Myroides: An Emerging Pathogen Causing Urinary Tract Infections in Hospitalized Patients

Mohit Agrawal[1], Ved Prakash Mamoria[2], Sonali Mittal[3], Ayushi Sharma[4]

ABSTRACT

Introduction: The genus *Myroides* comprises of Gram-negative, non-motile, and non- fermenting bacteria. It is a rare opportunistic pathogen but many recent case reports, however, underscore the pathogenic potential that *Myroides spp.* possesses for humans. Immunocompromised patients are at higher risk for *Myroides* infection. Diabetes, catheterization and ICU stay may increase the chances of acquiring *Myroides* infection.

Material and Methods: Urine specimens collected from inpatients were cultured as per standards. *Myroides spp.* were identified and sensitivity was performed on VITEK® 2 Compact™.

Results: A total of 16 *Myroides spp.* isolates were obtained in the study period. All the isolates were from catheterized patients residing in intensive care units. Eleven (69%) patients were suffering from diabetes mellitus. Extensive resistance was seen in antibiotic sensitivity results. Minocycline was 100% sensitive.

Conclusion: *Myroides spp.* should be considered among pathogens in hospitalized, catheterized patients. They could be extremely drug resistant. Minocycline is a useful antibiotic while treating UTI caused by *Myroides spp.*

Keywords: Catheterized, Diabetes, ICU, Minocycline, *Myroides,* Non- fermenter, Urinary Tract Infection.

INTRODUCTION

The *Myroides spp*. are ubiquitously present as environmental bacterial organisms.[1] In the past, they were not considered pathogenic but despite of their low virulence, now a days increasing number of cases are being reported in literature. The traditional epidemiology of *Myroides spp.* involves infection of an immunocompromised host. The organism has been reported in cases of urinary tract infection[2], endocarditis[3], ventriculitis[4], cutaneous infections[5], pneumonia[6], catheter-associated bacteraemia[7], and soft tissue infections[8], typically in severely immunocompromised patients, although rare severe infections also occur in immunocompetent hosts.[9]

Myroides belong to family *Flavobacteriaceae*. Members of the genus *Myroides* were initially isolated from human intestine in 1923 by Stutzer and named as *Bacterium faecale aromaticum.*[10] Later in 1929 they were named as *Flavobacterium odoratum.*[11] An extensive polyphasic taxonomic analysis of 19 strains of *F. odoratum* in 1996 led to the establishment of the genus *Myroides* which included two species, *M. odoratus* and *M. odoratimimus.*[12] The genus differs from *Flavobacterium* species by its lack of gliding motility, its ability to grow well at 37°C, its salt tolerance, and differences in its fatty acid composition. The characteristics of being nonsaccharolytic and indole-negative differentiate *Myroides odoratus* from *Elizabethkingia meningosepticum* and other similar medically important organisms.

Genus *Myroides* gets its name from Greek word Myron, and it literally means resembling perfume. They are Gram-negative rods and cells are thin, middle sized (0.5 µm in diameter and 1–2 µm long) but longer rods and long chains (containing four to ten cells) may occur in broth medium. They are strict aerobes. They show good growth on nutrient agar and MacConkey agar. They are non hemolytic on blood agar. They can be salt tolerant up to 5% of NaCl. *Myroides* form yellow pigmented colonies on culture due to the presence of flexirubin pigment. These colonies emit a characteristic fruity odour, similar to *Alcaligenes faecalis*. However *Myroides* can be differentiated from *A. faecalis* on the basis of absence of nitrate reductase and colistin resistance.

Myroides genus includes five species: *Myroides odoratus, Myroides odoratimimus, Myroides pelagicus*[13], *Myroides profundi*[14] and *Myroides marinus.*[15] While first two species are recovered from human clinical specimens, last three are found in sea water. *M. odoratus* can be differentiated from *M. odoratimimus* by its susceptibility to desferrioxamine.

As infections with *Myroides spp.* are being reported as individual case reports more frequently, we thought it was an opportune time to look at antimicrobial agents and their *in vitro* effectiveness against a number of clinical isolates. Present study was conducted to find out the occurrence and susceptibility of *Myroides spp.* in urine specimens of hospitalized patients.

MATERIAL AND METHODS

Urine specimens (mid-stream and catheter catch) collected from inpatients attending Mahatma Gandhi Hospital, Jaipur

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Antibiotic	Sensitive Isolates (%)	Intermediate Isolates (%)	Resistant Isolates (%)
Piperacillin/Tazobactam	0 (0%)	0 (0%)	16 (100%)
Ceftriaxone	0 (0%)	0 (0%)	16 (100%)
Cefoperazone/Sulbactam	0 (0%)	0 (0%)	16 (100%)
Cefepime	0 (0%)	1 (6.25%)	15 (93.75%)
Imipenem	0 (0%)	0 (0%)	16 (100%)
Amikacin	0 (0%)	0 (0%)	16 (100%)
Gentamicin	0 (0%)	0 (0%)	16 (100%)
Ciprofloxacin	0 (0%)	0 (0%)	16 (100%)
Levofloxacin	0 (0%)	0 (0%)	16 (100%)
Minocycline	16 (100%)	0 (0%)	0 (0%)
Tigecycline	0 (0%)	0 (0%)	16 (100%)
Co-trimoxazole	0 (0%)	0 (0%)	16 (100%)
Colistin	0 (0%)	0 (0%)	16 (100%)

Table-1: Antimicrobial susceptibility result

Condition	Number of patients (%)
Diabetes mellitus	11 (69%)
Foley's catheter	16 (100%)
ICU stay	16 (100%)

Table-2: Distribution of comorbidities

and sent to Department of Microbiology for culture and sensitivity test and showing growth of *Myroides spp.* from October 2018 to September 2019 were included in this study. A semi quantitative method was taken on for the primary isolation of organisms by using a calibrated loop with diameter of 4 mm, delivering 0.01 ml of urine. Specimens were then cultured on Blood agar and MacConkey agar media plates and incubated at 37 overnight. Culture on blood agar revealed 2-3 mm round, convex, smooth, yellowish colonies. Gram stain showed gram negative bacilli. The organism was non-motile, indole negative, oxidase and catalase positive. 20% KOH test was also positive. Specimens with a colony count of $\geq 10^5$cfu/ ml were considered with significant bacteriuria.

The final identification of the organism and antimicrobial susceptibility pattern were done on an auto-analyzer system (VITEK® 2 Compact™, BioMérieux, France). VITEK® 2 is suitable to identify bacteria at the genus level, it can't differentiate between species. Antimicrobial susceptibility was done by using VITEK N364 card (BioMerieux, France) which has a panel of antimicrobials on a single card to which susceptibility results can be tested. This panel has antibiotics which are intended to be used against non-fermenter bacteria. The results were interpreted as per Clinical Laboratory Standards Institute guidelines.[16] As CLSI currently does not provide any direct standards for *Myroides*, we used criteria suggested by CLSI for non-enterobacteriaceae non-fastidious, glucose-nonfermenting, Gram-negative bacilli.[16]

RESULTS

A total of 16 *Myroides spp.* isolates were isolated in the study duration. In all 16 instances they were isolated with significant count of $\geq 10^5$cfu/ ml. These patients were from different intensive care units of hospital. All of these patients were catheterized and specimens were obtained from catheter port. Antimicrobial susceptibility is shown in table 1,2.

DISCUSSION

Myroides spp. are suggested to affect hosts with immunocompromised status like liver cirrhosis, end stage renal disease, diabetes mellitus, and chronic obstructive pulmonary disease.[17-19] Cases of *Myroides spp.* causing UTI have been reported in patients with chronic nephritis, urinary retention, urinary calculi, and diabetes mellitus.[20-21]

Myroides spp. grow well in high concentrations of glucose, and in our study we found that diabetes was a comorbidity in several cases. In present study out of 16, eleven (69%) patients were suffering from diabetes mellitus. An association of diabetes and UTI was also reported by Solanki *et al.* where 54% cases of *Myroides* UTI had diabetes mellitus.[21] Eight (73%) out of these eleven patients were long standing diabetics. Verma *et al.* in their study reported 100% patients were long standing diabetics.[22]

Another risk factor could be presence of Foley's catheter.[23] It is possibly because of the strong tendency of *Myroides spp.* to form biofilms.[24] *Myroides spp.* display strong adherence profiles, with a preference for adherence at lower temperatures.[25] Their ubiquitous presence and their ability of autoaggregation and coaggregation leading to biofilm formation might explain their ability to infect debilitated or immunosuppressed hosts where presence of urinary catheters is very common.[8,26] In our study all the 16 patients were catheterized. Chen et al. reported 82% of their cases were catheterized.[27]

The treatment of *Myroides spp.* is difficult due to extensive antibiotic resistance. They have been reported resistant to beta lactams, fluroquinolones, aminoglycosides and sulfamethoxazole.[8] *M. odoratum* produce a chromosomally mediated non-inducible metallo-beta-lactamase which is capable of hydrolysing cephamycins, penicillins, cephalosporins, aztreonam, imipenem, and meropenem.[28] There are various susceptibility patterns seen in different studies due to the lack of standards provided by CLSI. There are many studies which performed antimicrobial susceptibility testing by disk diffusion also, though which is

not recommended.[28-29] In our study we used criteria suggested by CLSI for non-enterobacteriaceae non-fastidious, glucose-nonfermenting, gram-negative bacilli.[16]

In our study also isolates showed very high degree of resistance. The most effective agent was minocycline. It was only antibiotic which demonstrated 100% sensitivity. Isolates were resistant to all other tested antibiotics. Licker *et al* also reported 100% sensitivity against minocycline while resistance to all other antibiotics.[30]

None of our isolates were susceptible to anti-pseudomonal cephalosporins ceftazidime and cefepime. This finding is in accordance with previous reports.[31-32] Only one isolate demonstrated intermediate result which is similar to reported by other authors.[27,33] Though it has been suggested that meropenem can be a better treatment option in comparison of imipenem[31-32], we found all isolates resistant to both these antibiotics. In quinolones moxifloxacin has been suggested as better alternative than other quinolones.[31,34] As Vitek® 2 compact does not test for moxifloxacin we could not verify it. However all the isolates were resistant to ciprofloxacin and levofloxacin. Chen *et al*. reported 100% sensitivity against co-trimoxazole but in our study we found it completely resistant.[27]

CONCLUSION

Although *Myroides spp.* are uncommon pathogens, clinicians should be aware of its ability to cause UTI especially in the immunocompromised population. Empirical therapy is usually ineffective due to the multidrug resistance found in *Myroides spp.* Minocycline can be a useful antibiotic in successful treatment of such patients. We also insist that further studies are required to understand this emerging pathogen.

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