ARAŞTIRMA MAKALESİ / *RESEARCH ARTICLE*

Fusidic Acid Sensitivity in Methicillin-Resistant *Staphylococcus aureus* Strains Isolated From Hospital- and Community-Acquired Skin and Soft Tissue Infections

Hastane ve Toplum Kaynaklı Deri ve Yumuşak Doku Enfeksiyonlarından İzole Edilen Metisilin Dirençli Staphylococus Aureus Suşlarında Fusidik Asit Duyarlılığı

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ABSTRACT

Aim: *We aimed to detect the frequency of methicillin-resistant Staphylococcus aureus (MRSA) strains that were isolated from wound infections in our hospital, and then we want to evaluate the in vitro fusidic acid (FA) susceptibility rates of them to determine the place of FA in empirical treatment.*

Material and Method: *A total of 110 S. aureus strains, which were isolated from wound culture samples from various services and outpatients, were included in the study. The bacteria were identified and antibiogram using our microbiology laboratory's classical methods and VITEK 2 (Biomerieux, France) system. Methicillin sensitivity was evaluated according to Clinical and Laboratory Standards Institute (CLSI) criteria, and Fusidic acid sensitivity was assessed according to European Committee on Antimicrobial Susceptibility Testing (EUCAST) criteria. The data were recorded in the IBM Statistical Package for Social Sciences (SPSS) program version 17, statistical analyses were performed, and P <0.05 was considered significant.*

Results: *51 (46.4%) of S. aureus were isolated from service patients, and 59 (53.6%) were separated from outpatient clinics. The total methicillin resistance of 110 S. aureus strains was 20.9%. Methicillin resistance in outpatient clinics and services was 17.4% and 23.72%, respectively; their difference was not statistically significant (P >0.05). Sensitivity rates of FA in the outpatient clinics and services were found to be 90.2% and 94.9%, respectively, and the difference was not statistically significant (P >0.05). Methicillin-resistant Staphylococcus aureus was primarily isolated from pediatrics, orthopedics, general surgery, and otorhinolaryngology. In these units, FA sensitivities were 93.7%, 96.1%, 100%, and 100%, respectively.*

Conclusion: *FA should be considered an effective and safe empirical treatment option in treating soft tissue and wound infections caused by community and hospital-acquired MRSA.*

Keywords: *fusidic acid; wound infections; methicillin-resistant Staphylococcus aureus*

ÖZET

Amaç: *Hastanemizde yara enfeksiyonlarından izole edilen metisiline dirençli Staphylococcus aureus (MRSA) suşlarının sıklığı ve bunların fusidik asite (FA) in vitro duyarlılığı değerlendirerek FA'in ampirik tedavideki yerini göstermeyi amaçladık.*

Materyal ve Metot: *Çeşitli servis ve polikliniklerden alınan yara kültür örneklerinden izole edilen toplam 110 S. aureus suşu çalışmaya dâhil edildi. Bakterilerin tanımlanması ve antibiyotiklere olan duyarlılığı mikrobiyoloji laboratuvarımızda klasik yöntemler ve VITEK 2 (Biomerieux, Fransa) sistemi ile gerçekleştirildi. Metisilin duyarlılığı, Klinik ve Laboratuvar Standartları Enstitüsü (CLSI) kriterlerine göre ve Fusidik asit duyarlılığı ise European Committee on Antimicrobial Susceptibility Testing (EUCAST) kriterlerine göre değerlendirildi. Veriler IBM Sosyal Bilimlerde İstatistik Paket Programı (SPSS) sürüm 17 programına kaydedilerek istatistiksel analizleri yapıldı (P <0,05 anlamlı kabul edildi).*

Bulgular: *S. aureus şuşlarının 51'i (%46,4) servis hastalarından 59'u (%53,6) polikliniklerinden izole edildi. One hundred and ten S. aureus suşunun total metisilin direnci %20,9 olarak bulundu. Polikliniklerde ve servislerde metisilin direnci sırasıyla %17,4 ve %23,7 idi ve aralarındaki fark istatistiksel olarak anlamlı değildi (P >0,05). Poliklinik hastalarında ve servis hastalarında FA sensitivitesi sırasıyla %90,2 ve %94,9 olarak bulundu ve aradaki fark istatistiksel olarak anlamlı değildi (P >0,05). Methicillin-resistant Staphylococcus aureus çoğunlukla pediyatri, ortopedi, genel cerrahi ve Kulak Burun Boğaz (KBB) ünitelerinden izole edildi. Bu birimlerde FA sensitiviteleri sırasıyla %93,7, %96,1, %100, %100 idi.*

Sonuç: *FA, toplum ve hastane kaynaklı MRSA'ların neden olduğu yumuşak doku ve yara enfeksiyonlarının tedavisinde etkili ve güvenli bir ampirik tedavi seçeneği olarak akılda tutulmalıdır.*

Anahtar kelimeler: *fusidik asit; yara enfeksiyonları; metisiline dirençli Staphylococcus aureus*

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Introduction

Staphylococci are microorganisms which are located in the normal flora of the skin. Digestive and respiratory tracts can affect a wide range of skin and mucosa diseases, from upper respiratory tract infections to severe systemic infections.[1]

Today, methicillin resistance is one of the most important problems in treating staphylococcal infections. Methicillin-resistant staphylococcus strains are considered resistant to penicillins, combinations of β-lactam / β-lactamase inhibitors, cephalosporins, monobactams, and carbapenems. These strains also appear resistant to macrolides, clindamycin, chloramphenicol, tetracyclines, aminoglycosides, and quinolones.[2] There are a limited number of antibiotics that can be used in the treatment of these infections. Glycopeptides are antimicrobials that can be preferred for the treatment of these infections. But, if precautions are not taken, the widespread use of the glycopeptide group (vancomycin and teicoplanin) antibiotics will cause the development of resistant strains of staphylococci, leading to major problems in the treatment of these infections.[3]

Besides the risk of resistance development to glycopeptides, they can be used only parenterally and are also nephrotoxic. All these adverse situations lead researchers to find alternative effective treatments with minimal side effects.

In recent years, fusidic acid has been started to be the preferred antibiotic as a successful alternative treatment for skin and soft tissue infections. This antibiotic is known to be effective on MRSA and *methicillin-resistant Staphylococcus epidermidis* (MRSE). In addition, this antibiotic can be used parenterally, orally, and topically. When taken orally, it is completely absorbed, and it has good penetration to various body tissues, such as joint fluid, bone, and subcutaneous fat tissue.[3,4,5]

It is a drug recommended for the treatment of both systemic and cutaneous staphylococcal infections because of its low toxicity and low allergic reactions. However, it does not cross-react with other antibiotics due to its specificity in the mechanism of action.[6]

FA may be an alternative safe and effective choice of antibiotics in the empirical treatment of wound infections.

We aimed to determine the methicillin resistance of Staphylococcus aureus strains isolated from the polyclinic and service patients. We also wanted to determine the FA sensitivity of these MRSA strains in our hospital. Thus, we wanted to take attention to the place and importance of FA in treating skin and soft tissue infections.

Material and Method

After the ethics committee's approval from Kocaeli University Faculty of Medicine with decision No. 22/16 dated 18.11.2014 was taken, wound culture samples were collected from various services and outpatient clinics. After the wounds were cleaned with 70% alcohol, swabs were taken from the wounds with sterile cotton swabs, and the abscess contents were aspirated with sterile injectors. The samples were immediately transferred to microbiology laboratories and were incubated for 18-24 hours at 37°C in 5% sheep blood agar, Eosin Methylene Blue agar (EMB), and chocolate agar media. After gram staining, the light microscopic examination was done under x100 objective by dripping immersion oil on all samples. If the sample was taken from a sterile body area with few flat epithelial cells, it was considered significant even if leukocytes were detected on gram staining. As a result, 110 S. aureus strains isolated from infected skin lesions such as folliculitis, impetigo, erysipelas, surgical wound infections, and abscesses were included in the study.S. aureus strain was identified both by VITEK 2 Compact System fully automated identification system and by conventional methods such as catalase test, coagulase test. The susceptibility of the strains to antibiotics was determined with the VITEK 2 Compact System system, and the limit values were evaluated under the guidance of CLSI.[7] Since there is no CLSI-approved standard limit value for fusidic acid, those with a minimum inhibitory concentration (MIC) value of ≤1 μg/ml according to the criteria of the European Committee on Antimicrobial Susceptibility Testing (EUCAST) were evaluated as sensitive.[8]

If repetitive bacterial growth occurred in the same patient, they were excluded from the study. S. aureus ATCC 29213 and MRSA ATCC 43300 strains were used for quality control. The data were recorded in the SPSS 17 program, and statistical analyses were performed. $P<0.05$ was considered significant.

Results

110 S.aureus strains were obtained from the wound cultures; 51 (46.4%) were isolated from service patients,

Table 1. *Distribution of wound culture samples according to the medical units they were sent*

Units	n	%
Orthopedics	26	23.6
Dialysis	1	0.9
Burn	12	10.9
Infection Diseases	15	13.6
Nephrology	1	0.9
Intensive Care Unite	2	1.8
Plastic surgery	4	3.6
Cardiovascular surgery	5	4.54
Gastroenterology	2	1.8
Brain surgery	3	2.7
Pediatric diseases	16	14.5
Dermatology	9	8.2
Obtetrics and gynecology	3	2.7
Urology	1	0.9
General surgery	7	6.4
Otolaryngology	3	2.7
Total	110	

Table 2. *Methicillin-resistant rates of outpatient clinics and services*

	METHICILLIN		
Units	Sensitive n (%)	Resistant n (%)	Total
Outpatient clinics	42 (82.36)	9 (17.64)	51
Services	45 (76.28)	14 (23.72)	59
Total	87 (79.1)	23 (20.9)	110

Table 3. *Fusidic acid sensitivity rates of outpatient clinics and services*

	FA			
Units	Sensitive n (%)	Resistant n (%)	Less sensitive n (%)	Total
Outpatient clinics	46 (90.2)	4 (7.8)	1 (2)	51
Services	56 (94.9)	1 (1.7)	2 (3.4)	59
Total	102 (92.7)	5 (4.5)	3 (2.7)	110

Fusidic acid: FA.

and 59 (53.6%) were isolated from outpatient clinics. The samples mostly came from orthopedics, pediatrics, infectious diseases, and burn units (Table 1).

The total methicillin resistance of these 110 S. aureus strains was 20.9%. Methicillin resistance in policlinics and services was 17.4% and 23.72%, respectively, and the difference was not statistically significant (p>0.05). (Table 2).

When we examined FA sensitivity, 102 of 110 strains (92.7%) were sensitive, 3 of them (2.7%) were less sensitive, and 5 of them (4.5%) were resistant. In the outpatient clinics and services, the sensitivity rate to FA was 90.2 % and 94.9 %, respectively, and the difference was not statistically significant (Table 3). (P>0.05).

Table 4. *Distribution of MRSA according to units*

Units	n (%)
Orthopedics	4 (17.4)
Dialysis	1 (4.3)
Burn unit	2 (8.7)
Cardiovascular surgery	1 (4.3)
Pediatrics	6 (26.1)
Dermatology	2 (8.7)
Urology	1 (4.3)
General surgery	3 (13)
Otolaryngology	3 (13)
Total	23

Table 5. *Fusidic acid sensitivity rates according to units*

Units	Sensitive n (%)	Resistant n (%)	Less sensitive n (%)	Total
Orthopedics	25 (96.1)	1 (3.9)	0 (0)	26
Dialysis	0 (0)	0 (0)	1 (100)	1
Burn unit	11 (91.6)	0 (0)	1 (8.4)	12
Infection Diseases	14 (93.3)	1 (6.7)	0 (0)	15
Nephrology	1 (100)	0 (0)	0 (0)	1
Coronary intensive care	2 (10)	0 (0)	0 (0)	2
Plastic surgery	4 (100)	0 (0)	0 (0)	4
Cardiovascular surgery	5 (100)	0 (0)	0 (0)	5
Gastroenterology	2 (100)	0 (0)	0 (0)	2
Brain surgery	2 (66.6)	0 (0)	1 (33.4)	3
Pediatric diseases	15 (93.7)	1 (6.3)	0 (0)	16
Dermatology	8 (88.8)	1 (11.2)	0 (0)	9
Ostetrics and gynecology	3 (100)	0 (0)	0 (0)	3
Urology	0 (0)	1 (100)	0 (0)	1
General surgery	7 (100)	0 (0)	0 (0)	7
Otolaryngology	3 (100)	0 (0)	0 (0)	3
Total	102	5	3	110

MRSA was primarily isolated from pediatrics, orthopedics, general surgery, and Otorhinolaryngology (Table 4).

In these units, FA sensitivities were found to be 93.7%, 96.1%, 100%, and 100%, respectively (Table 5).

Discussion

Recent studies have reported increased hospital admission rates due to skin-soft tissue infections. Bacterial infections of the skin are the most common infections in the community. In dermatology outpatient clinics, about 20% of patients were diagnosed with bacterial skin infections.[1,5] In bacterial skin infections, the most

frequently isolated pathogenic microorganism was reported as S. aureus .[9,10]

Resistance against penicillin and penicillinase-resistant antibiotics is a known big problem in treating S. aureus. Strains resistant to all beta-lactams, termed MRSA, were originally defined as hospital-acquired but later began to be isolated from community-acquired infections.[11] Chronic dermatoses, surgical operations, vascular injections, intensive care units, and systemic diseases are risk factors for MRSA infections. Still, recently, it is worrying that MRSA infections are beginning to be seen even in people who do not have these risk factors in society. The increasing resistance rates against commonly used antibiotics and isolation of methicillin-resistant strains in community-acquired infections have been major difficulties in managing S. aureus infections.[12]

Belbase et al. stated that knowing the regional prevalence of methicillin resistance and regional antibiotic susceptibility rates is important in combating MRSA.[13] When we look at the studies reporting the prevalence of MRSA in our country, the MRSA rates isolated from various clinical specimens ranged from 38.2% to 63%.[2,6,14] In our country and the world, the MRSA rates isolated from only wound specimens have been reported between 15% and 35%.[14,15] In our study, *S. aureus* strains isolated from wound specimens were only evaluated in both clinics and outpatient clinics, and the methicillin resistance was found to be 20.9%.

Hospital-acquired MRSA (HA-MRSA) strains were first reported in the United States in 1960.[10] In addition, several studies are investigating the prevalence of HA-MRSA strains. For example, in a study including only wound culture isolates of five centers in the US and Canada, the HA-MRSA ratio was found to be 30 %.[15] From our country, Doğan et al. explored HA-MRSA rates of isolates, including various clinical specimens, in 2001 and 2012, and the methicillin resistance rates were found to be 49.1% and 37.3%, respectively.[16] In our study, the HA-MRSA rate was 23.72%. Compared with the other studies, this ratio is lower than national and international data. Factors such as antibiotic usage guidelines and infection control measures affect the rate of MRSA. In our hospital, the use of restricted antibiotics and the regular work of the infection control committee can explain why our MRSA rates are low.

Community-acquired MRSA (CA-MRSA) strains were first reported in the mid-1990s.[17] CA-MRSA prevalence varies according to countries and regions. From various areas of the World, the CA-MRSA rate in skin and soft tissue infections has been reported to range from 1% to 69%, and from our country, it ranges from 1% to 12.5%.[5,9,18,19] The CA-MRSA rate in our study was found to be 17.64%. This result is similar to other studies in our country and is lower than worldwide studies.

After vancomycin-resistant strains were reported, different antibiotic treatments began to be tried for MRSA infections. Some drug combinations have been proposed as alternatives to vancomycin use in MRSA, such as FA-rifampin or FA-trimethoprim-sulfamethoxazole (TMP-SMZ).[20,21]

When we search the literature, studies report FA sensitivity in MRSA and MSSA isolated from various clinical specimens. In these previous studies, FA susceptibility rates were reported to be ranging from 92.3% to 97% for MRSA and ranging from 94% to 100% for MSSA .[2,14,16,22,23]

In our study, FA sensitivity was 92.7% among all S.aureus strains and 94.25% and 87% for MSSA and MRSA strains, respectively. In addition, susceptibility rates of the FA in outpatient and service patients were found to be 90.2% and 94.9%, respectively. These results have shown that FA may be a good treatment option for wound infections caused by MRSA and MSSA. These ratios make FA a valuable treatment alternative, particularly in outpatient clinics in MRSA where treatment options are limited.

In the previous studies, S.aureus strains isolated from wound infections were reported to be mostly isolated in dermatology, orthopedic, general surgery, and internal diseases clinics.[15,24] When we evaluated the distribution of the samples in our study, the samples were mostly isolated from orthopedics, pediatrics, infectious diseases, and burn units.

When we look at the distribution of the units where MRSA strains are most isolated, it was seen that the studies reported similar results. For example, in a study conducted in Russia, MRSA patients were mainly isolated from burn, intensive care, and orthopedics clinics.[17] In our study, MRSA was mainly isolated from pediatric diseases and orthopedics, followed by general surgery and otolaryngology units

In our study, FA susceptibilities of MRSA isolates in pediatric diseases, orthopedics, general surgery, and otolaryngology

units were found to be 93.75%, 96.15%, 100%, and 100%, respectively.

This data will be informative in starting empirical treatment, especially in wound infections, which will occur in these units. Data related to the types of infectious agents and the development of antibiotic resistance rates must be shared with clinicians. This approach will contribute to reducing resistance rates to antibiotics.

Several studies are comparing the susceptibility of staphylococcal infections to FA and other antibiotics. Altun et al. compared FA with methicillin, ofloxacin, erythromycin, sulbactam/ampicillin (SAM), and TMP-SMZ, and they found that FA was the most effective antibiotic for MRSA strains among these antibiotics.[25]

Demir et al. compared resistance rates of the most commonly used antibiotics, SAM and amoxicillin-clavulanic acid. FA resistance rates were 36.4%, 45.5%, and 18.2%, respectively.[10] This study also shows that F.A. is more effective in empirical treatment than other antibiotics.

In another study, glycopeptides, linezolid, and FA were mentioned to be the most effective antibiotics for *S. aureus* strains. No resistance against these antibiotics was reported.[17] In another study, FA and TMP-SMZ susceptibility rates were compared, and FA was reported to be as effective as TMP-SMZ.[26] Therefore, FA appears to be an alternative agent in MRSA infections, particularly in cases where long-term sequential therapy is required.

According to Atmaca S et al. Fusidic acid resistance in MRSA strains was reported as 18.9%, 22.3%, and 13.2% in 2001, 2011 and 2017, respectively. [27] A similar study conducted later at the same hospital, and it was observed that these rates were 5% in 2018 and 2019 and 4% in 2020.[28] Şanlı K. et al. was also found that the MRSA and MSSA strains isolated from various clinical samples were 8.2%-1.9% resistant to fusidic acid, respectively.[29] Together with these, in another study, the fusidic acid sensitivity of MRSA strains was 76.2%.[30]

In the hospital, MRSA infections are usually treated with intravascular (i.v) antibiotics such as vancomycin and teicoplanin. Treating these patients with antibiotics that can be used orally, such as FA, provides significant benefits for healthcare professionals and patients. It has the advantages of reducing the length of hospital stay, preventing other patients from being infected, not needing tools such as catheters, and reducing the energy loss of health workers. All these make FA the most effective and reliable treatment for skin infections.

Knowing hospital flora and resistance rates of bacteria are the most important factors in choosing empirical treatment of skin and soft tissue infections. Regular follow-up of antibiotic resistance rates may be useful in selecting the right treatment.

References

1. Ray GT, Suaya JA, Baxter R. Incidence, microbiology, and patient characteristics of skin and soft-tissue infections in a U. S. population: a retrospective population-based study. BMC Infect Dis. 2013;13:252.
2. Erdemoglu A, Ozsoy MF, Emekdas G, Oncul O, Pahsa A. The resistance of Staphylococci isolated from urine to fusidic acid and other antimicrobials. Türk Mikrobiol Cem Derg. 2000;30:6–12.
3. Akcay SS, Oguzoglu N, Inan AS, Kucukercan M, Cobanoglu F. Fusidic acid and mupirocin sensitivity of methicillin-resistant Staphylococcus aureus isolated from skin and soft tissue infections. Klimik Derg. 2005;18:117–120.
4. Howe RA, Wootton M, Walsh TR, Bennett PM, Macgowan AP. Heterogeneous resistance to vancomycin in Staphylococcus aureus. J Antimicrob Chemother. 2000;45(1):130–132.
5. Bonamonte D, Belloni Fortina A, Neri L, Patrizi A. Fusidic acid in skin infections and infected atopic eczema. G Ital Dermatol Venereol. 2014;149(4):453–459.
6. Shanson DC. Clinical relevance of resistance to fusidic acid. J Antimicrob Chemother. 1990;25:15–21.
7. Clinical and laboratory standards institute. performance standards for antimicrobial susceptibility testing; 20th Informational Supplement, M100–S20. Wayne, PA. CLSI; 2010. p. 60–74.
8. The European Committee on Antimicrobial Susceptibility Testing. Breakpoint tables for interpretation of MICs and zone diameters. Version 5.0, 2015.
9. Evirgen Ö. Empirical treatment of skin and soft tissue infections. Yoğun Bakım Dergisi. 2012;3:120–127.
10. Demir B, Denk A, Karlıdağ EG, Uçak H. Antibiotic susceptibility of microorganisms isolated from the bacterial skin infections and evaluation of empirical antibiotic therapy. F Ü Sağ Bil Tıp Dergisi. 2014;1:05–10.
11. Ippolito G, Leone S, Lauria FN, Nicastri E, Wenzel RP. Methicillin-resistant Staphylococcus aureus: the superbug. Int J Infect Dis. 2010;14 Suppl 4:S7–S11.
12. Liu Y, Zhang J, Ji Y. PCR-based approaches for the detection of clinical methicillin-resistant Staphylococcus aureus. The Open Micr Journ. 2016;10:45–56.

13. Belbase A, Pant ND, Nepal K, Neupane B, Baidhya R, Baidya R, et al. Antibiotic resistance and biofilm production among the strains of Staphylococcus aureus isolated from pus/wound swab samples in a tertiary care hospital in Nepal. Ann Clin Microbiol Antimicrob. 2017;16(1):15.
14. Yazgı H, Ertek M, Aktaş O. İnvestigation of fusidic acid susceptibility of staphylococcus strains isolated from various clinical specimens. Turk Mikrobiyol Cem Derg. 2003;33:12–15.
15. Renniea RP, Jonesb RN, Mutnickb AH. Occurrence and antimicrobial susceptibility patterns of pathogens isolated from skin and soft tissue infections: report from the SENTRY Antimicrobial Surveillance Program (United States and Canada, 2000). Diagnostic Microbiology and Infectious Disease. 2003;45:287–293.
16. Doğan M, Feyzioğlu B, Baykan M. The change of antibiotic resistance in S. aureus strains within ten-year periods. Abant Medical Journal. 2014;3:237–241.
17. Gosbell IB. Methicillin-resistant Staphylococcus aureus. Am J Clin Dermatol. 2004;4:239–59.
18. DeLeo FR, Otto M, Kreiswirth BN, Chambers HF. Community-associated meticillin-resistant Staphylococcus aureus. Lancet. 2010;375(9725):1557–1568.
19. Wang HK, Huang CY, Huang YC. Clinical features and molecular characteristics of childhood community-associated methicillin-resistant Staphylococcus aureus infection in a medical center in northern Taiwan, 2012. BMC Infect Dis. 2017;17(1):470.
20. Khawcharoenporn T, Alan T. Oral antibiotic treatment for methicillin-resistant Staphylococcus aureus skin and soft tissue infections: review of the literature, Hawaii Med J. 2006;65(10):290–3.
21. Geisel R, Schmitz FJ, Fluit AC, Labischinski H. Emergence, mechanism, and clinical implications of reduced glycopeptide susceptibility in Staphylococcus aureus. Eur J Clin Microbiol Infect Dis. 2001;20(10):685–697.
22. Yaman G, Çıkman A, Berktaş M, Paelak M, Güdücüoğlu H, Karahocagil MK. MLSB, fusidic acid, and various antibiotic resistance rates of nosocomial Staphylococcus aureus isolates. Ankem Derg. 2010;24(3):130–135.
23. Nishijima S, Kurokawa I. Antimicrobial resistance of Staphylococcus aureus isolated from skin infections. Int J Antimicrob Agents. 2002;19:241–3.
24. Doğan SŞ, Paköz NİE, Aral M. The distribution and antibiotic susceptibility of the microorganisms isolated from wound specimens. Türk Mikrobiyol Cem Derg. 2010;40(4):243–249.
25. Altun B, Kocagöz S, Hasçelik G, Uzun Ö, Akova M, Ünal S. Susceptibilities to fusidic acid and frequently used antibiotics of staphylococcus strains isolated in various hospitals. Turk Mikrobiyol Cem Derg. 2003;33:8–11.
26. İskender S, Yılmaz G, Aydın K, Sucu N, Aktoz Boz G, Çaylan R. et al. İnvestigation of susceptibility of methicillin-resistant Staphylococcus aureus strains to fusidic acid and trimethoprim-sulfamethoxazole with disc diffusion method. Flora derg. 2007;12(3):153–156.
27. Atmaca S, Özekinci T, Yakut S, Akpolat N, Gül K. Üç farklı zaman aralığında (2001, 2011, 2017) hastanemizde izole edilen Staphylococcus aureus suşlarının fusidik aside karşı direnç durumları. ANKEM Derg. 2018;32(1):25–30.
28. Kangül H, Atmaca S, Uzuner N, Çelik M. Dicle Üniversitesi Tıp Fakültesi Hastanesi'nde yatan hastalardan 2018, 2019 ve 2020 yıllarında izole edilen metisiline dirençli Staphylococcus aureus suşlarının çeşitli antibiyotiklere karşı direnç oranları. ANKEM Derg. 2021;35(2):38–44.
29. Şanlı K. Hastane kökenli ve toplum kaynaklı Staphylococcus aureus suşlarının çeşitli antimikrobiyallere duyarlılıkları. İKSSTD. 2020;12(2):188–93.
30. Coşkun MV, Alper Y, Uyanık MH, Yazgı H. Sensitivity of methicillin-resistant Staphylococcus aureus strains to fusidic acid and other non-β-lactam antibiotics. Klimik Derg. 2019;32(1):52–6.