said to be rare, with a previously estimated frequency of 0.2-3 cases per 100,000 people in the period 1979-1982 in Denmark,[5,6] many countries now report 7.4 cases per 100,000 people per year.[7,8] In addition to more cases being diagnosed due to the development of new technologies,[9] the increase in the number of cases is a consequence of the increase in chronic and degenerative pathologies of the spine, the number of surgical procedures, the use of immunosuppressants, vascular devices and the use of intravenous substances.[10,11]

Three forms of infection are well described: endogenous, exogenous, and contiguity. The hematogenous form is the most common, mainly via the arterial system,[9] accounting for around 60-80% of cases. Through direct inoculation, the exogenous form is responsible for around 15-40% of cases. Diffusion by contiguity remains the most infrequent form, at around 3% of known cases.[12]

Usually, spondylodiscitis is a monomicrobial infection, with the main germs responsible being *Staphylococcus aureus*, *Escherichia coli*, *Enterobacter*, *Salmonella*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae,* and the most common of all, *Mycobacterium tuberculosis*.[9,12]

Therefore, the diagnosis goes beyond radiological findings, requiring clinical, laboratory, and microbiological evaluation, which can delay the treatment of the specific germ.[9] Although spondylodiscitis has a low mortality rate, around 2-4%, this figure increases to more than 20% when inadequately treated.[8] In addition, the disease is considered to have a high morbidity, leading to instability, chronic pain, and neurological deficit.[2]

This study compares the bacterial profile identified in intervertebral disc and vertebral body biopsies with those identified in blood culture and uroculture samples.

METHODS

This cross-sectional observational study evaluated the medical records and laboratory results of patients with spondylodiscitis. The spinal Surgery team at Santa Marcelina Hospital (SP) treated all the patients.

Free and Informed Consent forms were obtained from patients still in outpatient or inpatient follow-up. The authors of this study signed the Data Use Commitment Form, agreeing to do so anonymously. The Research Ethics Committee of Casa de Saúde Santa Marcelina (SP) approved the research project.

The study used data collected from 20 patients diagnosed with spondylodiscitis between 2022 and 2023. Inclusion criteria were patients with suspected spondylodiscitis who underwent blood culture, uroculture, and biopsy of the intervertebral disc and vertebral body.

Patients whose results were not available for all the samples to be analyzed, as well as patients without a closed diagnosis of spondylodiscitis, were excluded from the study.

Information on gender and age was collected from medical records. From the results of laboratory tests, the germs identified in blood culture, uroculture intervertebral disc and vertebral body biopsy samples were evaluated.

Data analysis initially consisted of cleaning and coding the database, a process carried out within the data analysis software, SPSS (Statistical Package for the Social Sciences) - version 26. A descriptive analysis of patient data was then carried out, showing means, medians, minimum and maximum values, standard deviation, interquartile range, frequency, and percentages for all the variables collected. The inferential analysis of the data consisted of applying Pearson's Chi-squared association tests between patients' gender and test results, as well as normality analysis (Shapiro Wilk test) to define the most appropriate comparison test to be applied to the quantitative data (Student's t-test or Mann-Whitney's Wilcoxon U test) for age and number of positive results, and the most appropriate correlation coefficient (Pearson's correlation or Spearman's correlation). A significance level of 5% was adopted for all analyses, and all ethical criteria were respected.

RESULTS

The sample consisted of 20 patients of both genders: 13 men (65%) and seven women (35%). The patients' ages ranged from 32 to 79, with the average age for men being 58.46 with a standard deviation of 10.666, while for women, the average age was 59.86 with a standard deviation of 15.25.

Table 1 shows the data of the registered patients, with biopsy, uroculture, and blood culture results, and Table 2 shows the frequency of pathogens in each test.

The blood culture results were 16 negative (80%), with S. aureus being the most prevalent bacterium found in two results (10%). Only three types of bacteria were found among the results.

For urocultures, 13 samples showed negative results (65%). The most prevalent bacteria were *E. Coli* and *K. pneumoniae ssp pneumoniae*, with two results (10% each). Five varieties of bacteria were found in this test.

Table 1. Individual results of biopsy, uroculture, and blood culture.

Patient	Sex	Age	Hemoculture	Uroculture	Biopsia
patient 1	male	54	Negative	Negative	s. Epidermidis
Patient 2	male	58	Negative	Negative	Negative
Patient 3	male	45	E. Coli	K. Pneumoniae ssp pneumoniae	E. Coli
patient 4	female	70	Negative	Negative	s. Epidermidis
Patient 5	male	66	Negative	Negative	Negative
Patient 6	male	63	Negative	K. Pneumoniae/p. Mirabilis	S. Haemolyticus
patient 7	female	54	Negative	Negative	Negative
Patient 8	male	63	Negative	Negative	Negative
Patient 9	male	55	Negative	Negative	enterobacter clocae complex
Patient 10	female	79	Negative	Negative	staphylococcus capitis
Patient 11	male	65	S.Aureus	Negative	S. Aureus
Patient 12	female	43	Negative	Negative	s. Aureus
Patient 13	male	63	S.Aureus	Negative	E. Coli
Patient 14	male	32	Bacillus spp	Serratia maroescens	Pseudomonas aeruginosa
patient 15	female	73	Negative	Enterococcus faecalis	Negative
Patient 16	male	73	Negative	K. Pneumoniae ssp pneumoniae	Negative
Patient 17	male	67	Negative	E. Coli	Staphylococcus warneri
patient 18	male	56	Negative	E. Coli	Mycobacterium tuberculosis complex
Patient 19	female	39	Negative	Negative	Negative
Patient 20	female	61	Negative	Negative	Negative

Eight tests in the biopsy showed negative results (40%), and the most prevalent types of bacteria were *E. coli*, *S. aureus*, and *S. epidermidis*, all with two results each (10%). A total of nine varieties of bacteria were found in the biopsies carried out.

In the descriptive and exploratory analysis, we can see that the biopsy exams detected the presence of an infection the most (Table 3). There was also a high frequency of negative results in the other tests, especially blood cultures, which was significant compared to the positive results (p 0.012). (Table 2)

For the data distribution analysis, the agreement between answers was assessed using Conbrach's alpha, and none of the crossings showed results higher than 0.80 (an adequate value for good agreement of results); for the crossing between biopsy and blood culture, the value was -0.175 (Table 4); for the crossing between biopsy and uroculture, the value was 0.094 (Table 5), values that did not meet the test's assumptions, showing problems of agreement between the items.

As seen in Table 5, when correlating the results of the biopsies with the blood culture, of the 11 cases in which the biopsy was positive, the uroculture was also positive in 5 cases (45%). The blood culture was also positive in 4 cases (36%). It is important to note that in the 5 cases in which the uroculture and biopsy were positive, none of the cases identified the same germ among the samples. In comparison, in the 5 cases in which the blood culture and biopsy were positive, in 2 cases, the same germ was identified among the samples. (Table 1)

Table 2. Pathogens and their frequencies identified in each sample.

		Frequency	%
Blood culture	Bacillus spp	1	5%
	E. coli	1	5%
	Negative	16	80%
	S.aureus	2	10%
Uroculture	E. coli	2	10%
	Enterococcus faecalis	1	5%
	K. pneumoniae ssp pneumoniae	2	10%
	K. pneumoniae/P. mirabilis	1	5%
	Negative	13	65%
	Serratia maroescens	1	5%
Biopsy	Mycobacterium tuberculosis complex	1	5%
	E. coli	2	10%
	Enterobacter clocae complex	1	5%
	Negative	8	40%
	Pseudomonas aeruginosa	1	5%
	S. aureus	2	10%
	S. epidermidis	2	10%
	S. haemolyticus	1	5%
	Staphylococcus capitis	1	5%
	Staphylococcus warneri	1	5%

Table 3. Distribution of test results dichotomous classification.

		Frequency	%	p-value
Blood culture	Negative	16	80%	0.012*
	Positive	4	20%	
Uroculture	Negative	13	65%	0.346
	Positive	7	35%	
Biopsy	Negative	8	40.0%	0.371
	Positive	12	60.0%	

Notes: p-value corresponding to the Chi-squared test of homogeneity.

DISCUSSION

As far as the epidemiology of spondylodiscitis is concerned, this disease has a bimodal distribution. The first peak occurs before age 20, with no difference in prevalence between the sexes. The second peak, which represents the majority of cases, occurs between the ages of 50 and 70 and is more frequent in males in this age group (2:1-5:1 M/F).[13]

When we correlate this data with our own, we see that this profile has remained the same in terms of gender and age, with 65% of patients being male with an average age of 59.

In her review, Petkova[14] provides static data in which she associates the infectious condition with various situations such as intestinal or urinary tract infections, diabetes mellitus, immunosuppressed patients, and adults. In our study, some of the data is similar to Petkova's, where immunosuppressed and dialysis patients had a higher incidence of infections, and we believe that repeated skin invasion by catheters may be one of the main causes. Although many studies also include surgical patients in their data, our protocol did not address this. Still, we believe that many situations, such as chronic use of corticosteroids, alcoholism, and rheumatic diseases, may have a direct relationship with infectious involvement of the spine.[13,15,16]

This study evaluated blood and uroculture samples to determine the possible origin of spondylodiscitis, taking into account the known ways of spreading the disease.

Three routes of spondylodiscitis dissemination are well known: hematogenous, direct inoculation, or contiguity.[9,15] The main form responsible for dissemination is the hematogenous route, accounting for 60-80% of adult cases.[9] It can be arterial or venous, the most common form of dissemination.

Unlike in children, where the vessels go to the nucleus pulposus, in adults, they go to the endplate, but the arteries are far from the disc; it is believed that the microorganisms reach the terminal artery arches located in the metaphysis of the vertebral body, thus blocking the blood supply leading to ischemia and bone infarction, the destruction that occurs in the sequence allows the bacteria to reach the disc by contiguity, this destruction can reach the epidural space, contiguous areas and adjacent vertebrae.[16]

Another less frequent form of hematogenous dissemination is the venous route, through Batson's plexus, which can be a retrograde route of vertebral contamination of abdominal and pelvic infections.[17]

Table 4. Correlation between blood culture and biopsy samples according to germ.

	Blood culture							
	Bacillus spp		E. coli		Negative		S.aureus	
Biopsy	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Mycobacterium tuberculosis complex	0	0	0	0	1	6.25	0	0
E. coli	0	0	1	100	0	0	1	50
Enterobacter clocae complex	0	0	0	0	1	6.25	0	0
Negative	0	0	0	0	8	50	0	0
Pseudomonas aeruginosa	1	100	0	0	0	0	0	0
S. aureus	0	0	0	0	1	6.25	1	50
S. epidermidis	0	0	0	0	2	12.5	0	0
S. haemolyticus	0	0	0	0	1	6.25	0	0
Staphylococcus capitis	0	0	0	0	1	6.25	0	0
Staphylococcus warneri	0	0	0	0	1	6.25	0	0

Notes: Gray dotted cells show the concordant results between the tests.

Table 5. Correlation between uroculture and biopsy samples according to germ.

	Uroculture											
	E. coli		Enterococcus faecalis		K. pneumoniae ssp pneumoniae		K. pneumoniae/P. mirabilis		Negative		Serratia maroescens	
Biopsy	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Mycobacterium tuberculosis complex	1	50	0	0	0	0	0	0	0	0	0	0
E. coli	0	0	0	0	1	50	0	0	1	7.7	0	0
Enterobacter clocae complex	0	0	0	0	0	0	0	0	1	7.7	0	0
Negative	0	0	1	100	1	50	0	0	7	53.8	0	0
Pseudomonas aeruginosa	0	0	0	0	0	0	0	0	0	0	1	100
S. aureus	0	0	0	0	0	0	0	0	2	15.4	0	0
S. epidermidis	0	0	0	0	0	0	0	0	1	7.7	0	0
S. haemolyticus	0	0	0	0	0	0	1	100	0	0	0	0
Staphylococcus capitis	0	0	0	0	0	0	0	0	1	7.7	0	0
Staphylococcus warneri	1	50	0	0	0	0	0	0	0	0	0	0

Notes: Gray dotted cells show the concordant results between the tests.

In the results of urocultures, 65% of patients did not identify the pathogens. The results obtained with the blood culture were lower than those obtained with the uroculture, where only 4 patients tested positive, 2 of whom were positive for *S. aureus*. We also identified 1 case of *E. coli* infection and 1 case of *Bacillus spp*.

The main causative agent of spondylodiscitis is, in fact, *S. aureus* (17,18) *Staphylococci* are followed in frequency by *Gram-negative bacilli* (4-30%) and *streptococci* (5-30%).[19] These bacteria are often associated with gastrointestinal and urinary tract infections. This is very similar to the results found in the literature.

We know that early treatment with empirical antibiotic therapy is essential for a good patient prognosis. Therefore, some samples were taken while the patient was already on antibiotic therapy to avoid delaying treatment. This may explain the high prevalence of negative results in the samples. If the result is negative, biopsy material should be obtained to identify the pathogen.

Percutaneous biopsy can identify the microorganism in up to 90% of cases and is the diagnostic method of choice in spondylodiscitis.[20,21] In our study, the positivity rate was lower than in the literature, with around 60% of biopsy samples being positive. In addition to using previous antibiotic therapy, other possible causes of negative results are small samples, areas without live microorganisms, low-grade infections, and the inability to culture certain microorganisms.[22] Another factor that we also believe is responsible for this lower positivity rate is related to the fact that patients are often admitted from other clinics due to some underlying disease. During hospitalization, because they already have an infectious condition, they encourage treatment. During this process, due to back pain, imaging tests are requested. When we carry out our assessment, the patient is already hospitalized and undergoing previous treatment for their underlying disease.

When we analyze the correlation between the samples, there is a clear disagreement between the results. When comparing biopsy and blood culture, we identified the same germ in only 10% of cases. Between uroculture and biopsy, no results identified the same germ between these samples. These results reinforce the importance of collecting a spinal biopsy for the diagnosis of spondylodiscitis.[23-26]

We opted for radioscopy-guided biopsy due to the ease of performing it, and an experienced senior surgeon should always perform it to reduce the risk of complications and have a higher assertiveness rate. But we know that one of the main causes of late diagnosis is the fact that non-specialist doctors don't think about spinal disease, associating these patients' back pain with the fact that they spend a lot of time at rest or relate the pain to age.[27] In general hospitals, campaigns to think about spondylodiscitis and call the spine team at the slightest sign of back pain can anticipate diagnosis, improve the patient's condition, and avoid neurological catastrophes such as paraplegia.

Many articles currently discuss new diagnostic possibilities for pathogens in spinal infections since the culture carried out after the biopsy has a positivity rate approaching 66% in the literature.[28-30] Still, gene research based on genetic sequencing or next-generation sequencing (NGS) has proved very effective where DNA is extracted from the biopsied tissue and sequenced, often with the help of polymerase chain reaction (PCR) amplifiers. Compared with DNA libraries,[29-32] this technique has shown promising results with positivity rates of up to 97%, much higher than the average for classic culture tests. As it is based on detecting the DNA of the invader, even if the patient is taking antibiotics, the result is positive.[31,32] The only limiting factor is the cost of the test.

CONCLUSION

Blood cultures and urocultures do not eliminate the need for a spinal biopsy since the latter has a higher positivity rate. Even when blood cultures or urocultures are positive, their findings can be inconsistent. Therefore, a spinal biopsy is essential for correctly identifying the pathogen and determining its antimicrobial sensitivity profile.

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