Case Report

Severe septicemia and electrolyte imbalance in a 2-month-old infant caused by *Brevundimonas diminuta*

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ABSTRACT

Brevundimonas diminuta, an opportunistic Gram-negative bacterium, is increasingly recognized as a potential pathogen in clinical settings, particularly among immunocompromised individuals. We present a case of *B. diminuta* bacteremia in a 2-month-old male infant presenting with high-grade fever and hypocalcemic seizures. Despite initial treatment, the patient experienced recurrent seizures, leading to hospital readmission. Microbiological analysis revealed *B. diminuta*, sensitive to beta-lactam antibiotics and carbapenems. Prompt initiation of targeted antibiotic therapy resulted in significant clinical improvement, highlighting the importance of timely diagnosis and tailored treatment. This case underscores the evolving clinical significance of *B. diminuta* and emphasizes the need for heightened awareness among health-care providers for effective management of such infections, especially in pediatric patients. Further research collaboration is warranted to better understand the epidemiology and optimal treatment strategies for *B. diminuta* infections.

Key words: Antibiotic susceptibility, Bacteremia, *Brevundimonas diminuta*, Pediatric, Seizures

Brevundimonas diminuta, a Gram-negative bacillus belonging to the family Caulobacteraceae, is primarily regarded as a low-virulence environmental organism. However, it has been increasingly implicated in opportunistic infections, particularly among immunocompromised individuals. Despite its significance, literature on the clinical implications of *B. diminuta* remains scarce, especially in pediatric patients [1]. This bacterium is part of a group of opportunistic pathogens that includes several clinically relevant species, such as *Acinetobacter baumannii*, *Burkholderia cepacia*, *Ralstonia pickettii*, *Pseudomonas aeruginosa*, *Sphingomonas paucimobilis*, and *Stenotrophomonas maltophilia*. Notably, these organisms demonstrate a remarkable ability to survive in diverse environments, thriving in various water sources encountered in health-care settings, including aircraft water, bottled water, hospital water, and purified water. Moreover, they often exhibit resistance to a wide array of antimicrobial agents, posing challenges in treatment and infection control [2,3]. Despite its ubiquitous presence, accurately diagnosing infections caused by *B. diminuta* remains a diagnostic conundrum due to its phenotypic variability and the limitations of conventional identification methods [4,5]. This emphasizes the need for advanced diagnostic techniques to facilitate precise identification and guide appropriate therapeutic interventions. As such, understanding the clinical significance of *B. diminuta* is paramount in effectively managing infections caused by this emerging opportunistic pathogen.

We have reported this case to highlight the emerging clinical significance of *B. diminuta* as an opportunistic pathogen, particularly in pediatric patients, and emphasize the challenges and clinical implications associated with its diagnosis and management.

CASE PRESENTATION

A 2-month-old male infant was admitted to the pediatric emergency ward with high-grade fever, generalized tonic-clonic seizures, and difficulty in breathing for 3 days. Initial investigations showed hypocalcemia (serum calcium −2.02 mg/dL) and hypomagnesemia (serum magnesium −0.5 mg/dL) and treatment at a private hospital included antiepileptics (injection levetiracetam), intravenous calcium gluconate, magnesium sulfate, paracetamol, and ceftriaxone. Despite initial symptomatic relief, the patient left against medical advice. 2 days later, the patient was readmitted to our hospital with active seizures with high-grade fever (103.2°F). The seizures were controlled with intravenous diazepam.

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The infant's vital signs at admission included a temperature of 103.2° F, heart rate of 150/min, SpO_2 of 98%, pulse of 146/min, and a respiratory rate of 58/min. Capillary refill time was <3 s.

Serum electrolyte analysis revealed hyponatremia with sodium levels at 132.8 mmol/L, hypocalcemia with calcium levels at 2.72 mg/dL, hypomagnesemia with magnesium levels at 0.83 mg/dL, and hyperphosphatemia with phosphorus levels at 6.70 mg/dL. Inflammatory markers were elevated, with procalcitonin at 2.01 ng/mL and C-reactive protein at 24 mg/dL. The hematologic evaluation showed anemia with hemoglobin at 10.8 G/dL and thrombocytosis with platelets at 347,000/mm³. The total leukocyte count was 10,600 cells/mm³ with a differential showing neutrophilia (70%) and lymphopenia (26%). The investigations have been summarized (Table 1).

Blood culture incubated in the BacT/ALERT system beeped positive on day 2. Upon sheep blood agar colonies were gray and non-hemolytic and on MacConkey agar colonies were non-lactose fermenters, small, and convex (Fig. 1). Gram staining showed short Gram-negative rods. Oxidase and catalase tests were positive. Matrix-assisted laser desorption ionization-time-of-flight mass spectrometry (MALDI-TOF MS) (Biomeriux, France) identified the organism as *B. diminuta*. The isolate was susceptible to amoxicillin-clavulanic acid, cefepime, gentamicin, levofloxacin, meropenem, piperacillin-tazobactam, and ceftazidime; and resistant to cefoxitin, aztreonam, and vancomycin (Table 2). Repeat blood cultures confirmed the presence of *B. diminuta*. Cerebrospinal fluid (CSF) was negative for Anti-Japanese encephalitis virus immunoglobulin M antibody by enzyme-linked immunosorbent assay and real-time polymerase chain reaction for herpes simplex virus. CSF bacterial aerobic cultures were sterile after 72 h.

The patient was initially started on intravenous ceftazidime at 25 mg/kg/dose, antiepileptic (injection levetiracetam), calcium gluconate in 10% dextrose, magnesium sulfate, paracetamol, and other supportive treatments. Subsequently, the antibiotic regimen was escalated to piperacillin-tazobactam (2.25 mg/dose, every 8 h) and amikacin (15 mg/kg/day). This treatment continued for 10 days.

The patient showed significant clinical improvement and was successfully discharged in stable condition 14 days post-admission. On discharge, he was prescribed antiepileptics, multivitamins, multi-minerals, and calcium supplements. A follow-up evaluation 15 days post-discharge showed no signs of disease progression, and all vital parameters were normal.

Table 1: Summary of laboratory investigations in a 2-month-old infant with *Brevundimonas diminuta* Septicemia

Investigation	Result
Serum electrolytes	
Sodium	132.8 mmol/L (Hyponatremia)
Calcium	2.72 mg/dL (Hypocalcemia)
Magnesium	0.83 mg/dL (Hypomagnesemia)
Phosphorus	6.70 mg/dL (Hyperphosphatemia)
Inflammatory markers	
Procalcitonin	2.01 ng/mL (Elevated)
C-reactive protein	24 mg/dL (Elevated)
Hematologic evaluation	
Hemoglobin	10.8 g/dL (Anemia)
Platelets	347,000/mm³ (Thrombocytosis)
Total leukocyte count	10,600 cells/mm³
Neutrophils (%)	70
Lymphocytes (%)	26 (Lymphopenia)
Serum alkaline phosphatase	1367.7 IU/L (Significantly elevated)
Prothrombin time	14.5 s (Normal)
International normalized ratio	1.08 (Normal)
Cerebrospinal fluid	
Appearance	Clear fluid
pH	Alkaline
Protein	72.34 g/dL
Glucose	47.5 mg/dL
Total nucleated cell count	15 cells/mm³
Neutrophils (%)	20
Lymphocytes (%)	20

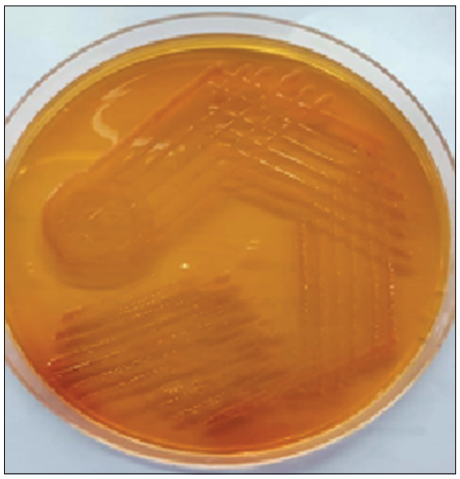

Figure 1: MacConkey agar displaying small, convex-shaped, non-lactose fermenting colonies

Table 2: Antimicrobial susceptibility profile of *Brevundimonas diminuta* isolate

Antimicrobial	MIC	Interpretation
Piperacillin/tazobactam	-	S
Ceftazidime	-	S
Cefoperazone/Sulbactam	16	S
Cefepime	8	S
Imipenem	1	S
Meropenem	4	S
Amikacin	≥64	R
Gentamicin	≥16	R
Ciprofloxacin	≥4	R
Levofloxacin	≥8	R
Colistin	≥16	R

MIC: Minimum inhibitory concentrations

Table 3: Clinical profiles of *Brevundimonas* infections: A comparative summary of global case studies

Author	Country	Comorbidity	Diagnosis	Age/Gender	Bacterial isolates	References
Burch *et al*. [6]	USA	Type 1 diabetes mellitus and stage 0 chronic lymphocytic leukemia	Pyogenic liver abscess	67 Years/Male	*B. diminuta*	[6]
Lupande-Mwenebitu *et al*. [8]	Democratic Republic of the Congo	Maternal hypoglycemia in active Hepatitis B	Omphalitis	Low-weight preterm of 36 gestational weeks	*B. diminuta*	[8]
Chandra *et al*.(2018) [9]	India	Steroid-resistant focal segmental glomerulosclerosis	Nephrotic syndrome	18 Years/Male	*B. diminuta*	[9]
Christiadi *et al*. [10]	Australia	End-stage kidney disease from hypertensive nephrosclerosis	Peritonitis	41 Years/Male	*B. vesicularis*	[10]
Bhatawadekar *et al*. [11]	India	Bacteremia	Viral Hepatitis	1 Year/Female	*B. vesicularis*	[11]
Nandy *et al*. [12]	India	Bacteremia	Meconium aspiration	14 Days/Female	*B. vesicularis*	[12]
Present study	India	Bacteremia	Hypocalcemic seizure	2 Months/Male	*B. diminuta*	-

***B. diminuta: Brevundimonas diminuta, B. vesicularis: Brevundimonas vesicularis*, UTI: Urinary tract infection**

DISCUSSION

In clinical settings, the emergence of Gram-negative bacteria as significant pathogens, particularly in nosocomial infections, presents a substantial challenge to health-care providers [6]. Among these bacteria, *B. diminuta* has garnered attention due to its association with opportunistic infections and its ability to survive in diverse environmental niches [7]. *Brevundimonas species*, including *B. diminuta* and *Brevundimonas vesicularis* have been implicated in various infections across different age groups and clinical settings, often associated with underlying health conditions (Table 3) [6,8-12]. In India, diverse clinical presentations of *Brevundimonas* infections are predominantly caused by *B. vesicularis*. In these cases, infections ranged from urinary tract infections to bacteremia, occurring in patients with various underlying conditions such as viral hepatitis, neonatal complications, and nephritic syndrome [8,9].

In contrast, our case study presents a rare case of bacteremia caused by *B. diminuta* in a 2-month-old male infant. Notably, the patient presented with hypocalcemic seizures, which is an unusual manifestation of *B. diminuta* infection. This underscores the importance of considering uncommon pathogens in the differential diagnosis of pediatric septicemia, particularly in cases with atypical clinical presentations. The antimicrobial susceptibility profile of *B. diminuta* in this patient highlights the utility of beta-lactam antibiotics and carbapenems, while also pointing out the resistance to several other classes of antibiotics, which is crucial for guiding effective treatment strategies.

B. diminuta, a rare pathogen in infants, can cause severe sepsis and requires prompt identification and targeted antibiotic therapy. This case emphasizes the importance of considering rare pathogens in pediatric sepsis and the role of advanced diagnostic tools like MALDI-TOF MS in identifying uncommon organisms. Our case highlights the importance of recognizing and characterizing infections caused by *B. diminuta*, especially in pediatric patients. Further research is warranted to elucidate the pathogenic mechanisms and optimal management strategies for infections caused by *B. diminuta*.

CONCLUSION

This case highlights the increasing importance of *B. diminuta* as an opportunistic pathogen, particularly in pediatric patients with atypical symptoms. Timely identification and personalized antibiotic treatment guided by susceptibility testing are essential for successful patient outcomes. Heightened awareness among health-care providers and continued research collaboration is vital for effectively addressing this emerging public health concern.

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AUTHOR CONTRIBUTIONS

SV: Supervised and provided final approval for publication. MC: Contributed to the laboratory diagnosis of the patient and data collection. VV, SNS, ST. and MK: Provided critical revisions to the manuscript and contributed to the discussion section. All authors reviewed and approved the final manuscript.

INSTITUTIONAL REVIEW BOARD STATEMENT

This study was approved by the Institutional Review Board of King George's Medical University (Ethical Approval No: [1677/Ethics/R.Cell-17]).

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