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Are *Myroides* spp. Isolated From Urinary Catheter Cultures of Patients in Intensive Care Units an Infection or Colonization? Analysis of 36 Cases

Yoğun Bakım Ünitesi Hastalarının Üriner Kateter Kültürlerinden İzole Edilen *Myroides* spp. İzolatları Enfeksiyon mu Yoksa Kolonizasyon mu? 36 Olgunun Analizi

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ABSTRACT *Objective:* *Myroides* species are mostly low-grade opportunistic pathogens and infect immunocompromised patients. Reports of *Myroides* spp. increased from clinical samples due to unique developments in molecular microbiology. However, clinical importance of this microorganism in intensive care units' patients is debated. We aimed to determine whether *Myroides* spp. strains isolated from urinary catheter cultures of patients in intensive care units are led to an infection or colonization by examining the risk factors of the patients between January 2018 and December 2022.

Materials and Methods: In a university hospital, the patients who *Myroides* spp. isolated from urine cultures in intensive care units between January 2018 and December 2022 were included in the study. The method and reasons of taking urine samples, the presence of a urinary catheter, blood cultures samples in terms of urinary sepsis, the antimicrobial susceptibility of the isolates, and hospital stay were evaluated retrospectively. Also, control culture samples were taken after 24 and 72 hours by changing the urinary catheters of these patients.

Results: Thirty-six patients were enrolled to the study. Urine cultures were taken for investigate the source of infection in 23 patients, and nine for control urinary culture and in three patients for macroscopic urine blurred and in one patient to detect colonization before urinary surgery. There was not any blood culture positivity found. All *Myroides* spp. isolated patients had urinary catheter. Average length of hospital stay was determined as 41.3 days (7-355). A total 34 of the 36 isolated *Myroides* spp. were pan-drug resistant. Antibacterial treatment was not initiated in any of the patients. Urinary catheters change after first isolation of *Myroides* spp. was recommended in all patients. After the patients' urinary catheters were changed, *Myroides* spp. were not grown in the control culture samples taken 24 and 72 hours after.

Conclusion: As a result of our study, *Myroides* spp. were isolated especially in patients with long hospital stays and urinary catheters. It was determined that the patients were controlled without treatment, only with urinary catheter replacement. We believe that this agent should be evaluated as having a very high rate of urinary colonization, and the urinary catheter should be changed first, urinary symptoms should be followed up, and unnecessary antimicrobial use should be avoided.

Keywords: *Myroides* species, urinary tract infections, colonization

ÖZ Amaç: *Myroides* türleri çoğunlukla düşük dereceli fırsatçı patojenlerdir ve bağışıklık sistemi baskılanmış hastaları enfekte eder. Moleküler mikrobiyoloji alanındaki benzersiz gelişmeler nedeniyle klinik örneklerden *Myroides* spp. identifikasyonu artmıştır. Ancak yoğun bakım hastalarında bu mikroorganizmanın klinik önemi tartışılmaktadır. Çalışmamızda, Ocak-2018 Aralık 2022 tarihleri arasında yoğun bakım ünitelerinde yatan hastaların üriner kateter kültürlerinden izole edilen *Myroides* spp. suşlarının enfeksiyona mı yoksa kolonizasyona mı yol açtığını, hastaların risk faktörlerini inceleyerek belirlemeyi amaçladık.

Gereç ve Yöntem: Bir üniversite hastanesinde Ocak 2018-Aralık 2022 tarihleri arasında yoğun bakım ünitelerinde idrar kültürlerinden *Myroides* spp. izole edilen hastalar çalışmaya dahil edildi. İdrar örneklerinin alınma yöntemi ve nedenleri, üriner kateter varlığı, üriner-sepsis açısından kan



kültürü örnekleri, izolatların antimikrobiyal duyarlılıkları ve hastanede kalış süreleri retrospektif olarak değerlendirildi. Ayrıca bu hastaların üriner kateterleri değiştirilerek 24 ve 72 saat sonra kontrol kültür örnekleri alındı.

Bulgular: Çalışmaya otuz altı hasta dahil edildi. Yirmi üç hastada enfeksiyon kaynağını araştırmak için, dokuz hastada kontrol idrar kültürü için, üç hastada makroskopik idrar bulanıklığı nedeniyle ve bir hastada cerrahi öncesi kolonizasyon tespiti için idrar kültürü alındı. Herhangi bir kan kültüründe pozitiflik saptanmadı. Tüm *Myroides* spp. izole hastalarda üriner kateter vardı. Ortalama hastanede kalış süresi 41,3 gün (7-355) olarak belirlendi. İzole edilen 36 *Myroides* spp. suşundan 34'ü çoklu ilaca dirençli idi. Hiçbir hastaya antibakteriyel tedavi başlanmadı. Tüm hastalara *Myroides* spp.'nin ilk izolasyonundan sonra üriner kateter değişimi önerildi. Hastaların üriner kateterleri değiştirildikten 24 ve 72 saat sonra alınan kontrol kültür örneklerinde *Myroides* spp. üremedi.

Sonuç: Çalışmamız sonucunda, *Myroides* spp. özellikle hastanede uzun süre yatan ve üriner kateteri olan hastalarda izole edilmiştir. Hastalara antimikrobiyal tedavi verilmeden sadece üriner kateter değişimi ile kontrol altına alındığı belirlendi. Bu mikroorganizmanın üriner kolonizasyon oranı çok yüksek olarak değerlendirilmesi ve öncelikle üriner kateterin değiştirilmesi, üriner semptomların takibi ve gereksiz antimikrobiyal kullanımından kaçınılması gerektiği kanaatindeyiz.

Anahtar Kelimeler: *Myroides* türleri, idrar yolu enfeksiyonu, kolonizasyon

Introduction

In recent years, in line with the unique developments in molecular microbiology, many bacteria that were previously isolated from clinical samples but could not be typed have begun to be typed. Therefore, the incidence of *Myroides* species reports has increased in clinical samples, especially urine culture samples taken from patients with urinary catheters (1).

Myroides species are yellow-pigmented, non-fermentative, Gram-negative bacilli and previously classified as *Flavobacterium* species. Also, *Myroides* spp. is widely found in environmental sources, especially in soil and water, but it is also isolated from seafood, and meat processing plants. Although *Myroides* spp. are ubiquitous in marine and soil environments, they have been associated with very few documented infections in humans since their first identification in the 1920s (2). *Myroides* spp. are reported to rarely cause infection in immunocompromised patients (3,4). Although this microorganism is considered a pathogen with low infection potential, it has been reported to be associated with various life-threatening infections such as meningitis, pneumonia, septicemia, urinary tract, and soft tissue infections in recent years. *Myroides* spp. are mostly low-grade opportunistic pathogens and infect immunocompromised patients such as those with kidney failure, liver cirrhosis, lung disease, cancer, and prolonged stays in intensive care units (4,5).

Myroides species were rarely isolated from a variety of clinical samples of human infections, such as urine, wounds, and blood. In the literature, the most common infections, depending on *Myroides* spp. are reported as urinary tract infections (UTIs). Urinary catheter use is an important risk factor for these infections. However, although infections caused by *Myroides* spp. are rare, they are resistant to

multiple antibiotics, such as carbapenems, beta-lactams, and have variable sensitivity to aminoglycosides, quinolones, and sulfamethoxazole (6).

In this context, it was observed in our hospital that the reporting of multi-drug resistant *Myroides* spp. isolates increased. In this study, we aimed to determine whether *Myroides* spp. strains isolated from urinary catheter cultures of patients in intensive care units led to infection or colonization by examining the risk factors of the patients between January 2018 and December 2022.

Materials and Methods

Hospital Setting

The study was conducted in a tertiary university hospital with a capacity of 1370 beds and 352 intensive care beds. Thirty-six patients who were hospitalized in intensive care units between January 2018 and December 2022 and whose *Myroides* spp. were isolated from their clinical samples were included in the study. An informed consent form for the patients was provided. All clinical samples were urine culture samples. Repeated samples from the same patient were excluded from the study. The study was managed following the principles of the Declaration of Helsinki. Ethics committee approval was obtained from the İnönü University Scientific Research and Publication Ethics Committee (decision no: 2021/1240, date: 05.01.2021).

The method and reason for taking urine samples, the presence of a catheter in the patients, blood culture samples in terms of urinary sepsis, the antimicrobial susceptibility of the isolated *Myroides* spp., and hospital stay were evaluated. Also, control culture samples were taken after 24 and 72 hours by exchanging the urinary catheters of these patients.

Identification and Antimicrobial Susceptibility

Urine culture samples were taken from patients' catheters in accordance with aseptic techniques. The samples were sent to the microbiology laboratory to be processed within 30 minutes in sterile containers. Urine samples were quantitatively inoculated on 5% sheep blood agar and eosin methylene blue agar medium in the laboratory. After 18-24 hours' incubation at 37 °C, identification of the isolates that were grown as 1-2 mm round, smooth yellow pigmented, fruit-scented oxidase and catalase positive, Gram-negative bacilli was made by Matrix-Assisted Laser Desorption Ionization Time of Flight Mass Spectrometry (MALDI-TOF MS) (BioMérieux, France). The antimicrobial susceptibility of the isolates to ciprofloxacin, levofloxacin, amoxicillin-clavulanic acid, ceftazidime, cefotaxime, imipenem, meropenem, gentamicin, amikacin, piperacillin/tazobactam, and trimethoprim/sulfamethoxazole was determined by the disk diffusion method on Mueller-Hinton agar medium, and colistin susceptibility was determined by the broth microdilution method. Results were interpreted according to The European Committee on Antimicrobial Susceptibility Testing guideline recommendations (7). Blood culture samples sent to our laboratory were incubated for 5 days in the BACT/ALERT 3D (BioMérieux, France) fully automated blood culture system.

Statistical Analysis

Statistical analyses were performed using SPSS for Windows, version 17.0 (IBM-SPSS Inc, Armonk, NY).

Results

Myroides spp. was isolated in 36 of the urine culture samples sent from intensive care units to our laboratory over a period of five years. The mean age of the patients was 59±19.9 years (10-84 years), and 22 (61.1%) were male patients. Patients were hospitalized in ICU due to trauma, intracranial events, myocardial infarction, acute renal failure. There was no comorbidity in 11 patients, the other patients had renal or urogenital problems, pulmonary and cardiac problems, intracranial events, and malignancy. All *Myroides* spp. isolated patients had urinary catheters. Thirty four isolates were resistant to the studied antimicrobials, ciprofloxacin, levofloxacin, amoxicillin-clavulanic acid, ceftazidime, cefotaxime, imipenem, meropenem, gentamicin, amikacin, piperacillin/tazobactam, trimethoprim/

sulfamethoxazole, and colistin. One isolate was susceptible to ceftazidime, ceftazidime, cefotaxime, gentamicin, amikacin, trimethoprim/sulfamethoxazole, and two isolates were susceptible to colistin. Based on these results, we concluded that the isolates were pan-drug resistant, except for two strains. It was found that urine cultures were taken during the investigation of the infection focus in 23 of the patients to determine whether the urinary agent was controlled in nine patients, in three patients because of turbidity in the urine color, and in one patient to detect colonization before urinary surgery. None of the patients had urinary symptoms. Before *Myroides* spp. was isolated, six patients were not receiving any antibiotic treatment, eight patients were using piperacillin/tazobactam, 19 patients were using meropenem, and three patients were using ciprofloxacin. However, specific antibacterial treatment was not initiated in any of the patients against *Myroides* spp.

Urinary catheter changes were recommended for all patients. After the patients' urinary catheters were changed, *Myroides* spp. isolates were grown in only four of the control culture samples taken 24 hours later. There was no growth in the control culture samples taken 24 and 72 hours after exchanging the urinary catheters of the other thirty-two patients. Urinary catheters of the patients who had growth at the 24th hour was exchanged again, and there was no growth in the samples taken at the 24th and 72nd hours.

In blood cultures, *Myroides* spp. were not isolated. The average length of hospital stay was determined to be 41.3 days (7-355).

Discussion

Currently, the spectrum of healthcare associated, and community-acquired infections caused by new opportunistic pathogens is constantly increasing. This increase in the number of newly described microorganisms is due to the introduction of MALDI-TOF into clinical microbiology laboratories and the use of molecular identification methods such as 16S rRNA sequencing (1). Due to these technological advances, *Myroides* spp. are much more isolated in urine culture samples.

Myroides spp. is an aerobic, non-fermentative, immobile Gram-negative bacillus, usually found in water and soil. Due to the presence of flexirubin, they are bacteria with a yellow pigment and a characteristic fruity smell like strawberries (4). They do not belong to the normal human flora. However,

since they are rare pathogens in humans, they are considered low-grade opportunistic pathogens. Opportunistic infections have been reported mostly in immunocompromised patients (3,4). Also, despite their low pathogenicity potential, *Myroides* spp. isolates are multidrug resistant. They can also form biofilms and have a polysaccharide capsule that makes their surface hydrophobic (4,6).

It has been reported in the literature that *Myroides* spp. can cause the most common UTIs and rarely soft tissue, bone, pneumonia, and sepsis (8). *Myroides* spp. was first reported as an infection agent by Holmes et al. (9) after it was identified from urine cultures. Ktari et al. (10) reported seven UTIs cases due to *Myroides* spp. in patients who underwent endo-urological operations and had urinary stones. Licker et al. (11) reported four hospital acquired UTIs due to *Myroides odoratimimus* isolated from the urine specimens of immunocompromised patients. The patients had urinary catheters, and all isolates were resistant to antibiotics. In the report of Yağci et al. (12), in our country, it has been shown that patients with UTIs due to *Myroides* spp. are catheterized or have urinary tract neoplasia or stones. Kutlu et al. (13) reported an outbreak of UTIs in intensive care units. They isolated six strains of *M. odoratimimus* from the urine samples. They said that all the patients were immunocompromised, underwent urinary catheterization, and none of the patients had urinary neoplasm, surgery, or calculi. Additionally, they identified the isolates as *M. odoratimimus* by 16S rRNA-based sequencing and determined that the isolates were resistant to antibiotics.

Antimicrobial treatment of infections due to *Myroides* spp. isolates is difficult due to their production of metallo-beta-lactamase. Therefore, many strains are resistant to beta-lactams and carbapenems. They may show variable sensitivity to aminoglycosides, quinolones, and trimethoprim/sulfamethoxazole (6,8). A total of 34 of the isolated strains in our study were resistant to beta-lactams, carbapenems, aminoglycosides, quinolones, and trimethoprim/sulfamethoxazole. One isolate was susceptible to beta-lactams, aminoglycosides, and trimethoprim/sulfamethoxazole two isolates were susceptible to colistin. Kara et al. (14) reported that eleven *Myroides* spp. isolates they identified were resistant to all groups except tigecycline. Death has been reported in two cases due to *Myroides* spp. multi-drug resistance (15,16).

As a result of our study, *Myroides* spp. was isolated from urine culture samples taken from the urinary catheters of thirty-six intensive care patients. No growth was detected in the control cultures taken after 72 hours of exchanging the urinary catheters of the patients. The most important risk factors for *Myroides* spp. in these patients seems to be the length of hospital stay and the presence of a urinary catheter. The average length of hospital stay for the patients were determined to be 41.3 days. However, isolated *Myroides* spp. was not considered an infection agent, and antimicrobial treatment was not applied to any of the patients.

The limitation of the study was that clonal relationship between the isolates and the source of *Myroides* spp. spread was not determined.

Conclusion

Myroides spp. were isolated, especially in patients with long hospital stays and urinary catheters. It was determined that the patients were controlled without treatment, only with urinary catheter replacement. We believe that this agent should be evaluated as having a very high rate of urinary colonization, and the urinary catheter should be changed first, urinary symptoms should be followed up, and unnecessary antimicrobial use should be avoided.

Ethics

Ethics Committee Approval: Ethics committee approval was obtained from the İnönü University Scientific Research and Publication Ethics Committee (decision no: 2021/1240, date: 05.01.2021).

Informed Consent: An informed consent form for the patients was provided.

Authorship Contributions

Surgical and Medical Practices: D.Ç., Y.E., A.B.Ö., Concept: Y.D., Y.E., A.B.Ö., Design: Y.D., E.N.P., Data Collection or Processing: D.Ç., Analysis or Interpretation: Y.D., E.N.P., Y.E., Literature Search: D.Ç., Y.E., A.B.Ö., Writing: Y.D., Final Approval: Y.D., Y.E., D.Ç., N.P., A.B.Ö.

Conflict of Interest: No conflict of interest was declared by the authors.

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References

1. Schröttner P, Rudolph WW, Eing BR, Bertram S, Gunzer F. Comparison of VITEK2, MALDI-TOF MS, and 16S rDNA sequencing for identification of *Myroides odoratus* and *Myroides odoratimimus*. *Diagn Microbiol Infect Dis*. 2014;79:155-9.
2. Zumla A. Mandell, Douglas, and Bennett's principles and practice of infectious diseases. *Lancet Infect Dis*. 2010;10:303-4.
3. Vancanneyt M, Segers P, Torck U, Hoste B, Bernardet JF, Vandamme P, et al. Reclassification of *Flavobacterium odoratum* (Stutzer 1929) strains to a new genus, *Myroides*, as *Myroides odoratus* comb. nov. and *Myroides odoratimimus* sp. nov. *Int J Syst Bacteriol*. 1996;46:926-32.
4. Benedetti P, Rassa M, Pavan G, Sefton A, Pellizzer G. Septic shock, pneumonia, and soft tissue infection due to *Myroides odoratimimus*: report of a case and review of *Myroides* infections. *Infection*. 2011;39:161-5.
5. Elantamilan D, Lyngdoh WW, Choudhury B, Khyriem AB, Rajbongshi J. Septicaemia caused by *Myroides* spp. - A case report. *JMM Case Reports*. 2015;5:1-4.
6. Hu SH, Yuan SX, Qu H, Jiang T, Zhou YJ, Wang MX, et al. Antibiotic resistance mechanisms of *Myroides* sp. *J Zhejiang Univ Sci B*. 2016;17:188-99.
7. EUCAST (2021). Available from: URL: https://www.eucast.org/fileadmin/src/media/PDFs/EUCAST_files/Breakpoint_tables/v_14.0_Breakpoint_Tables.pdf.
8. Willems P, Muller J, Verhaegen J, Saegeman V, Desmet S. How to treat a fulminant erysipelas and sepsis caused by *Myroides odoratimimus*: case report and literature review. *Acta Clin Belg*. 2017;72:331-5.
9. Holmes B, Snell JJ, Lapage SP. *Flavobacterium odoratum*: a species resistant to a wide range of antimicrobial agents. *J Clin Pathol*. 1979;32:73-7.
10. Ktari S, Mnif B, Koubaa M, Mahjoubi F, Ben Jemaa M, Mhiri MN, Hammami A. Nosocomial outbreak of *Myroides odoratimimus* urinary tract infection in a Tunisian hospital. *J Hosp Infect*. 2012;80:77-81.
11. Licker M, Sorescu T, Rus M, Cirlea N, Horhat F, Jurescu C, et al. Extensively drug-resistant *Myroides odoratimimus* - a case series of urinary tract infections in immunocompromised patients. *Infect Drug Resist*. 2018;11:743-9.
12. Yağcı A, Cerikcioğlu N, Kaufmann M E, Malnick H, Söyletir G, Babacan F, et al. Molecular typing of *Myroides odoratimimus* (*Flavobacterium odoratum*) urinary tract infections in a Turkish hospital. *Eur J Clin Microbiol Infect Dis*. 2000;19:731-2.
13. Kutlu HH, Avcı M, Dal T, Arı O, Durmaz R. A Healthcare-Associated Outbreak of Urinary Tract Infections Due to *Myroides odoratimimus*. *Jpn J Infect Dis*. 2020;73:421-6.
14. Kara I, Kalem F, Unaldı O, Arslan U. *Myroides* Sp, a Rare Opportunistic Infective Agent, at a Hospital in Turkey. *Southeast Asian Journal of Tropical Medicine and Public Health*. 2019;50:248-57.
15. Crum-Cianflone NF, Matson RW, Ballon-Landa G. Fatal case of necrotizing fasciitis due to *Myroides odoratus*. *Infection*. 2014;42:931-5.
16. Prateek S, Gupta P, Mittal G, Singh AK. Fatal Case of Pericardial Effusion Due to *Myroides Odoratus*: A Rare Case Report. *J Clin Diagn Res*. 2015;9:DD01-2.