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Outbreak of *Ralstonia mannitolilytica* Infection in Hemato-Oncology Unit: Case Series and Review of Literature

Priyanka Chauhan[1] Anshul Gupta[1] Chinmoy Sahu[2] Nihar Desai[1] Soniya Nityanand[1]

[1] Department of Haematology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India
[2] Department of Microbiology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India

Address for correspondence Anshul Gupta, MD, DNB, FIAP, Department of Haematology, I block, Ground Floor, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Raebareli Road, Lucknow 226014, India (e-mail: anshulhaemat@gmail.com).

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Abstract

Ralstonia mannitolilytica is a Gram-negative, nonfermentative, soil bacterium that is reported to cause opportunistic infections in immunocompromised patients in nosocomial settings. After extensive review of literature, it was found that this is second outbreak reported from India. This study is a retrospective analysis of the clinical features, outcome, and source identification of *R. mannitolilytica* infection outbreak in a hemato-oncology unit of a tertiary care center of North India between February 2020 and March 2020. We report an outbreak of *R. mannitolilytica* bacteremia (with or without septic shock) in five patients admitted in hemato-oncology unit at a tertiary care institute in North India for 1 month period. Four patients were cured after administration of appropriate antibiotics as per sensitivity reports, while one patient died of septicemia due to delayed diagnosis. Environmental cultures revealed multi-dose saline bottles used for administration of drugs as the source of outbreak. Following implementation of use of single dose diluents and flushing solutions in patients with central venous catheter, no new case was reported. Clinicians and microbiologists should keep high index of suspicion to identify these organisms as timely diagnosis is the only key to improve outcomes.

Keywords
- Ralstonia
- outbreak
- hematology
- infections
- microbiology

Introduction

Ralstonia mannitolilytica is an aerobic, Gram-negative, nonfermenting bacterium that has been classified as one of the emerging opportunistic pathogens globally. It survives well in low-nutrient conditions and is found commonly residing in water and soil.[1] Infections with this organism are often nosocomial (hospital acquired), affecting mainly immunocompromised hosts.[2] *Ralstonia* spp is reported to cause serious infections such as sepsis, meningitis, and pneumonia mainly in hospital setting.[3–7] The progression of infection is rapid and early identification of the organism and treatment with appropriate antibiotics is the key to prevent adverse outcome (►**Table 1**).

We report an outbreak of *R. mannitolilytica* infection in our hemato-oncology unit with five patients testing positive for this infection during the same time.

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Table 1 Cases of *Ralstonia mannitolilytica* infection reported in literature

Ref no.	Year	Country	Sex/age (in years)	No. of cases	Comorbidity/primary disease	Type of infection/CVC	Antibiotic sensitivity	Antibiotic resistance	Antibiotic treatment	Outcome
11	1972	UK	Multiple	40	Various	Bacteremia and bacteriuria CVC—N/A	Trimethoprim sulfonamides, tetracycline, cephalexin	Polymyxin Gentamicin, carbenicillin	N/A	Complete recovery
5	2001	Belgium	F/38	2	Hydrocephalu s	Meningitis Ventriculoatrial catheter	Cotrimoxazole, piperacillin, imipenem, cefuroxime, cefotaxime, ceftazidime, and quinolones	Temocillin, aztreonam ampicillin, gentamicin	Co-trimoxazole and doxycycline	Complete recovery
			F/32		Cholangiocarci noma	Peritoneal infection Kehr drain	Cotrimoxazole, cefuroxime and quinolones	Ampicillin, gentamicin, colimycin, temocillin	Cefuroxime, metronidazole	Complete recovery
12	2003	India	M/14	1	Post renal transplant	Bacteremia CVC—present	Cefuroxime, ceftriaxone, cefotaxime cefoperazone—sulbactam, ampicillin, ampicillin—sulbactam, amoxicillin, amoxicillin—clavulanic acid, piperacillin	Amikacin, gentamicin cephalexin, ceftazidime, ciprofloxacin	Ciprofloxacin, amikacin —no response cefoperazone–sulbactam	Cured
13	2005	Austria	Multiple patients	26	Various	Bacteremia CVC—N/A	Cefepime, ciprofloxacin	Gentamicin, amikacin, imipenem, piperacillin–tazobactam	N/A	2 Deaths, complete cure in others
11	2007	USA	Multiple patients	38	Various (pediatric patients)	Respiratory infections including pneumonia CVC —N/A	N/A	N/A	N/A	1 Death, complete cure in others
6	2007	Germany	Multiple	5	Cancer	Bacteremia CVC—N/A	Ampicillin–sulbactam, piperacillin, piperacillin– tazobactam, cefuroxime, cefotaxime, co-trimoxazole, levofloxacin, ciprofloxacin	Meropenem, gentamicin, tobramycin, ampicillin	N/A	Complete recovery
14	2011	China	M/78	1	Type 2 DM COPD	Respiratory infection CVC —N/A	Levofloxacin, ciprofloxacin ceftriaxone, piperacillin–tazobactam, imipenem, trimethoprim–sulfamethoxazole	Amoxicillin–clavulanic acid, ampicillin–sulbactam, ticarcillin–clavulanic acid Gentamicin, amikacin, ceftazidime, ampicillin, tobramycin, piperacillin, cefazolin, cefoxitin	Piperacillin-tazobactam	Death
15	2012	Greece	F/6	1	On peritoneal dialysis for ESRD	Peritonitis CVC—N/A	Levofloxacin cefepime ceftazidime, ciprofloxacin, imipenem	Aztreonam, colistin, meropenem	Failed co- trimoxazole f/b vancomycin and ceftazidime	Complete recovery
7	2013	Israel	Neonate	1	Prematurity	Bacteremia	N/A	Ampicillin, gentamicin, cefotaxime, meropenem	Initially ampicillin, cefotaxime, gentamicin	Complete recovery
									Failure then upgraded to co-trimoxazole	
16	2016	China	F/74	3	Gastric T cell lymphoma, HTN, DM	Bacteremia/CVC present	Co-trimoxazole, ceftriaxone, piperacillin–tazobactam, ampicillin—sulbactam	Gentamycin, amikacin, cefepime, imipenem, ampicillin, cefazolin	Piperacillin–tazobactam	Complete recovery
			M/56		Gastric carcinoma	Bacteremia/CVC—present			Piperacillin–tazobactam	
			F/55		Hepatic hemangioma, HTN, DM	Bacteremia			Piperacillin–tazobactam	
17	2016	Canada	F/39	2	Cystic fibrosis	Pneumonia, septi c shock, lung abscess CVC—N/A	N/A	Resistant to all antibiotics on antibiogram	Multiple iv antibiotic combinations	Death
			F/19			Pneumonia, septic shock CVC—N/A	Piperacillin-tazobactam			Death
8	2017	Japan	F/65	1		Bacteremia/CVC—present	Ceftazidime, piperacillin—tazobactam		Ceftazidime	

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Table 1 (*Continued*)

Ref no.	Year	Country	Sex/age (in years)	No. of cases	Comorbidity/primary disease	Type of infection/CVC	Antibiotic sensitivity	Antibiotic resistance	Antibiotic treatment	Outcome
					ESRD on dialysis, DM, HTN, ischemic heart disease			Amikacin, gentamicin, meropenem, polymyxin		Complete recovery
10	2017	Rome	Multiple	22	Solid cancer	Bacteremia/ CVC all patients	Piperacillin–tazobactam	Gentamicin, amikacin, ciprofloxacin, meropenem, ceftazidime	N/A	Complete recovery
9	2018	India	M/70	4	ESRD on dialysis, HTN, hypothyroid	Bacteremia, shock /tunneled catheter	Ciprofloxacin, levofloxacin, cefoperazone—sulbactam, cefepime, co-trimoxazole	Gentamicin, amikacin, meropenem, imipenem, aztreonam	Cefoperazone–sulbactam	Complete recovery
			M/36		ESRD on dialysis, HTN	Bacteremia, shock/right IJV HD catheter			Ciprofloxacin	Complete recovery
			F/50		HTN, DM, hypothyroid	Bacteremia/right IJV HD catheter			Cefepime	Complete recovery
			F/32		ESRD on dialysis, HTN	Bacteremia/tunneled catheter			Levofloxacin	Complete recovery
18	2019	Italy	F/46		H/o breast implants, thyroidectomy/post carotid artery aneurysm clipping	Bacteremia	Ciprofloxacin, levofloxacin, piperacillin—tazobactam, piperacillin, co-trimoxazole	Amikacin, gentamicin, tobramycin, meropenem, imipenem, ertapenem, ceftazidime, cefepime, aztreonam	Ciprofloxacin, co-trimoxazole	Complete recovery

Abbreviations: ESRD, end-stage renal disease; DM, diabetes mellitus; COPD, chronic obstructive pulmonary disease; CVC, central venous catheter; HD, hemodialysis; HTN, hypertension; IJV, internal jugular vein.

Materials and Methods

Patients

This study is a retrospective analysis of the clinical features, outcome, and source identification of *R. mannitolilytica* infection outbreak in a hemato-oncology unit of a tertiary care center of North India between February 2020 and March 2020. A total of 268 patients were admitted during the study period having febrile illness. All of them were included in this study. Relevant demographical, clinical, and treatment details of the patients as well as surveillance culture data of the haemato-oncology unit during the study period were reviewed. Patients with positive *R. mannitolilytica* culture reports were identified. The following data of such cases were collected from medical records: demographical and clinical profile along with laboratory work that included complete blood counts, coagulation profile, urea and electrolytes, liver function tests, chest X-ray, pro-calcitonin assay, both aerobic and anaerobic blood cultures drawn under strict aseptic precautions (one set from central venous catheter (CVC) line and second from periphery), urine culture, and cultures from any probable infection sites. All patients gave informed and written consent for the publication of data. The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1964, as revised in 2013.

Microbiological Identification and Sensitivity Testing

Blood cultures were incubated in BD BACTEC system (BD Diagnostic Systems, Sparks, Maryland, United States) at the microbiology laboratory of our institute.

Positive blood cultures were subcultured on solid media and incubated for 24 hours. Identification of the isolate as *Ralstonia* was done using by Vitek 2 system (BioMeriuex, Marcy l'Etoile, France) and confirmed by matrix-assisted laser desorption ionization-time of flight mass spectrometry (MALDI-TOF MS). Sensitivity testing was done by Kirby-Bauer method according to Clinical and Laboratory Standards Institute guidelines.

Environmental Sampling and Source of Infection

An outbreak investigation was initiated by the hospital infection control team when two successive *R. mannitolilytica* cases were reported.

Surveillance cultures were sent from several putative sources of infection like sterile swabs from furniture, medical equipment, medicine trolleys, water coolers, contaminated solutions, including water for injection, saline solutions, respiratory solutions, sterile drug solutions, O_2 humidifiers, and tap water were also sent for culturing. All the surveillance cultures were done on routine bacteriological media and incubated for minimum 48 hours. Bacterial isolates were first detected by routine morphological tests and confirmed by MALDI-TOF MS.

Results

Of the 45 hemato-oncology cases admitted during the study period, 5 cases were identified to be positive for *R.*

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mannitolilytica infection. The clinical characteristics of these cases are summarized in ►**Table 2**. The detailed clinical profile of these cases is mentioned below.

Case 1

A 36-year-old female was diagnosed as a case of acute myeloid leukemia (AML), Eastern Cooperative Oncology Group performance status-02 and was started on induction chemotherapy with cytarabine and daunorubicin (3 + 7) regimen in our hematology isolation ward. On day 18, post chemotherapy, she developed high-grade fever accompanied by rapidly worsening respiratory distress and severe headache. On physical examination, she had fever (temperature = 103[§]F), tachycardia (pulse rate = 158/minute), and tachypneic (respiratory rate = 26/minute). She was also hypotensive (blood pressure= 82/48mm Hg) and respiratory system examination revealed B/L fine basal crepitation.

Her complete blood count revealed pancytopenia with hemoglobin (Hb)—8 g/dL, total leucocyte count (TLC)—200 cells/mm^3, and platelet count—11,000/mm^3 (►**Table 2**). Kidney and liver function tests showed no abnormality; serum lactate concentration was found to be 24 mmol/L. Two sets of blood cultures were sent for testing from periphery as well as the central line through which the chemotherapy was administered. Workup for tropical fever was negative.

Chest X-ray revealed nonspecific bilateral perihilar opacities. Electrocardiogram showed that sinus tachycardia and two-dimensional echocardiography was within normal limit.

She was resuscitated for her septic shock with fluid bolus at 30 mL/kg along with initiation of noradrenaline infusion as an inotropic agent.

Immediately, she was started on meropenem and teicoplanin empirically as per the institutional antibiotic policy for unstable febrile neutropenia.

However, due to persistent fever spikes, even after 48 hours of antibiotic treatment and for underlying profound neutropenia, the antifungal drug liposomal amphotericin B was also administered.

Blood culture (BACTEC) was flagged positive on day 2 with sensitivity pattern as shown in ►**Table 2**. The patient's antibiotics were changed to levofloxacin and cotrimoxazole and she responded in the form of resolution of fever and tachypnoea and hypotension. She was eventually weaned off inotropic support and discharged after neutrophil recovery on day 28.

Case 2

A 4-year-old male child, a known case of thalassemia major on regular hypertransfusion therapy from 6 months of age was admitted for matched sibling donor allogenic stem cell transplant. Patient was admitted to high-efficiency particulate air-filtered bone marrow transplant unit and conditioning regimen comprising of chemotherapy drugs fludarabine, busulfan, cyclophosphamide, and rabbit antithymocyte globulin was initiated. On day 7 of transplant conditioning, patient developed high-grade fever with chills and anorexia. On examination, he was febrile with a temperature of 102°F associated with tachycardia (hazard ratio [HR] = 130/min. His respiratory rate and BP were normal. Rest of the systemic examination was also within normal limits.

Laboratory investigations are documented in ►**Table 2**. Kidney and liver function tests showed no abnormality. Blood cultures were sent from periphery as well as the central line through which the chemotherapy was administered. Chest X-ray result was normal.

Patient was empirically treated with cefoperazone–sulbactam that was upgraded after 24 hours to meropenem and teicoplanin due to nonresolution of fever. Hickman line blood culture flagged positive on day 2 and isolate was identified as *R. mannitolilytica*. On day 3, post submission to microbiology and sensitivity pattern was as depicted in ►**Table 2**. Antibiotics were altered as per sensitivity pattern of the isolate and fever subsided within 48 hours. He received further conditioning regimen under antibiotic treatment. Hickman catheter was retained and subsequent cultures from the same were negative. Patient was engrafted successfully on day 22 without any further complications.

Case 3

A 5-year-old male child, who was a diagnosed case of refractory acute lymphoblastic leukemia, was admitted in our hematology isolation ward for intensive salvage chemotherapy (Fludarabine, Cytosine Arabinoside, Granulocyte – colony stimulating factor [G-CSF]-idarubicin). On day 10 post chemotherapy, he developed high-grade fever and chills. On examination, patient had fever (temp =102.2 ° F) along with tachycardia (HR = 126/min). Systemic examination was unremarkable.

Laboratory investigations are summarized in ►**Table 2**. Two sets of blood cultures were drawn, one from chemo port and the other from peripheral blood and sent to microbiology laboratory for testing and culturing.

Patient was empirically started on piperacillin–tazobactam, but the fever persisted. Blood cultures drawn on day 10 did not reveal any growth. In view of persistent high-grade fever, repeat blood cultures were sent and antibiotics upgraded to meropenem along with antifungal agent liposomal amphotericin B in view of prolonged neutropenia observed in the patient. Repeat blood cultures showed growth of *R. mannitolilytica* after 24 hours and it was discovered to be resistant to carbapenems, sensitive to levofloxacin and moderately sensitive to piperacillin–tazobactam. Antibiotics were altered as per the sensitivity pattern and patient's condition gradually improved with the fever subsiding within 48 hours.

Case 4

A 67-year-old elderly male, diagnosed as a case of low-grade B cell Non-Hodgkin Lymphoma was started on rituximab, cyclophosphamide, vincristine, prednisone, and Adriamycin chemotherapy. On day 7 post chemotherapy, he developed high-grade fever along with altered sensorium. On physical examination, patient was found to be febrile (temp =103° F), and drowsy, responding only to painful stimulus.

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Table 2 Clinical characteristics of cases presenting with *Ralstonia mannitolilytica* infection

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5
Age(y)	36	4	5	67	5
Gender	Female	Male	Male	Male	Female
Underlying disease	AML	Thalassemia undergoing MSD allogenic SCT	Refractory ALL	B cell NHL	AML
Prior chemotherapy	Daunorubicin+ cytarabine	Bu+ Cy+ Flu+ ATG based conditioning	FLAG-IDA Regimen	R-CHOP regimen	AIE
Clinical features	Respiratory distress, fever	High-grade fever	High-grade fever	High-grade fever, altered sensorium	High-grade fever
Vascular access	PICC line	Hickmann catheter	Port-a-cath	PICC line	Port-a-cath
Days from CVP insertion	28	8	94	15	7
Positive culture site	Peripheral	CVC	Peripheral	PICC line	Port-a-cath
Hb g/dL	8.0	8.2	9	8.9	8.4
TLC/ANC/μl	200	1100/600	1400/340	18,350/12,000	2300/1250
Platelets/mm^3	11,000	90,000	69,000	10,4000	1,14,000
Procalcitonin ng/mL	16	0.4	5.6	56	1.2
Antibiotic sensitivity	Doxycycline, levofloxacin, co-trimoxazole, cefoperazone–sulbactam	Ceftazidime, piperacillin–tazobactam, doxycycline, levofloxacin, co-trimoxazole, cefoperazone—sulbactam	Ceftazidime, doxycycline, levofloxacin, co-trimoxazole, cefoperazone–sulbactam	Piperacillin tazobactam, doxycycline, levofloxacin, co-trimoxazole, cefoperazone–sulbactam	Doxycycline, levofloxacin, co-trimoxazole
Therapeutic antibiotic	Levofloxacin, co-trimoxazole	Levofloxacin + cefoperazone —sulbactam	Levofloxacin	NA	Levofloxacin
Outcome	Cured	Cured	Cured	Death	Cured

Abbreviations: AIE-Ara-c, idarubicin, etoposide; ALL, acute lymphoblastic leukemia; AML, acute myeloid leukemia; ATG, antithymocyte globulin; Bu, Busulfan; CVC, central venous catheter; Cy, cyclophosphamide; FLAG, fludarabine, Ara-c, G-CSF; Flu, fludarabine; MSD, matched sibling donor; NHL, non-Hodgkin's lymphoma; PICC, peripheral inserted central line; R-CHOP, rituximab, cyclophosphamide, vincristine, Adriamycin, prednisone; SCT, stem cell transplant.

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Rest of the neurological examination was unremarkable. Laboratory investigations revealed Hb as 8.9 g/dL, TLC as 18350/μL, and platelet count as 1,79,000/mm^3. Renal function test revealed blood urea as 58 mg/dL, serum creatinine as 1.8 mg/dL, serum sodium as 118meq/L, and other serum electrolytes were normal. Liver function tests and coagulation profile were also observed to be within normal limits. Blood cultures were drawn consisting of two sets, one from CVC line and other from peripheral blood that was sterile. Patient was empirically treated with cefoperazone–sulbactam antibiotics that was later upgraded to meropenem and teicoplanin due to nonresolution of fever after 24 hours. In view of hyponatremia and altered sensorium, 3% hypertonic saline was administered that led to marked improvement in patient's sensorium. In view of persistence of fever, blood and urine cultures were repeated thrice to detect any infective foci along with lumbar puncture and cerebrospinal fluid examination. All the culture reports were normal. Two-dimensional echocardiography was done to rule out any vegetation and it was found out to be normal. Peripherally inserted central catheter (PICC) line was removed, and the tip was sent for culturing. The patient's condition progressively deteriorated, and he developed septic shock refractory to inotropes. The patient finally succumbed on the 10th day post his admission to the hospital. Posthumously, his last blood culture from PICC line revealed growth of *R. mannitolilytica* with a sensitivity pattern as shown in ►**Table 2**.

Case 5

A 5-year-old female patient, a known case of AML, was admitted for first consolidation chemotherapy with cytarabine and idarubicin. Patient completed her chemotherapy without any adverse events. On day 8 post chemotherapy, patient developed high-grade fever (Tmax = 102.4° F). Laboratory investigations are documented in ►**Table 2**. Patient was empirically started on intravenous meropenem in view of neutropenia. However, the fever spikes persisted. Twenty-four hours after fever onset, BACTEC culture from the central line blood culture sample flagged positive for nonfermentative Gram-negative bacilli. It was later identified as *R. mannitolilytica*. Patient was started on levofloxacin as per the previous cases and their sensitivity pattern. The resolution of fever occurred in 36 hours.

Surveillance cultures: Surveillance cultures of the hemato-oncology unit were sent from several different sources like sterile swabs from furniture, medical equipment, medicine trolleys, water coolers, contaminated solutions, including water for injection, saline solutions, respiratory solutions, sterile drug solutions, O_2 humidifiers, and tap water. The culture of fluid from the multidose saline bottles being used for central line flushing by the nursing staff came out to be positive for *R. mannitolilytica*, thereby proving to be the source of infection for this outbreak.

Discussion

We report an outbreak of *R. mannitolilytica* infection in our hemato-oncology unit through a series of five cases occurring almost at the same time point. Extensive review of literature showed that this is the second reported outbreak of *R. mannitolilytica* from India.[8] Our cases highlight the importance of identifying this rare emerging opportunistic pathogen in our clinical practice as delay in detection is associated with high mortality. One of our patients succumbed due to this infection due to delayed diagnosis.

Ralstonia spp. is aerobic, Gram-negative, non-fermentative rod that is usually found in water and soil.[1] *Ralstonia pickettii* is the most common member of this genus known to cause serious infections in immunocompromised hosts. *Ralstonia insidiosa* and *R. mannitolilytica* are other two species of clinical importance.[1,2] The type of infections caused by *Ralstonia* spp. is myriad ranging from osteomyelitis, meningitis, pneumonia, peritonitis, bacteremia followed by severe sepsis in nosocomial settings as highlighted in ►**Table 1**. In the present case series, we documented a life-threatening infection caused by *R. mannitolilytica* in our neutropenic patients. Immunocompromised patients, for example, those with hematological malignancies, patients in intensive care, cystic fibrosis patients, patients with indwelling devices such as CVC, ventriculoatrial drains for hydrocephalous and neonates (►**Table 1**), are at increased risk of infection with these bacteria. This bacterium has a unique ability to produce biofilm (usually around CVC) that in turn adds to their virulence by evading the host's immune response and their frequent antibiotic resistance.[2,3] In the present case series, the CVC was removed only in one case, while in all the other cases CVC was retained as the patients showed improvement on antibiotic therapy. Boattini et al[3] in their literature review suggested that CVC should be removed in CVC-related bacteremia while it may be retained in CVC associated bacteremia if the patient responds to antibiotic therapy, as in the present case series.

Additionally, on investigating the cause for this outbreak, we noticed a recent change in our nursing infection control protocol of repeatedly using multidose saline bottles for administering medicines through the central venous lines of the patients. Similar outbreak of *R. mannitolilytica* has previously been described by Lucarelli et al[9] in 22 oncology patients possibly due to flushing of the CVC by contaminated saline solutions. Another national outbreak was reported by Jhung et al[10] in United States using contaminated oxygen delivery devices in pediatric patients. An extensive review of literature of *R. mannitolilytica* infections reported to date with epidemiological, clinical, and prognostic features has been summarized in ►**Table 1**.

The appropriate antimicrobial treatment and management of *Ralstonia* spp. infections is difficult, first because of the difficulty in identifying and differentiating between various *Ralstonia* spp. members using routine biochemical methods. However, with the advent of new automated identification systems like Vitek 2 and molecular techniques like polymerase chain reaction amplification of housekeeping genes, especially 16S rRNA gene, and MALDI-TOF MS, the accurate identification of pathogens is often possible.[2,3,6] In the present case series, the species identification of *Ralstonia* was done using Vitek 2 and confirmed by MALDI-TOF MS.

Second, literature review has revealed a notably high percentage of antibiotic resistance especially with

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carbapenems and aminoglycosides in *Ralstonia* spp. which is critical to know for the primary care physician managing febrile neutropenic patients with this infection (►**Table 1**). However, local antibiogram should be taken into consideration for the treatment of these cases. In our case series, we noticed that all our cases of *R. mannitolilytica* were sensitive to cephalosporins, fluoroquinolones, and doxycycline while uniformly resistant to carbapenems as shown in ►**Table 2**.

To summarize the similarities between this case series and available literature, *Ralstonia* causes infections mostly in immunocompromised patients of any age group. Indwelling devices usually catheters are a frequent site of infection. In contrast with available literature, all the cases in this series were carbapenem resistant, source of infection was detected to be the multidose saline bottles, and CVCs were salvaged in four of our cases.

Thus, despite *Ralstonia* spp. being recognized as emerging pathogens, their biofilm formation potential, multidrug resistance, and ability to survive in the environment make this pathogen virulent especially in an immunocompromised host. Clinicians and microbiologists should keep high index of suspicion to identify these organisms as a timely diagnosis is the only key to improved outcomes in these patients.

Conclusion

Prompt microbiological identification, early appropriate antibiotic therapy with good supportive care, remains the cornerstone of management of such severe opportunistic infections. Proper environmental cleaning and infection control is the key to the management of an outbreak. In our setup, no further outbreaks were reported after starting the use of single-use flushing solutions for central venous lines. Four of our patients' central venous lines were salvaged and were used for prescribing further chemotherapy.

Future studies on phenotypic and genotypic differentiation of *R. mannitolilytica* strains will throw more light on the differences in the presentation, sites involved, and severity of infection by the same species in different patients.

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Conflict of Interest
None declared.

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