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Evaluation of distribution and susceptibility of microorganisms isolated from joint fluid cultures: five-year data

Halil Er, Özlem Koca, Nevgün Sepin Özen

Medical Microbiology Laboratory, Antalya Training and Research Hospital, Antalya, Turkey

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ABSTRACT

Aims: Septic arthritis is joint inflammation. It is an orthopedic emergency that requires prompt diagnosis and treatment. In this study, it was aimed to examine the distribution and antibiotic resistance profiles of microorganisms isolated from joint fluid samples taken from patients who applied to the orthopedic clinic of our hospital in the last five years.

Methods: In our study, 1162 joint fluid samples were sent to the medical microbiology laboratory of our hospital from the orthopedics and traumatology clinic between January 01, 2018 and December 31, 2022. Joint fluid samples taken from clinically appropriate patients under sterile conditions were incubated in a BacT/Alert 3D (Biomerieux, France) culture device. Bacteria isolated from 164 specimens with growth detected, were identified by matrix-mediated laser desorption/ionization-time-of-flight mass spectrometry (MALDI-TOF MS) based VITEK MS (Biomerieux, France). Antibiotic susceptibility tests were performed on the VITEK 2 Compact (Biomerieux, France) device.

Results: *Staphylococcus aureus* (*S. aureus*) (29.3%) and coagulase negative Staphylococci (CNS) (29.3%) were the most commonly grown microorganisms. Other microorganisms grown were *Streptococcus* spp. (9.1%), *Enterococcus* spp. (6.1%), *Pseudomonas aeruginosa* (*P. aeuruginosa*) (7.3%), *Escherichiae coli* (*E. coli*) (4.3%) and *Klebsiella pneumoniae* (*K. pneumoniae*) (4.3%). When antibiotic susceptibility results were evaluated according to EUCAST restricted reporting criteria, linezolid in Gram-positive strains, amikacin in *Enterobacterales*, colistin and tigecycline in nonfermentative Gram-negative bacteria were found to be the most susceptible antibiotics.

Conclusion: The continuous change in antibiotic susceptibility profiles in joint infections, the long duration of treatment and follow-up, and the increase in polymicrobial infections require regular monitoring of culture and antibiotic susceptibility tests. In our study, the distribution of microorganisms isolated from joint fluid samples of our hospital and the determination of antibiotic resistance profiles will contribute to the clinician in terms of guiding empirical treatment.

Keywords: Joint fluid, antibiotic resistance rates, septic arthritis, *Staphylococcus aureus*

INTRODUCTION

Although bone and joint infections are rare, they are potentially associated with significant mortality and morbidity.[1,2] Septic arthritis is an infection of the joint space and is an orthopedically emergency requiring prompt diagnosis and treatment.[3]

Septic arthritis should be suspected when clinically there is swelling, redness, and pain in one or more joints.[1] The diagnosis of septic arthritis is made by stained microscopic examination and culture of bacteria in synovial fluid.[1] Septic arthritis is caused by bacteria, fungi, mycobacteria or viruses.[3] Although bacterial agents are the most common cause of septic arthritis, fungi, mycobacteria or viruses can also rarely be caused.[3]

In recent years, the incidence of septic arthritis has been increasing gradually.[1] In developed countries, it varies between 2-6/100,000 cases per year in the general population and increases in populations with low socioeconomic status.[1] Although individuals of all ages can be affected, septic arthritis is more common in children and the elderly, and men are affected more often than women.[1] Various factors may have contributed to this increase, including increased infections associated with orthopedic procedures and the increase in the use of immunosuppressive therapy.[1] Risk factors for the development of septic arthritis include rheumatoid arthritis or osteoarthritis, joint replacement, low socioeconomic status, intravenous drug use, alcoholism, diabetes, previous intra-articular corticosteroid injection, and cutaneous ulcers.[4]

In this study, it was aimed to determine the distribution of microorganisms isolated from joint fluid samples and

Corresponding Author: Halil Er, dr.haliler@gmail.com

antibiotic resistance profiles of patients who applied to the orthopedic clinic in our hospital in the last 5 years. It is predicted that the determination of antibiotic resistance profiles will guide the empirical treatment to be applied and increase the success of the treatment.

METHODS

The study was carried out with the permission of Antalya Training and Research Hospital Ethics Committee (Date: 08.06.2023, Decision No: 8/28). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

In our study, the identification and antibiotic susceptibility test results of 164 specimens with growth in culture from 1162 joint fluid samples sent from orthopedics and traumatology clinics to the medical microbiology laboratory during the five-year period between 01 January 2018 and 31 December 2022 were retrospectively analyzed.

Joint fluid samples taken from clinically appropriate patients under sterile conditions were incubated in a BacT/Alert 3D (Biomerieux, France) culture device for 5-7 days. Gram staining was done for each sample in the bottles that gave a growth signal during incubation, and inoculated on 5% sheep blood agar, chocolate agar and Eosin Methylene Blue (EMB) media. It was evaluated as conventional after 24-48 hours incubation at 37°C. Bacteria isolated from specimens with growth were identified by matrix-mediated laser desorption/ionization-time-of-flight mass spectrometry (MALDI-TOF MS) based VITEK MS (Biomerieux, France). Antimicrobial susceptibility tests were performed on the Vitek 2 Compact (Biomerieux, France) device in line with the manufacturer's recommendations. Antimicrobial susceptibility assessment was performed in line with the recommendations in the EUCAST guidelines of the European Committee on Antimicrobial Susceptibility Testing. Coagulase Negative Staphylococci isolated samples with leukocytes detected in Gram stains and those with high CRP levels was included in the study. Repeated growths were excluded from the study.

RESULTS

Reproduction was detected in 164 of 1162 joint fluid samples sent to the Medical Microbiology Laboratory between 01 January 2018 and 31 December 2022 from patients hospitalized in the orthopedics clinic. While 101 of the patients had a history of joint replacement, 63 patients had natural joint involvement (**Table 1**). Of the patients, 81 (49.4%) were male and 83 (50.6%) were female. The age range of the patients was determined as 6 to 85 years.

When we examined the age distribution of microorganisms grown in joint fluid cultures according to species, it was seen that patients with *S. aureus* growth were mostly (64.6%) in the 18-64 age range. It was determined that 73.3% of the patients with *Streptococcus* spp. growth were between the ages of 18-64, while the patients with gram-negative growths were generally over 64 years (53.3-85.7%) (**Table 2**).

The most frequently isolated microorganisms were *S. aureus* and CNS, and *Staphylococcus epidermidis* was the most isolated among CNS species. Distribution rates of Gram-positive microorganisms are *S. aureus* (29.3%), CNS (29.3%), *Streptococcus* spp. (9.1%), *Enterococcus* spp. (6.1%) and Gram-negative microorganisms are *P. aeuruginosa* (%). 7.3%, *E. coli* (4.3%), *K. pneumoniae* (4.3%). The distribution of isolated microorganisms by years is given in **Table 1**.

Table 1. Distribution of isolated microorganisms by years

Microorganism	2018	2019	2020	2021	2022	Joint prosthesis (%)	Natural joint (%)	Total (%)
S. aureus	5	6	13	13	11	26 (25.8)	22 (34.9)	48 (29.3)
Methicillin susceptible *S. aureus*	4	6	8	7	9	21	13	34 (20.7)
Methicillin resistant *S. aureus*	1	0	5	6	2	5	9	14 (8.6)
CNS	11	15	5	4	13	40 (39.6)	8 (12.7)	48 (29.3)
Methicillin susceptible CNS	0	2	0	1	2	3	2	5 (3.1)
Methicillin resistant CNS	11	13	5	3	11	37	6	43 (26.2)
Streptococcus spp.	2	4	3	3	3	8 (7.9)	7 (11.1)	15 (9.1)
Enterococcus spp.	2	2	1	4	1	7 (6.9)	3 (4.8)	10 (6.1)
Non fermentative bacteria	5	5	2	4	1	8 (7.9)	9 (14.3)	17 (10.4)
Psoudomonas spp.	4	5	2	1	0	4	8	12 (7.3)
Acinetobacter spp.	1	0	0	3	1	4	1	5 (3.1)
Enterobacterales	3	4	4	6	4	11 (10.9)	13 (20.6)	24 (14.6)
E. coli	1	4	0	1	1	4	3	7 (4.3)
K. pneumoniae	1	1	0	3	2	4	3	7 (4.3)
Other *Enterobacterales*	1	2	4	2	1	3	7	10 (6.1)
Yeast	1	1	0	0	0	1 (1)	1 (1.6)	2 (1.2)
Total	29	40	28	34	33	101 (100)	63 (100)	164 (100)

Table 2. Distribution of isolated microorganisms by patient age

Microorganism	0-17 years (%)	18-64 years (%)	Over 64 years old (%)	Total (%)
S. aureus	1 (2.1)	31 (64.6)	16 (33.3)	48 (100)
Methicillin susceptible *S. aureus*	1	19	14	34
Methicillin resistant *S. aureus*	0	12	2	14
CNS	0 (0)	22 (45.8)	26 (54.2)	48 (100)
Methicillin susceptible CNS	0	3	2	5
Methicillin resistant CNS	0	19	24	43
Streptococcus spp.	0 (0)	11 (73.3)	4 (26.7)	15 (100)
Enterococcus spp.	1 (10)	3 (30)	6 (60)	10 (100)
Non fermentative bacteria	0 (0)	6 (35.3)	11 (64.7)	17 (100)
Psoudomonas spp.	0	4	8	12
Acinetobacter spp.	0	2	3	5
Enterobacterales	1 (4.2)	8 (33.3)	15 (62.5)	24 (100)
E. coli	0	1	6	7
K. pneumoniae	0	3	4	7
Other *Enterobacterales*	1	4	5	10
Yeast	0 (0)	0 (0)	2 (100)	2 (100)
Total	3 (1.8)	81 (49.4)	80 (48.8)	164 (100)

Of the *S. aureus* isolates, 14 were Methicillin Resistant *S. aureus* (MRSA) (29.2%) and 34 were Methicillin Susceptible *S. aureus* (MSSA) (70.8%), and antibiotic resistance rates are given in **Table 3**. MRSA strains were found susceptible to vancomycin, teicoplanin, daptomycin, gentamicin, linezolid, tigecycline, and fosfomycin. MSSA strains were found susceptible to vancomycin, teicoplanin, daptomycin, gentamicin, linezolid, tigecycline, trimethoprim/sulfamethoxazole and fosfomycin. High rates of resistance to tetracycline, 64.2%, clindamycin 50.0% and erythromycin 48.2% were detected in MRSA strains. The resistance rates for tetracycline, clindamycin and erythromycin in MSSA strains were lower than MRSA strains as 8.8%, 5.8% and 8.8%, respectively.

Table 3. Antibiotic Resistance Rates of *S. aureus* and CNS Strains Growing in Joint Fluid Cultures

Antibiotic	MSSA n: 34 (%)	MRSA n: 14 (%)	MSCNS n: 5 (%)	MRCNS n: 43 (%)
Trimethoprim/ Sulfamethoxazole	-	2 (14.2)	-	10 (23.2)
Erythromycin	3 (8.8)	6 (48.2)	-	20 (46.5)
Clindamycin	2 (5.8)	7 (50.0)	-	16 (37.2)
Tetracycline	3 (8.8)	9 (64.2)	1 (20.0)	16 (37.2)
Ciprofloxacin	1 (2.9)	2 (14.2)	-	22 (51.0)
Vancomycin	-	-	-	-
Teicoplanin	-	-	-	3 (6.9)
Gentamicin	-	-	1 (20.0)	19 (44.1)
Linezolid	-	-	-	1 (2.3)
Fusidic acid	2 (5.8)	3 (21.4)	2 (40.0)	34 (79.0)
Tigecycline	-	-	-	-
Daptomycin	-	-	-	2 (4.6)
Fosfomycin	-	-	1 (20.0)	13 (30.2)

- No resistant microorganism was detected

Of the 48 isolated CNS strains, 43 (89.6%) were Methicillin Resistant CNS (MRCNS) and 5 (10.4%) were Methicillin Susceptible CNS (MSCNS). While MRCNS strains were found susceptible to vancomycin and tigecycline, MSCNS strains were found to be susceptible to linezolid, vancomycin, teicoplanin, daptomycin, tigecycline, ciprofloxacin, clindamycin, erythromycin, and trimethoprim/sulfamethoxazole. Resistance rates to ciprofloxacin 51.0%, erythromycin 46.5%, gentamicin 44.1%, clindamycin 37.2% and tetracycline 37.2% were detected in MRCNS strains. Tetracycline and gentamicin resistance was found in 20% of MRCNS strains. Antimicrobial resistance profiles of *S. aureus* and CNS growths are given in **Table 4**.

Table 4. Antibiotic resistance rates of other microorganisms grown in joint fluid culture (%)

	Enterobacterales * n: 24 (%)	Non fermentative bacteria** n: 17 (%)
Antibiotics	Resistance rates	Resistance rates
Cefuroxime	14 (58.3)	-
Gentamicin	4 (16.7)	4 (23.5)
Piperacillin/ Tazobactam	8 (33.3)	3 (17.6)
Trimethoprim/ Sulphamethoxazole	9 (37.5)	4 (23.5)
Ceftazidime	12 (50.0)	5 (29.4)
Ceftriaxone	12 (50.0)	-
Amikacin	1 (4.2)	4 (23.5)
Ampicillin	20 (83.3)	-
Ciprofloxacin	10 (41.7)	7 (41.2)
Levofloxacin	-	7 (41.2)
Meropenem	2 (8.3)	4 (23.5)
Ertapenem	6 (25)	-
Tigecycline	2 (8.3)	0 (0)
Cefepim	10 (41.7)	0 (0)
Colistin	4 (16.7)	0 (0)

**E. coli, Klebsiella* spp., *Enterobacter* spp., *Serratia marcescens, Proteus mirabilis, Salmonella enterica* ssp. enterica
** *Pseudomonas aeruginosa, Acinetobacter baumannii*
- Antibiotic not tested.

Of the Gram-negative microorganisms isolated from the joint fluid, 24 (14.6%) were *Enterobacterales* and *E. coli* and *K. pneumoniae* were the most isolated species. Among the 17 (10.4%) non-fermentative bacteria isolated in the second frequency, P.aeurginosa was the most isolated. The highest resistance was found against cephalosporin group antibiotics (over 50%) in *Enterobacterales* species. The resistance rates of broad-spectrum antibiotics meropenem, gentamicin and tigecycline were found to be 4.7%, 8.3%, 16.7% and 8.3%, respectively.

Cefepime, colistin and tigecycline resistance were not detected in gram negative nonfermentative bacteria, and the most resistant antibiotics were determined as ciprofloxacin (41.2%) and levofloxacin (41.2%). Antibiotic resistance rates of gram negative bacteria are given in **Table 4**.

DISCUSSION

Bacterial septic arthritis represents joint infection caused by colonization of the joint space by a pathogenic bacteria.[5] Septic arthritis has an incidence of 2-6/100,000 per year and a high mortality rate of 10-15%.[1,2,5] It is an orthopedic emergency that requires early diagnosis and treatment.[5] If left untreated, chronic inflammation and sequelae may ocur.[5] Generally, monoarticular involvement and, less frequently, polyarticular involvement in approximately 22% can be seen clinically. There are physical examination findings such as redness, swelling and pain in the involved joint.[5] The diagnosis of septic arthritis is made by isolating the causative microorganism by Gram staining and culture.[6] Old age, diabetes, cirrhosis, kidney disease, rheumatoid arthritis, osteomyelitis, joint prosthesis, recent joint surgery, concomitant skin infection, intravenous drug use are possible risk factors.[5]

While *Haemophilus influenzae* is the main causative agent in children younger than two years of age, the most common organism in all other age and risk groups is *S. aureus*.[1] It is responsible for 37-56% of cases.[1] Studies have reported methicillin resistance in *S. aureus* isolates at rates ranging from 6 to 22%.5 Other gram-positive bacteria follow, including streptococci. It has been reported that CNSs are isolated from joint fluid cultures at a rate of 30-43%, but surgical interventions applied to the joint area have increased the frequency of identification of these microorganisms as agents in culture.[7] Gram-negative bacilli are the causative agent in 10-20% of bacteria isolated from joint fluid.[1]

As a result of the retrospective evaluation of five-year joint fluid samples in our study, the most frequently isolated microorganisms were *S. aureus* strains and CNS strains and were isolated at a rate of 29.3%. Of the *S. aureus* isolates, 14 (29.2%) were MRSA and 34 (70.8%) were MSSA. Of the *S. aureus* strains, 26 (54.2) were isolated from joint fluids with prosthetic joint involvement and 22 (45.8) with natural joint involvement. Similar to our study, the growth rate for *S. aureus* strains was determined as 46% in synovial fluid cultures taken from natural joints by Flores-Robles et al.[8] The detection rate of *S. aureus* was reported as 35.8% in the post-arthroplasty synovial fluid samples study by Bauer et al.[10] and 48% in the synovial fluid samples taken from both prosthetic and natural joints by El-Ganzoury et al.[9] Although the number and type of samples change when the literature is reviewed, *S. aureus* continues to be reported as the most common agent, as in our study. This is often followed by CNSs. Flores-Robles et al.[8] Bauer et al.[10] and El-Ganzoury I. et al.[9] reported that 6.4%, 26.4% and 30% of CNS strains were isolated, respectively. In our study, 43 (89.6%) of the CNS strains isolated at a rate of 29.3% were MRCNS and 5 (10.4%) were MSCNS. While 40 (83.3%) of CNS strains were detected in prosthetic joints, 8 (16.7%) were isolated from synovial fluids with natural joint involvement. In the study of Hasbek et al.[11] in our country, CNS strains isolated at a rate of 20.4%; 15 (71.4%) were isolated from synovial fluids with natural joint and 6 (28.6%) prosthetic involvement. In the same study, 6 (31.6%) of CNS strains were determined as MSCNS and 9 (10.8%) as MRCNS, and methicillin resistance was found at a lower rate than our study.[11] Differences between CNS growth and methicillin resistance rates generally vary according to the patient group and sample diversity.

Streptococcus spp. are the second most common microorganisms that cause infectious arthritis in adults, after staphylococci, and are often associated with autoimmune disorders, chronic skin infections, and trauma.1 In studies conducted in France, Egypt and Spain, 17%, 13% and 12.7% of *Streptococcus* spp. strains were isolated, respectively.[8-10] In studies conducted with joint fluid samples in Spain and China, *Enterococcus* spp. strains were reported at rates of 1.6% and 7.1%. 8,12 In our study, *Streptococcus* spp. was found at a rate of 9.1% in line with the literature, and it is noteworthy that the growth rate was 53.3% in patients with joint prosthesis. Our rate of *Enterococcus* spp. detected in the presented study was 6.1%, which was compatible with the literature.

When the literature is examined, it has been observed that there are very few studies on antibiotic resistance levels in joint fluid cultures in our country. Studies are generally studies on post-surgical infectious agents. In a study in which Savcı et al.[13] examined postoperative orthopedic surgical wound infections, all *S. aureus* isolates were found to be susceptible to clindamycin, linezolid, teicoplanin and vancomycin; Over 90% sensitivity was detected against ciprofloxacin, gentamicin, tetracycline, daptomycin, fosfomycin, fusidic acid and trimethoprim/sulfamethoxazole; The highest resistance rate was found against erythromycin with 13.6%.[13] Kurutepe et al.[14] detected vancomycin and teicoplanin as the most susceptible antibiotics in *S. aureus* species isolated from various clinical specimens; They reported resistance to tetracycline 46.8%, erythromycin 42.0%, ciprofloxacin 27.1%, rifampicin 26.1%, clindamycin 23.1%, gentamicin 24.7% and TMP-SXT 18.3%.[14]

While Özel et al.[15] did not detect vancomycin, teicoplanin, daptomycin, linezolid and tigecycline resistance in MRSA and MSSA strains from various clinical samples. They found resistance to erythromycin, clindamycin, TMP-SXT, and tetracycline at a rate of 41.7%, 41.7%, 33.3%, and 33.3%, respectively, in MRSA strains, and 16.4%, 12.7%, 7.3%, and 14.5%, respectively, to erythromycin, clindamycin, TMP-SXT, and tetracycline in MSSA strains.[15] In the studies of Hasbek et al.[11] resistance to vancomycin, teicoplanin, daptomycin, linezolid, and tigecycline was not found in MRSA strains isolated from joint fluids; The highest resistance rates (42.8%) were determined against tetracycline, clindamycin and erythromycin.[11] Resistance to vancomycin, teicoplanin, daptomycin, tigecycline, trimethoprim/sulfamethoxazole and fosfomycin was not detected in MSSA strains; Resistance to gentamicin, erythromycin and clindamycin was found at a rate of 5.6%.[11] In our study, resistance to vancomycin, teicoplanin, daptomycin, gentamicin, linezolid, tigecycline, and fosfomycin was not detected in MRSA strains isolated from joint fluids; the highest resistance was found to tetracycline (64.2%), clindamycin (50%) and erythromycin (48.2%), consistent with the literature data. No resistance was found in MSSA strains to vancomycin, teicoplanin, daptomycin, gentamicin, linezolid, tigecycline, trimethoprim/sulfamethoxazole and fosfomycin. The highest resistance was found with 8.8% against erythromycin and tetracycline. We think that the presented study will contribute to the literature as one of the few studies that reveal susceptibility data from joint fluid.

Şen et al.'s[16] study on various clinical samples and Hasbek et al.'s[11] study of joint fluids found higher levels of antibiotic resistance against erythromycin, clindamycin, ciprofloxacin, levofloxacin, tetracycline, and fusidic acid in MRCNS isolates. In our study, vancomycin and tigecycline resistance was not found in MRCNS strains; Resistance rates were 51.0% to ciprofloxacin, 46.5% to erythromycin, 44.1% to gentamicin, 37.2% to clindamycin and 37.2% to tetracycline. No resistance was found in MSCNS isolates to linezolid, vancomycin, teicoplanin, daptomycin, tigecycline, ciprofloxacin, clindamycin, erythromycin, and trimethoprim/sulfamethoxazole. Tetracycline, fosfomycin and gentamicin resistance was observed in only 1 of the strains with MSCNS growth. The fact that five MSCNS strains were isolated in our study is a limiting situation for evaluating antibiotic resistance rates.

Gram-negative pathogens account for 10-20% of septic arthritis cases. It is more common in patients with long-term implants.[17] In a study conducted; The most susceptible (90%) antibiotics in *E. coli* strains isolated from hip joint fluid were meropenem and ertapenem; Sensitivity rates of 60% to amikacin and levofloxacin and 61% to ciprofloxacin have been reported. Gentamicin 85% and trimethoprim/sulfamethoxazole 75% were resistant. In the same study, all *Klebsiella* strains were reported to be carbapenem resistant but colistin susceptible.[18] In our study, of 41 (25%) Gram-negative microorganisms isolated from joint fluid, 24 (14.6%) were isolated as *Enterobacterales* and 17 (10.4%) were non-fermentative gram-negative bacteria. Of the isolates with Gram-negative agents,[19] were isolated from the prosthetic joint and 22 from the natural joint. In our study, the highest sensitivity rate for the two most frequently isolated microorganisms in *Enterobacterales* species was found in amikacin (95.8%), similar to the studies in the literature. Resistance rates of 8.3%, 16.7% and 11.8% were determined for meropenem, gentamicin and tigecycline, respectively, and resistance rates above 50% were found for ampicillin, cefuroxime, ceftazidime and ceftriaxone. In our study, Gram-negative non-fermentative bacteria were all susceptible to cefepime, colistin and tigecycline; Resistance to ciprofloxacin and levofloxacin was detected at a rate of 41.2%. Arunshankar et al.[18] reported a sensitivity of 100% to colistin, 90% to cefepime, 70% to ciprofloxacin, 70% to meropenem, 60% to gentamicin, 50% to levofloxacin, 50% to amikacin in *P. aeruginosa* strains.

Our study has some limitations. First, this was a retrospective study at a single centre. In addition, the small number of gram-negative microorganisms grown in the synovial fluid cultures included in the study limited our discussion of antibiotic resistance profiles. Secondly, in our study, the microorganisms growing in joint fluid and the antibiotic susceptibilities of these microorganisms were presented retrospectively. Therefore, the clinical significance of the results and treatment follow-up could not be evaluated. However, our study is a guide in terms of conducting studies supported by prospective clinical studies.

CONCLUSION

The continuous change of antibiotic susceptibility profiles in joint infections and the increase in polymicrobial infections require long-term multi-antibiotic therapy. Appropriate antibiotic treatment will be given according to the susceptibility results following the isolation of the agent. However, since this is not always possible, empirical treatment should be planned by evaluating epidemiological data and risk factors. For this reason, multidisciplinary approaches in which culture and antibiotic susceptibility tests are regularly monitored are the main elements of success in treatment planning. Our study is important in that it is one of the few studies conducted in our country in which the distribution of microorganisms isolated from joint fluid samples and their antibiotic resistance profiles were evaluated with five-year data. In the light of regional and epidemiological information, the presented study will contribute to the literature on empirical antimicrobial selection and treatment planning in septic arthritis in terms of agent distribution and resistance profiles, and will guide multidisciplinary studies in our country.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Antalya Training and Research Hospital Ethics Committee (Date: 08.06.2023, Decision No: 8/28).

Informed Consent: Because the study was designed retrospectively, no written informed consent from was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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