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Case Series

Microbiology Section

Emerging Role of *Myroides odoratimimus* in Catheter-associated Urinary Tract Infection: A Case Series of Nine Patients from a Tertiary Care Centre

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ABSTRACT

Catheter-Associated Urinary Tract Infections (CAUTI) is one of the most common healthcare-associated infections and contribute to increased morbidity and prolonged hospital stay. Although Enterobacterales predominate, *Myroides* species are emerging opportunistic pathogens causing CAUTI with intrinsic multidrug resistance, posing diagnostic and therapeutic challenges. These bacteria are not commonly found in the normal human flora, but are known to cause infections, when introduced via contaminated water or medical equipment in hospital settings. In the current case series nine cases of CAUTI caused by *Myroides odoratimimus* were identified in a tertiary care centre. The patients were in the age group between 36 and 77 years and had indwelling urinary catheters for more than 10 days duration and Diabetes Mellitus (DM) as a major risk factor. All patients had a diagnosis of CAUTI based on catheter, symptom and culture criteria. Symptoms like fever more than 38°C could be non specific for urinary tract infection, and due to this, it is difficult to differentiate between true infection and colonisation. Identification was performed using Matrix-Assisted Laser Desorption Ionisation-Time Of Flight Mass Spectrometry (MALDI-TOFMS) and conventional methods. Antimicrobial susceptibility was performed using (VITEK® 2 Compact™, BioMérieux, France). The interpretation for antibiotic susceptibility was based on Minimum Inhibitory Concentration (MIC) breakpoints recommended for other non enterobacterales according to Clinical and Laboratory Standards Institute (CLSI) M100 -35th edition. All the isolates were found to be resistant to multiple antibiotic classes, with consistent susceptibility to minocycline. Targeted therapy resulted in clinical recovery and wellbeing in seven patients, while one patient was discharged against medical advice and lost to follow-up, and one patient succumbed to severe underlying illness.

Keywords: Diabetes mellitus, Drug resistance, Minocycline, Urinary catheterisation

INTRODUCTION

CAUTI account for a substantial proportion of hospital-acquired infections and are associated with increased morbidity, prolonged hospitalisation, and healthcare costs [1]. The incidence of CAUTI, according to the International Nosocomial Infection Control Consortium (INICC) report based on data obtained from 45 countries spanning Africa, Asia, Eastern Europe, Latin America, and the Middle East, is 2.91 per 1000 urinary catheter days [2]. Indwelling urinary catheters facilitate microbial colonisation by disrupting host defense mechanisms and enabling biofilm formation [3]. While members of the order Enterobacterales remain the most frequently isolated pathogens, infections caused by uncommon Non Fermenting Gram-Negative Bacilli (NF-GNB) are increasingly being recognised, particularly in Intensive Care Unit (ICU) settings [4]. Although the exact incidence of NF-GNB causing urinary tract infection is not known, a study that was conducted in a tertiary care hospital in Hungary over a ten-year period showed a rate of 3.46% for outpatients and 6.43% for inpatients among positive urine samples [5]. *Myroides* species are aerobic, non motile, NF-GNB that are commonly found in soil and water. Formerly classified under the genus *Flavobacterium*, these organisms have emerged as opportunistic human pathogens over the past two decades [6]. Current taxonomic databases list at least 13 species within the genus, which includes *Myroides odoratus* and *Myroides odoratimimus,* which remain the most frequently reported species causing human infection. *Myroides* species can cause pneumonia, skin and soft-tissue, bloodstream and urinary tract infections, most often affecting patients with DM, prolonged hospitalisation or exposure to invasive devices [7]. A major clinical concern associated with *Myroides* species is their intrinsic resistance to multiple antimicrobial agents, attributed to chromosomally encoded metallo-β-lactamases and biofilm-associated resistance mechanisms. As a result, therapeutic options are limited and delayed or inappropriate therapy may adversely affect patient outcomes [8]. This case series describes the clinical features, microbiological profile, antimicrobial susceptibility patterns and outcomes of nine patients with CAUTIs caused by *Myroides odoratimimus.*

CASE SERIES

Case 1

A 58-year-old patient was brought to the Male Medical Ward (MMW) with complaints of reduced urine output. He was a known case of Coronary Artery Disease (CAD) and long-standing DM for over 12 years, with no significant family history. During the course of the stay, he was catheterised for monitoring of urine output. Glycaemic parameters showed elevated fasting blood sugar (FBS - 165 mg/dL), post-prandial blood sugar (PPBS - 212 mg/dL) and HbA1c (6.9%). On day 15, he developed fever spikes (101.2°F) and dysuria. Systemic examination revealed suprapubic tenderness, and vitals were stable. The renal function test done was normal with blood urea nitrogen (BUN- 8 mg/dL) and serum creatinine of 1.0 mg/dL. A provisional diagnosis of acute bacterial cystitis was made. Gram stain of the urine showed occasional pus cells and moderate GNB. Urine culture grew *Myroides* species. A final diagnosis of *Myroides*-associated CAUTI was confirmed with culture. The patient was empirically started on cefoperazone/sulbactam 2 g intravenously (i.v.) 12 hourly, and after susceptibility

report, Inj. minocycline 200 mg i.v. 12 hourly was added for 10 days. Foley's catheter was removed on day 17. Repeat cultures were sent, which showed no growth, and he was discharged two days later, as he had no further symptoms.

Case 2

A 71-year-old female with a known history of insulin-dependent type II DM for 30 years was admitted to the ICU, post-laparotomy for a superficial Surgical Site Infection (SSI). She had required perioperative catheterisation. On day eight post-admission, she developed a rise in temperature (102°F) accompanied by cloudy urine. General examination showed mild pallor and warmth with localised redness at the surgical site. Systemic evaluation was otherwise unremarkable. She had elevated glycaemic parameters (FBS- 148 mg/dL, PPBS- 215 mg/dL, HbA1c- 6.5%). A provisional diagnosis of SSI with suspected urosepsis was made. Urinalysis revealed 40.80 pus cells/high power field (hpf). Gram stain of urine showed a few pus cells, a few GNB and occasional budding yeast cells. Urine culture showed growth of *Myroides* species. Management included Inj. meropenem 1g i.v. eight hourly for five days and Inj. minocycline 200 mg i.v. 12 hourly for 10 days. The catheter was removed on day 10, and the patient was discharged on day 18 following the resolution of both infections. Repeat urine culture was not done.

Case 3

A 36-year-old female came with complaints of shortness of breath associated with bilateral lower limb swelling. She was transferred to the ICU in view of grade IV dyspnoea after one day of admission and was intubated and catheterised. She had no significant past medical or family history. On day five, she developed rapid onset of high-grade fever. On examination, the patient was febrile with a temperature of 101.4°F. Echocardiography (ECHO) showed a grossly dilated heart with severe left ventricular dysfunction and moderate pulmonary artery hypertension. Systemic examination revealed bilateral crepitations. Lab investigations showed a normal haemoglobin level (Hb 12.3 g/dL), elevated leucocyte counts (TC- 15,610/mm^3), and normal renal and liver function tests. Blood culture showed growth of *Staphylococcus haemolyticus,* and the patient was started on Inj. vancomycin 1g i.v. 12 hourly for seven days. A provisional diagnosis of sepsis with heart failure was made. Gram stain of urine showed moderate pus cells and plenty of GNB. The final diagnosis was sepsis with septic shock, Multiorgan Dysfunction Syndrome (MODS) and Dilated Cardiomyopathy (DCM) associated with *Myroides*-associated CAUTI. She was treated with Inj. meropenem 1g i.v. 12 hourly for seven days, Inj. minocycline 200 mg i.v. 12 hourly for 10 days and Inj. vancomycin 1g i.v. 12 hourly was continued. Catheter was removed on day 17 and repeat urine culture showed growth of *Klebsiella pneumoniae,* following which Inj. meropenem 1g i.v. 12 hourly was continued for another seven days. The patient and her attenders wanted to continue further management in another hospital due to financial constraints, and she was discharged against medical advice. She required ongoing tertiary-level management for severe underlying cardiomyopathy and recent sepsis-related complications.

Case 4

A 65-year-old female with DM for 15 years and background history of recurrent Cerebrovascular Accident (CVA) was admitted to the ICU following sudden onset weakness of left upper limb and lower limb from five days. A Foley's catheter was inserted for neurogenic bladder management. A provisional diagnosis of acute ischemic stroke was made. On day 4 of admission, she had increased fever spikes of 102°F. Examination revealed febrile illness with stable vitals. Systemic examination was unremarkable. She had elevated glycaemic parameters (FBS-171 mg/dL, PPBS-221 mg/dL). Urinalysis was positive for nitrites. Gram stain of urine showed few pus cells, few Gram-Positive Bacilli (GPB), and moderate GNB and urine culture grew *Myroides* species. Final diagnosis was acute ischaemic stroke and *Myroides*-associated CAUTI. The catheter was removed on day 5 and the patient was treated with Inj. minocycline 200 mg i.v. 12 hourly for 10 days and Tab. nitrofurantoin 100 mg PO BD for seven days. The patient improved symptomatically and was discharged.

Case 5

A 77-year-old male with a history of long-standing DM for 30 years was admitted to the ICU with complaints of right diabetic foot ulcer for the past one month, along with right lower limb cellulitis. The patient had history of trauma to the right lower limb two months before hospital admission. General and systemic examination revealed tachycardia (120 beats/min), hypotension (100/50 mmHg). Local examination showed warmth and tenderness over the right lower limb with a visible ulcer on the plantar aspect of great toe and a fasciotomy ulcer over the plantar aspect. He had elevated glycaemic parameters (FBS- 212 mg/dL, PPBS- 326 mg/dL, HbA1c- 10.2%). Provisional diagnosis of diabetic foot ulcer with right lower limb necrotising fasciitis was made. He underwent wound debridement on day 3 of admission, followed by right below-knee amputation on day 6 of admission. The patient was catheterised before surgery and was shifted to ICU postoperatively for monitoring. On day 10, the patient had complaints of foul-smelling urine with temperature spikes (102.5°F) and tachycardia (108 beats/min). Urinalysis showed 18.75 pus cells/hpf. Total leucocyte count was elevated persistently (14,000 cells/mm^3) with mildly elevated liver function tests and normal renal function tests. SGOT- 74 U/L, SGPT- 44 U/L, Alkaline phosphatase- 142 I U/L, Potassium- 2.7 m Eq/L, BUN- 18 mg/dL, Sr. creatinine- 1.3 mg/dL. Diagnosis of septicaemia was made. Tissue culture from the right diabetic wound grew *Acinetobacter baumannii,* and patient was started on Inj. colistin two million international units i.v. once daily for one week. Gram stain of the urine showed few pus cells but no organisms. *Myroides* species was subsequently isolated on urine culture. Inj. minocycline 200 mg i.v. 12 hourly for 10 days was added to the treatment regimen. Despite the severity of the sepsis, the patient recovered. He was discharged with advice to follow-up after two weeks. Patient was lost to follow-up.

Case 6

A 53-year-old male with a history of uncontrolled DM for 10 years (FBS- 198 mg/dL, PPBS- 271 mg/dL, HbA1c- 9.2%) was admitted to the ICU with metabolic acidosis (Arterial Blood Gas analysis showed pH 7.1, bicarbonate 13 mmol/L, pCO2 36 mmHg) and was catheterised. Examination showed kussmaul breathing and dehydration. A provisional diagnosis of diabetic ketoacidosis was made based on Arterial Blood Gas (ABG) analysis, urinary ketone, random blood sugar levels of 332 mg/dL and he was started on fluid replacement therapy. A febrile episode occurred on day 6 of his stay. The fever spikes persisted (101.7°F) and he did not respond to initial empirical antipyretics. Systemic examination showed no localised signs of infection. Gram stain showed occasional pus cells, occasional epithelial cells and no organisms. Urine culture confirmed *Myroides*-associated CAUTI. The patient was managed with Inj. minocycline 200 mg i.v. 12 hourly for 10 days. The catheter was removed on day 15, following the resolution of metabolic acidosis. The patient showed a good clinical response and was discharged.

Case 7

A 64-year-old male with no significant past medical or family history was brought to the emergency department with an alleged history of Road Traffic Accident (RTA). A history of loss of consciousness was present, associated with two episodes of vomiting in the hospital. Patient was catheterised and intubated in view of low GCS

(Glasgow coma scale)- E1 VT M3 and was shifted to ICU for further management. Computed Tomography (CT) brain showed multiple haemorrhagic contusions in bilateral basi-temporal region. A provisional diagnosis of severe traumatic brain injury with intraventricular haemorrhage was made. The patient underwent emergency bilateral fronto-temporoparietal decompressive craniectomy surgery. He developed a sudden onset of fever (100.8°F) on day 3 postsurgery. Gram stain of urine revealed moderate pus cells and moderate GNB. Urine culture grew *Myroides* spp. He was treated with Inj. minocycline 200 mg i.v. 12 hourly for seven days as monotherapy. Catheter was removed on day 10, and repeat urine cultures were sent which again grew *Myroides* spp and patient was continued on Inj. minocycline for another week. Patient was also simultaneously treated with Inj. meropenem 1g i.v. 12 hourly for one week for a positive tracheal culture due to prolonged endotracheal intubation and mechanical ventilatory support following severe traumatic brain injury and postoperative neurosurgical care. Endotracheal secretion grew *Pseudomonas aeruginosa* susceptible to only carbapenems and polymyxins. Patient recovered and shifted to the step-down ICU. After he was neurologically and haemodynamically stable, he was discharged and referred to rehabilitation centre for further management. Follow-up was done after two weeks of discharge. Repeat cultures showed no growth.

Case 8

A 62-year-old male was brought to the emergency department with accidental ingestion of unknown substance presenting with abdominal pain, breathing difficulty and reduced oxygen saturation. The patient was a known case of DM and systemic hypertension on regular medications. Random blood sugar was found to be elevated (152 mg/dL). He was shifted to the ICU and an indwelling Foley catheter was placed upon admission. By the third day of catheterisation, the patient's clinical status deteriorated sharply. He exhibited signs of profound sepsis, including altered sensorium and reduced urine output. He was intubated and put on mechanical ventilator. His GCS was 2T/15 and required high levels of oxygen. General examination showed signs of septic shock (tachycardia- 115 beats/min and hypotension- 90/60 mmHg). Systemic examination revealed signs of multiorgan dysfunction. A provisional diagnosis of toxic substance ingestion associated with bacteraemia was made. Blood culture grew drug-resistant *Klebsiella pneumoniae* susceptible only to carbapenems and polymyxins. Patient was started on Inj. meropenem 1g i.v. eight hourly. Urine culture grew *Myroides* species. Despite the initiation of Inj. meropenem, the patient's condition did not stabilise. The final diagnosis was progressive sepsis with *Myroides*-associated CAUTI. The patient succumbed to the illness on the fifth day of treatment due to sepsis with septic shock.

Case 9

A 52-year-old diabetic patient (HbA1c 6.0%) was admitted to the ICU with fever, and shortness of breath. He had an alleged history of fall followed by loss of consciousness and was shifted to the ICU for further management. Patient had past history of CVA. In view of urinary retention, he was catheterised. On day 4, he had decreased responsiveness and was noted to have hypoglycaemia and was treated with 25% dextrose and i.v. 5% dextrose normal saline. He was intubated in view of low GCS (8T/15) and connected to a mechanical ventilator. ABG analysis done, showed type I respiratory failure and a provisional diagnosis of aspiration pneumonia was made. Patient was started on Inj. meropenem 1g i.v. eight hourly for one week. Urinalysis was done which showed pus cells 43.31 cells/hpf. Blood and urine cultures were sent. Gram stain of urine showed occasional pus cells and few GNB. Urine culture grew *Myroides* spp and *Pseudomonas aeruginosa* and patient was started on Inj. minocycline 200 mg i.v. 12 hourly for 10 days along with Inj. meropenem. Patient gradually improved and routine chest physiotherapy was given. He was shifted to ward and monitored. Patient was discharged after 28 days of hospitalisation, since all the parameters were within normal limits. Detailed clinical characteristics, duration of catheterisation, culture report, antimicrobial therapy and outcomes of all the nine cases are summarised in [Table/Fig-1].

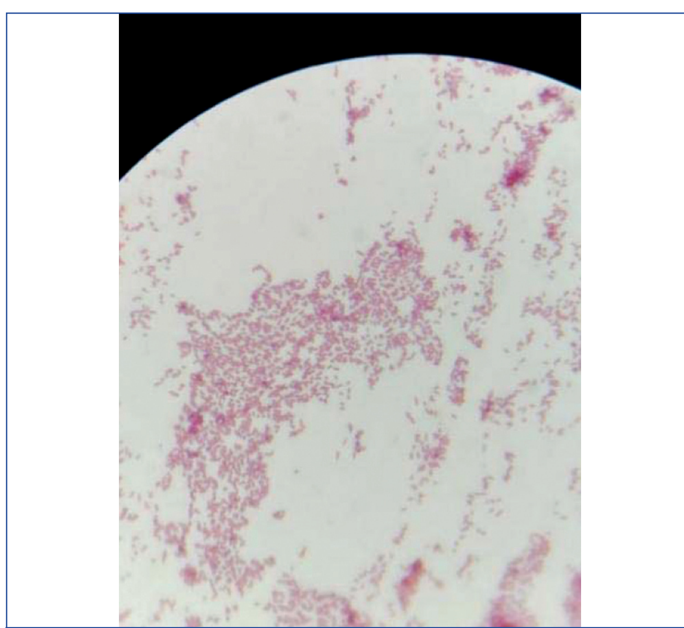
Microbiological findings: Urine samples were collected aseptically from indwelling catheters and processed as per standard microbiological criteria according to Centers for Disease Control and Prevention/ National Healthcare Safety Network (CDC/NHSN) guidelines [9]. Clinical specimens were cultured onto Cystine Lactose Electrolyte Deficient (CLED) agar with a standardised calibrated loop and incubated aerobically at 37°C for 24-48 hours. Cultures yielded ≥10^5 Colony-Forming Units (CFU/mL) of non lactose-fermenting smooth colonies with pale-yellow pigmentation, as depicted in [Table/Fig-2].

Age (years)/ Sex	Ward	Clinical presentation	Co-morbidities	Duration of hospital stay	Type of cath-eter	Gram stain	Urine routine	Urine culture report	Antibiotics given	Duration	Outcome
58/M	MMW	Acute bacterial cystitis	DM, CAD	20	Foley's catheter	Occasional pus cells, moderate GNB	Pus: 3-4 cells/hpf Epithelial: 4-5 cells/hpf Bacteria: 2+	>10^5 cfu/mL *Myroides odoratimimus*	Cefoperazone-sulbactam (2 g i.v. 12 hourly) + Minocycline (200 mg i.v. 12 hourly)	7 days+10 days	Recovered
71/F	ICU	Post laparotomy Surgical Site Infection (SSI)	DM	18	Foley's catheter	Few pus cells, few GNB, occasional budding yeast cells	Pus: 40.80 cells/hpf Epithelial:1 cells/hpf Bacteria: 2+ Yeast: positive	>10^5 cfu/mL *Myroides odoratimimus*	Meropenem (1g i.v. 8 hourly) + Minocycline (200 mg i.v. 12 hourly)	5 days+10 days	Recovered
36/F	ICU	Sepsis with MODS DCM	None	32	Foley's catheter	Moderate pus cells, plenty of GNB.	Pus: >204.55 cells/hpf Epithelial: Nil Bacteria: 1+	>10^5 cfu/mL *Myroides odoratimimus* 10^5 cfu/mL *Klebsiella pneumoniae*	Minocycline (200 mg i.v. 12 hourly) + Meropenem 1 g i.v. 12 hourly	10 days + 14 days	Discharged against medical advice.
65/F	ICU	Acute ischaemic stroke	DM, recurrent CVA	20	Foley's catheter	Few pus cells, few GPB, moderate GNB	Pus: 2.55 cells/hpf Epithelial: 3 cells/hpf Bacteria: 2+ nitrites: positive	>10^5 cfu/mL *Myroides odoratimimus*	Minocycline (200 mg i.v. 12 hourly) + Nitrofurantoin (100 mg PO 12 hourly)	10 days+7 days	Recovered
77/M	ICU	Sepsis, status post right BKA	DM	25	Foley's catheter	Few pus cells, no organisms	Pus: 18.75 cells/hpf Epithelial: 3 cells/hpf Bacteria: 2+	>10^5 cfu/mL *Myroides odoratimimus*	Minocycline (200 mg i.v. 12 hourly)	10 days	Recovered

53/M	ICU	Metabolic acidosis (DKA)	DM	23	Foley's catheter	Occasional pus cells, occasional epithelial cells, no organism	Pus: 3-4 cells/hpf Epithelial: 6-8 cells/hpf Bacteria: Negative	>10^5 cfu/mL *Myroides odoratimimus*	Minocycline (200 mg i.v. 12 hourly)	10 days+7 days	Recovered
64/M	ICU	Traumatic brain injury	None	23	Foley's catheter	Moderate pus cells, moderate GNB	Pus: 15.98 cells/hpf Epithelial: Nil Bacteria: 1+	>10^5 cfu/mL *Myroides odoratimimus*	Minocycline (200 mg i.v. 12 hourly)	14 days	Recovered
62/M	ICU	Accidental ingestion of unknown substance	DM	6	Foley's catheter	No cells, no organisms	Pus: 1.65 cells/hpf Epithelial: Nil Bacteria: Negative	>10^5 cfu/mL *Myroides odoratimimus*	Meropenem (1 g i.v. 8 hourly)	5 days	Died Cause of death: sepsis with septic shock
52/M	ICU	Urosepsis with septic shock, aspiration pneumonia	DM	16	Foley's catheter	Occasional pus cells, few GNB	Pus: 43.31 cells/hpf Epithelial: 2-3 cells/hpf Bacteria: Negative	>10^5 cfu/mL *Myroides odoratimimus* >10^5 cfu/mL *Pseudomonas aeruginosa*	Minocycline (200 mg i.v. 12 hourly) + Meropenem (1 g i.v. 8 hourly)	10 days + 7 days	Recovered

[Table/Fig-1]: Demographic and clinical profile of nine patients with Myroides-associated CAUTI.
GPB: Gram positive bacilli, GNB: Gram negative bacilli, ICU: Intensive care unit, i.v.: intravenous, MMW: Male medical ward, DM: Diabetes mellitus, CAD: Coronary artery disease, MODS: Multi-organ dysfunction syndrome, BKA: Below knee amputation, DKA: Diabetic ketoacidosis, DCM: Dilated cardiomyopathy, CVA: Cerebrovascular accident

[Table/Fig-2]: CLED agar plate showing non lactose fermenting colonies of *Myroides* spp.



[Table/Fig-3]: Culture smear showing Gram-Negative Bacilli (GNB) (100x).

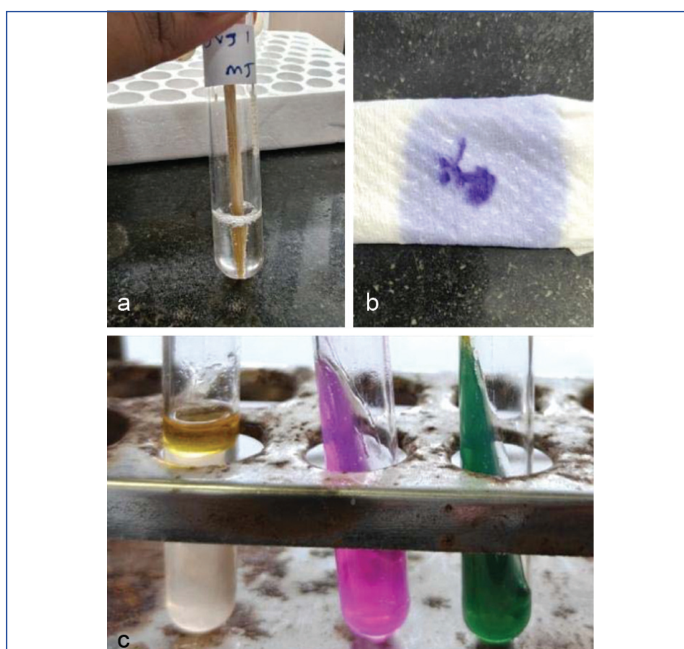
Gram staining demonstrated GNB, as given in [Table/Fig-3].

Species-level identification for all the isolates was performed using MALDI-TOF MS (bioMérieux, France) with 99.9% probability. Antimicrobial susceptibility testing was performed using the gram-negative (GN-406) card for non lactose fermenters, with VITEK® 2 Compact™ (BioMérieux, France) and the results were interpreted in accordance with CLSI M100-Ed35. The isolates were also identified using conventional techniques. They were catalase and oxidase positive, non motile indole negative, urea was hydrolysed and was negative for citrate utilisation as shown in [Table/Fig-4].

Subculture on nutrient agar shows insoluble yellow pigmented colonies as shown in [Table/Fig-5] and non lactose fermenting colonies on MacConkey agar as shown in [Table/Fig-6].

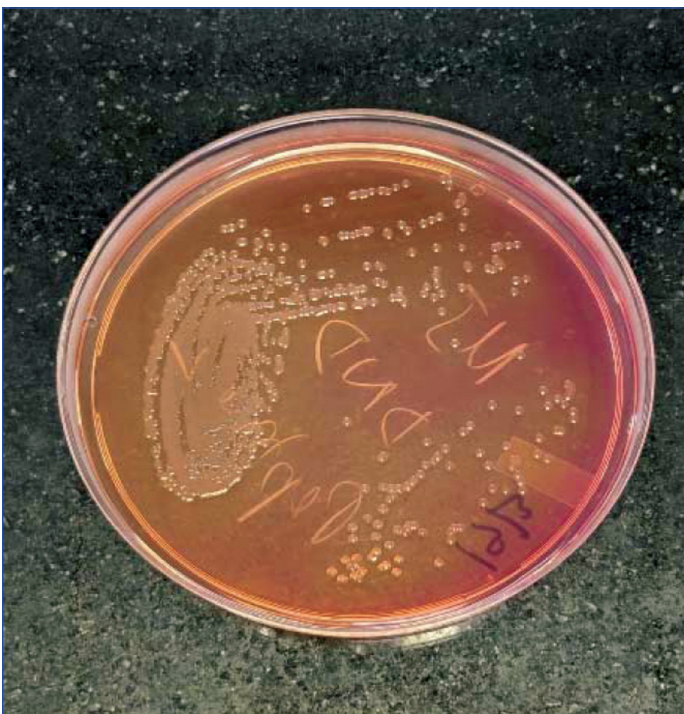
The organism was also cultured on to Deoxyribonuclease (DNase) agar where it produced characteristic pale-yellow colour colonies as shown in [Table/Fig-7] and diagnostic flowchart for the identification of *Myroides* by conventional methods is shown in [Table/Fig-8].

Treatment and outcome: Empirical antimicrobial therapy was initiated with clinical suspicion of CAUTI, and was later modified based on susceptibility results. The diagnosis of CAUTI was made as per the Infectious Disease Society of America (IDSA) guidelines

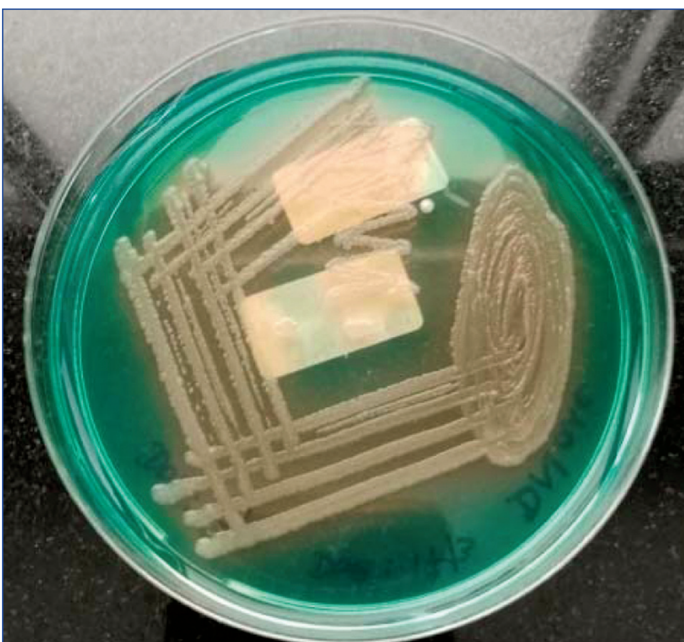


[Table/Fig-4]: Biochemical test results of the isolate; a) Positive for catalase by tube catalase method; b) Positive for oxidase by wet filter paper method; c) Biochemicals showing Indole negative, urea hydrolysed, citrate not utilised.

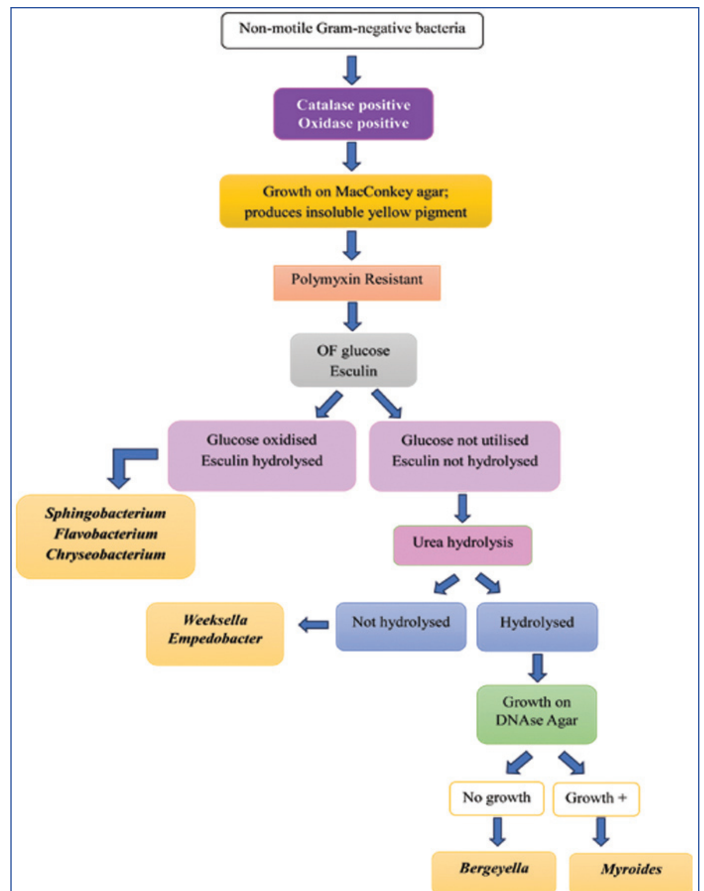
[Table/Fig-5]: Nutrient agar plate showing pale yellow colonies.



[Table/Fig-6]: Mac-Conkey agar plate showing non lactose fermenting colonies.



[Table/Fig-7]: DNase agar plate showing characteristic yellow colour colonies.



[Table/Fig-8]: Diagnostic flowchart for the identification of *Myroides* by conventional methods.

[9,10]. Minocycline was administered either as monotherapy or in combination with other antibiotics in most cases. Of the nine patients, seven patients demonstrated clinical and microbiological resolution following targeted treatment. One patient was discharged against medical advice and lost to follow-up (case 3). Another patient had rapid clinical deterioration and succumbed due to severe underlying illness (case 8). This patient was not treated with minocycline.

The isolates exhibited resistance to several antimicrobial classes, which includes beta-lactams (piperacillin-tazobactam, ceftazidime, cefepime), monobactams (aztreonam), fluoroquinolones (ciprofloxacin, levofloxacin), trimethoprim sulfamethoxazole (co-trimoxazole), aminoglycosides (amikacin, gentamicin), carbapenems (imipenem, meropenem) and polymyxin (colistin). Minocycline showed consistent in-vitro activity across most isolates and was used as the primary targeted therapy. The MIC breakpoints for the drugs that were identified (VITEK® 2 Compact™, BioMérieux, France) for each isolate are mentioned in [Table/Fig-9].

DISCUSSION

This case series highlights the importance of recognising *Myroides* species as the causative organisms of CAUTI. All patients had an indwelling urinary catheter, which could have been the most likely source of infection, but it could not be determined whether the patient had a true infection or colonisation of catheter by the strains. Prolonged catheterisation, ICU stay, and DM were consistently observed, which aligns with reports that were published earlier. These are known to weaken host immunity and promote colonisation by opportunistic NF-GNB [11]. Diagnosing *Myroides* infections is a challenge due to its rare occurrence and phenotypic resemblance to other non fermenters [12]. Automated systems like VITEK 2 compact and MALDI-TOF MS can give consistent species-level identification. Conventional microbiological methods continue to play a major role, particularly in resource-limited settings. Identification of the genus can be found with proper recognition of colony morphology, pigment

Antimicrobial agents	Case 1 MIC	Case 2 MIC	Case 3 MIC	Case 4 MIC	Case 5 MIC	Case 6 MIC	Case 7 MIC	Case 8 MIC	Case 9 MIC	Interpretation	Results (n=9)
Piperacillin-tazobactam	≥128	≥128	≥128	≥128	≥128	≥128	≥128	≥128	≥128	R	100%
Ceftazidime	≥64	≥64	≥64	≥64	≥64	≥64	≥64	≥64	≥64	R	100%
Cefepime	≥32	≥32	≥32	≥32	≥32	≥32	≥32	≥32	≥32	R	100%
Aztreonam	≥64	≥64	≥64	≥64	≥64	≥64	≥64	≥64	≥64	R	100%
Imipenem	≥16	≥16	≥16	≥16	≥16	≥16	≥16	≥16	≥16	R	100%
Meropenem	≥16	≥16	≥16	≥16	≥16	≥16	≥16	≥16	≥16	R	100%
Amikacin	≥64	≥64	≥64	≥64	≥64	≥64	≥64	≥64	≥64	R	100%
Gentamicin	≥16	≥16	≥16	≥16	≥16	≥16	≥16	≥16	≥16	R	100%
Ciprofloxacin	≥4	≥4	≥4	≥4	≥4	≥4	≥4	≥4	≥4	R	100%
Levofloxacin	≥8	≥8	≥8	≥8	≥8	≥8	≥8	≥8	≥8	R	100%
Minocycline	≤0.5	≤0.5	≤0.5	≤0.5	≤0.5	≤0.5	≤0.5	≤0.5	≤0.5	S	100%
Colistin	≥16	≥16	≥16	≥16	≥16	≥16	≥16	≥16	≥16	R	100%
Cotrimoxazole	≥320	≥320	≥320	≥320	≥320	≥320	≥320	≥320	≥320	R	100%

[Table/Fig-9]: MIC breakpoints and interpretation of susceptibility for the *Myroides* isolates.
R: Resistant, S: Susceptible, MIC: Minimum inhibitory concentration

References	CAUTI by *Myroides* species	Risk factors	AST	Treatment	Recovery
Sahu C et al., [13]	Case series (n=14)	Diabetes (28%), Chronic Kidney Disease (CKD) (14%)	100% susceptibility to minocycline and doxycycline (14/14) Colistin susceptibility observed in 3/14 (21.4%) isolates	Minocycline-based therapy (with/ without combination antibiotics) - 11/14 patients Colistin-based therapy- 3/14 patients	Clinical recovery in all patients (100%).
Khan U et al., [12]	Case series (n=5)	Diabetes (100%), prolonged hospitalisation (80%)	100% susceptibility to minocycline only (5/5)	Treated only with minocycline- 5/5	Clinical recovery in three patients (60%) Two patients succumbed due to underlying illness (40%).
Chauhan K et al., [11]	Case series (n=4)	Diabetes (100%)	100% susceptibility to minocycline only (4/4)	Minocycline-based monotherapy - 1/4 Minocycline-based therapy (with combination of antibiotics) - 3/4	Clinical recovery in all patients (100%).
Rusu D [14]	Case report (n=1)	Diabetes (100%)	100% susceptibility to minocycline only	Treated only with minocycline	Patient succumbed due to underlying illness.
Agrawal M et al., [15]	Case series (n=16)	Diabetes (69%), Foley's catheter (100%), ICU stay (100%)	100% susceptibility to minocycline only	Details not available	Details not available.
Jebamani MB et al.,	Case series (n=9)	Diabetes (78%), ICU stay (89%)	100% susceptibility to minocycline only	Treated with minocycline as monotherapy - 3/9 Minocycline-based therapy (with combination of antibiotics) - 5/9 Treated with antibiotics other than minocycline - 1/9	Clinical recovery seen in eight patients (78%) One patient succumbed due to underlying illness (11%).

[Table/Fig-10]: Summary of previously published case reports and case series along with the current study [11-15].
CKD: Chronic kidney disease; ICU: Intensive care unit

and odour production and biochemical profiling. The diagnostic workflow that can be used for identification in resource-limited settings is given in [Table/Fig-8]. The antimicrobial susceptibility patterns found in this study show the multidrug-resistant nature of the organism, where resistance to beta-lactams, aminoglycosides, and fluoroquinolones was observed. In most patients, minocycline showed consistent in-vitro activity with positive outcomes (cases 1-7,9), thereby supporting earlier remarks that tetracyclines can serve as an effective option with the confirmation of the susceptibility [12,13]. Second-generation semisynthetic tetracyclines like minocycline have a broad antimicrobial spectrum and are bacteriostatic by inhibiting protein synthesis. The usage of this antibiotic, against the same organism for UTI has been reported previously in few studies with successful outcomes [Table/Fig-10] [11-15]. The single mortality that occurred could be due to severe underlying illness and cannot be directly linked to absence of minocycline in the targeted therapy.

CONCLUSION(S)

Myroides species should be recognised as emerging uropathogens in catheterised patients, particularly those with DM and prolonged hospitalisation. Use of automated colony identification techniques based on mass spectrometry, colourimetric, and phenotype matching principles makes it easier to detect these organisms among non fermenting GNB. Their intrinsic multidrug resistance necessitates accurate microbiological identification and judicious antimicrobial selection. As there are no MIC breakpoints specific for *Myroides* species, the susceptibility pattern for the isolates can be determined using MIC breakpoints for other non enterobacterales, as per current CLSI M100 guidelines. Early recognition and targeted therapy are essential to improve patient outcomes. Even though minocycline is not an ideal antibiotic of choice for urinary tract infections, all the patients treated with minocycline for 7-10 days showed full recovery from the infection.

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