ORIGINAL ARTICLE

Achromobacter Xylosoxidans an Emerging Opportunistic Nosocomial Pathogen: A Retrospective Study in a Tertiary Care Hospital

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Abstract

Background: *Achromobacter* is a rare Gram negative bacilli which is found in soil and water but is emerging as cause of nosocomial infections. Patients with devices like central venous catheter, ventilator,and implants are at higher risk of developing these infections as compared to the normal population. Its ability to produce biofilm can result in development of resistance to many commonly used antibiotics making these infections difficult to treat. **Aims:** To study the demographic profile, comorbidities associated and the antibiotic susceptibility pattern of *Achromobacter xylosoxidans* infection in our center. **Study Design:** This cross-sectional retrospective study was done in the department of microbiology. All the clinical samples received in the microbiology laboratory from September 2018 to August 2022 from which *Achromobacter xylosoxidans*wasisolated, were included. **Material and Methods:** Lab records and Vitek 2 compact database(bioMérieux, Marcy l'Étoile, France) were verified to obtain the antibiotic susceptibility pattern of each isolate.Case records were studied to examine the demographic profile of the patients. **Results:** 25 samples grew *Achromobacter species.* 48% of isolates were obtained from blood sample. 50% of the patients had one or more comorbid conditions. 80% of the patients had device in situ. **Conclusion:** Though uncommon organisms like *Achromobacter species*are getting reported as a pathogen in many nosocomial infections, many physicians are still not aware this. Only timely diagnosis and the most appropriate treatment will reduce the morbidity and mortality caused by this organism.

Key Words

Biofilm, Device, Nosocomial infections.

Introduction

Achromobacter species are aerobic, Gram-negative rods which are non-fermenters. Two important pathogenic species include *Achromobacter xylosoxidans* and *Achromobacter denitrificans*.[1] *Achromobacter species*are not commonly seen as a part of the normal human flora,but it is capable of surviving in aquatic environment.They can live in sterile saline,water in the humidifiers, dialysis fluid, intravenous fluids as well as well water. They have been found to outlive various disinfectants like alcohol, chlorhexidine.[2,3] As a result of this unique character of these species, they are capable of surviving well in the ICU setting and causing outbreaks

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of nosocomial infections especially when there is a collapse of the infection control practices.[4] They are also regarded as opportunistic pathogens capable of causing serious infections in patients with risk factors like neonates,malignancy, neutropenia,HIV infection,long hospital stay and presence of intravenous catheter.[3,4] Common infections caused by *Achromobacter species* include pneumonia, meningitis, bacteremia, osteomyelitis, urinary tract infections, abscesses, peritonitis, ophthalmic infections and prosthetic valve endocarditis. Bacteremia is the most common infection among these with high mortality rate.[2] Case fatality risk of *Achromobacter xylosoxidans* infections varied from 3% in case of bacteremia to 80% in case of neonatal sepsis.[5] Added to this, *Achromobacter species* are commonly found to be resistant to frequently used antibiotics like first and second generation cephalosporins, aminoglycosides, quinolones and rifampicin.[2,5,6] They are susceptible to ceftazidime, Carbapenems and piperacillin-tazobactam. Though Achromobacter species are gaining importance day by day as a nosocomial pathogen, many of the treating physicians remain poorly informed about it and consider them as contaminant.[7] This study aims to study the demographic profile,comorbidities associated and the antibiotic susceptibility pattern of *Achromobacter xylosoxidans* infection in our center.

Subjects and Methods

This cross-sectional retrospective study was done in the department of microbiology after getting clearance from the Institutional ethics committee (IEC/238). The duration of the study was 4 years (September 2018 to august 2022). All the clinical samples received in the microbiology laboratorywhich on culture grew *Achromobacter species* during the study period were included (*Fig I*). Samples of those patients whose history was not available from the case records and a repeat same sample from the same patient were excluded from the study. Lab records and Vitek 2 compact database (bioMérieux, Marcy l'Étoile, France) were verified to obtain the Minimum Inhibitory Concentration (MIC) and theantibiotic susceptibility pattern of each isolate. Case records were studied to examine the demographic profile of the patients like age, sex, comorbidities associated with the present condition of the patient, location of the patient when the sample was collected (Example-Out patient or in patient) and the condition of the patient on discharge.Data was entered in Microsoft Excel and analysed using the same.

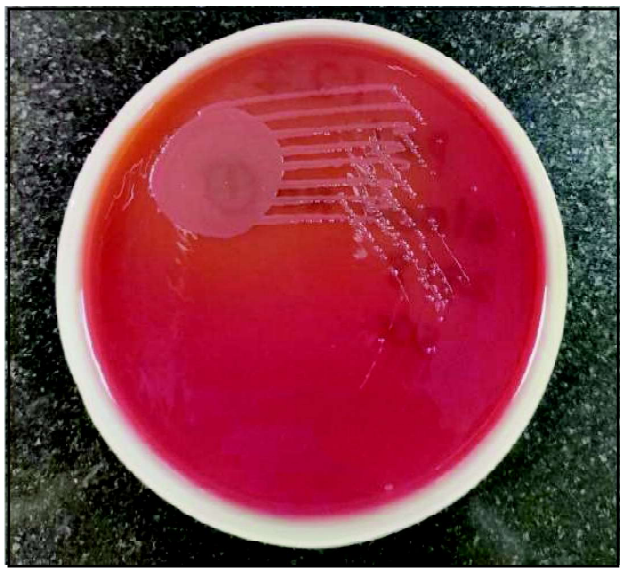

Fig I. Growth on MacConkey agar showing Non lactose fermenting colonies of Achromobacter xylosoxidans.

Results

A total of 25 patients were included in the study.*Achromobacterxylosoxidans was* isolated from birth (new born baby) to 80 years of age in our study. 40% of the patients were in the age group of 30-50 years. 12 patients (48%) were admitted in the ICU,seven in medicine ward, five in surgery ward and one in the oncology ward. Majority of the *Achromobacter species*(12 out of 25) were isolated from blood culture. (*Fig 2)* The other samples from which it was isolated include pus, endotracheal tube aspirate (ETT aspirate) and sterile body fluids like CSF, ascitic fluid, pleural fluid, and peritoneal fluid. 56% of the samples were received in the laboratory after 48 hours of admission of the patient in the hospital.

*Achromobacter xylosoxidansspp**xylosoxidans* was isolated from 60% of the samples and *Achromobacter xylosoxidansspp denitrificans* was isolated from 40%. Comorbidities associated were Diabetes mellitus (6 out of 25), systemic hypertension (7 out of 25), malignancy (4 out of 25).Chronic kidney diseases, Coronary artery disease,anemia were the other comorbidities present.80%

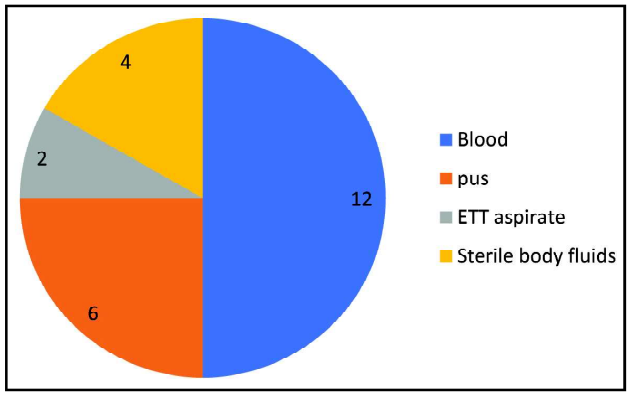

Fig 2. Distribution of samples from which Achromobacter species were isolated.

of the patients were on one or more medical devices like central venous catheter, ventilator, intercostal drainage tube, urinary catheter or endotracheal tube. (*Table I*) Most of the patients recovered after the treatmentperiod (64%) while 16% went on discharge against medical advice and 20% expired.Patients were considered recovered if all symptoms and signs of infection were not present anymore.[11] 96% of the isolates were susceptible to ceftazidime, 84% to both piperacillin-tazobactam and imipenem/meropenem and 92% to colistin. 68% of the isolates were resistant to ciprofloxacin,88% to gentamicin and 84% to amikacin (*Table 2*). 60% of the patients were treated with either meropenem or piperacillin-tazobactam in our hospital. (*Table 3*)

Table I: Patients with medical device in-situ

Device in-situ	Number of patients
Central line	7
Ventillator	5
Endotracheal tube	4
Foley's catheter	2
Intercostal tube	1
Omaya drain	1

Table 2 : Antibiotic susceptibility pattern of Achromobacter species

Antibiotics tested	Sensitive	Intermediate
Ciprofloxacin	3	5
Gentamicin	1	2
Amikacin	1	3
Cotrimoxazole	14	0
Ceftazidime	24	1
Piperacillin-tazobactam	21	2
Imipenem/Meropenem	21	1
Colistin	23	0

Table 3 : Antimicrobial drugs used for treating the patients.

Treatment given	Number of patients
Piperacillin-tazobactam	8
Meropenem	7
Colistin	3
Polymyxin B	2
cefoperazone-sulbactam	2
Ceftriaxone	2

Discussion

With the advent of automated methods, the frequency of identification of uncommon Gram negative bacilli like *Achromobacter species*have increased. These were initially misidentified as other non-fermenters like *Stenotrophomonas maltophilia, Burholderia species or Pseudomonas aeruginosa.*[3] *Achromobacter species*were predominantly isolated in the mean age of 61.5 years in a study done by Marion Sanchez *et al.*[7] No such age related correlation with *Achromobacter* infection was found in the present study. In the study conducted by Isler B

,the co-morbidities associated with *Achromobacter* infections included malignancies (hematologic and solid organ cancers), diabetes mellitus and renal disease.[8] Other risk factors for the development of these infections are long hospital stay, neutropenia, post valve replacement and neonates.[4,5] Many studies have shown the association of *Achromobacter species*with cystic fibrosis.[6] Half of the patients in our study had one of the above comorbidity while remaining half did not have any comorbidity. Therefore both immunocompromised and immunocompetent individuals have the risk of developing *Achromobacter* infections.[7]

Majority of the samples which grew *Achromobacter species* were sent for culture atleast 48 hour after admission of the patient to the hospital. Being a retrospective study, we could not trace back to the source of this organism in the hospital environment for these patients. But as *Achromobacterspecies*survives well in aquatic environment, commonly used solutions in the hospital like saline infusion, alcohol or even contaminated medicines could be the probable source.[4] In a case series published by Duggan *et al*,the source of *Achromobacter species* was found to be contaminated solution, use of well water and contaminated equipment in the hospital.[2] 48% of the patients (12 out of 25) had *Achromobacter* bacteremia. Out of these 12 patients, six were on central line, seven were on ventilator and two were on urinary catheter. Although *Achromobacter species* are low-virulence environmental organisms, they have a tendency to form biofilms and cause serious infections.[8] Increasedbiofilm biomass generation has been found with *Achromobacter xylosoxidans* when compared to other *Achromobacter species*.[9] Therefore patients who have been on intravascular devices could have increased risk of developing *Achromobacter* bacteremia.[10,11] Presence of implants like coronary stent, heart valves,neurosurgical ventricular shunts, central venous catheters,arthro-prostheses, intraocular lens, fracture fixation devices etc can also be associated with biofilm production.[12] Six isolates were obtained from pus. The first sample was taken from an infected abdominal wound,post ventriculoperitoneal shunt (VP); the second from an infected nail,post open reduction internal fixation of fracture ofthe tibia and the third from an infected peritoneal catheter. Three isolates from pus were obtained from patients suffering from chronic suppurative otitis

media (CSOM). Incidentally, *Achromobacter xylosoxidans* was first isolated from patients with CSOM and was named by Yabuuchi and Oyama in 1971.[3]

The predisposition of *Achromobacter species* to form biofilm can result in the transfer of resistant genes among these bacteria resulting in development of antibiotic resistance.[13] *Achromobacter species*are intrinsically resistant to aminoglycosides,aztreonam and cephalosporins(except ceftazidime) as per Isler *et al*.[14] Most active antibiotics against *Achromobacter*infections are ceftazidime, Carbapenems and Cotrimoxazole.[14] In our study among the 12 patients who had *Achromobacter* bacteremia, five patients were treated with piperacillin-tazobactam all of whom had recovered. This indicates that piperacillin-tazobactam is an effective agent in treating bacteremia.Recently many strains are acquiring carbapenem resistance which is due to the presence of efflux pumps and betalactamase enzymes.[14] In our study,72% of the isolates are Multidrug resistant (MDR). MDR isolates are defined as isolates which are resistant to atleast one drug from three different classes of antimicrobials.[15] Majority of the isolates in our study were resistant to amikacin and gentamicin and most were susceptible to Ceftazidime, Piperacillin-tazobactam and Imipenem/Meropenem.Therefore, in *Achromobacter species*, due to its higher tendency of developing biofilm and antibiotic resistance, removal of prostheses and implants form an equally important step towards the recovery of patients along with the appropriate treatment.[13]

Presently there are many publications with case reports and case series on *Achromobacter species* from selected populations. But studies like the present study done over a longer time frameand on broad population are the need of the hourto increase our knowledge on the epidemiology of this bacteria.[8]

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Conflicts of Interest
There are no conflicts of interest.

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