Stenotrophomonas maltophilia bacteremia in children - A 10-year analysis

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ABSTRACT

Stenotrophomonas maltophilia is a multidrug-resistant, Gram-negative, and biofilm-forming pathogen. Information is limited concerning *S. maltophilia* bacteremia in children. Clinical data and microbiological test results collected in a tertiary children's hospital over a ten-year period were reviewed. Children 0–18 years old who had positive clinical specimen, blood and/or catheter cultures were included. We identified 20 *S. maltophilia* isolates from 12 pediatric patients with confirmed infections. The median age was 28 months (range: 3.1-187.3). The rate of previous use of antimicrobial therapy was 83 %. The median antibiotic number was 3 (range: 0–7) within 30 days prior to onset of *S. maltophilia* bacteremia. Catheter related infection was the main infectious source (66.6 %). The mortality rate was 33.3 %. The death of two non-survivors was associated with pneumonia. *S. maltophilia* should be considered a breakthrough agent for bacteremia in children with underlying disease exposed to broad-spectrum antibiotics during long-term hospitalization.

Key words: *bacteremia,* Stenotrophomonas maltophilia*, catheter related infection, child, pneumonia.*

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INTRODUCTION

Stenotrophomonas maltophilia is an aerobic, non-glucose-fermenting, Gram-negative, motile, and biofilm-forming bacterium[1] that has been isolated from soil, water, plant material, and humans and animals. It has the ability to colonize different sites, like epithelial cells of the respiratory tract and surfaces of medical devices.[2] *S.maltophilia* was initially thought to be of low level pathogenicity; however, recent studies have identified it as an important opportunistic and nosocomial pathogen that is now observed with increasing frequency.[2] This is particularly frequent among patients who are immunosuppressed or who have an underlying serious medical condition with high morbidity and mortality.

Nosocomial *S.maltophilia* infections are common, but community-acquired pathologies have also occasionally been reported.[2] The most common clinical manifestations of *S. maltophilia* infection are pneumonia and bacteremia,[3] with endocarditis, or central nervous system, ocular, urinary tract, bone and joint, skin and soft tissue, or gastrointestinal tract infections, occurring less often. It is occasionally associated with septic shock in critically ill and immunosuppressed patients.[1]

The treatment of *S. maltophilia* infections is a significant management challenge.[1,2] *S. maltophilia* exhibits intrinsic resistance to many available broad-spectrum antibiotics.[4] Consequently, an appropriate antimicrobial therapy is often delayed.[1]

A limited number of case-control studies on *S. maltophilia* bacteremia have been reported and there are only a few reports describing *S. maltophilia* bacteremia and its features in the pediatric population.[5] However, pediatric patients with *S. maltophilia* bacteremia have a high mortality rate, ranging from 6 % to 40 %, which is similar to the rate reported in adults.[6]

The objective of the present study was to identify the clinical and microbiological characteristics of pediatric patients with *S.maltophilia* bacteremia over a 10-year period in our center.

METHODS

Patients and Methods

Study design and setting

This single-center, retrospective, observational study was conducted at Hacettepe University İhsan Doğramacı Children Hospital, which is a

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270-bed, tertiary-care children's referral hospital in Ankara, Turkey. This study was approved by the Institutional Review Board of the Hacettepe University Faculty of Medicine.

Data collection and variables

This 10-year retrospective study examined the pediatric patients (0-18 years old) who were hospitalized from January 2007 to June 2017 and whose blood and/or catheter cultures were positive for *S.maltophilia* along with clinical symptoms of systemic infection. Microbiological data (isolation sites, susceptibility results, co-isolated or persistent organisms, previous isolation of S. *maltophilia* within 30 days) were confirmed through the microbiological laboratory information system. Clinical data were collected from electronic medical records and patient charts. Exclusion criteria were age >18 years and a positive blood culture without adverse clinical signs or symptoms.

Bacterial identification and antimicrobial susceptibility testing

All blood samples were taken from peripheral veins and/or a central line. Blood cultures were identified using conventional tests and the BBL Crystal E/NF ID system (Becton Dickinson Microbiology Systems, Cockeysville, Maryland, USA) or a matrix-assisted laser desorption ionization-time of flight mass spectrometry system (BioMerieux, France). Antibiotic susceptibilities were tested using the Kirby-Bauer disc diffusion method, according to the Clinical and Laboratory Standards Institute guidelines.[7,8]

Definitions

S. maltophilia bacteremia was defined as at least one positive blood culture of *S. maltophilia* with clinical signs of infection.[3] The Centers for Disease Control and Prevention criteria were used to define central-line-associated bloodstream infection (CLABSI)[9] (see *Annex* for definitions).

Statistical analysis

Data were analyzed using SPSS Statistics 22.0 (SPSS, Chicago, IL, USA). Descriptive statistics were used to summarize the baseline patient characteristics. The continuous variables for patient characteristics were summarized as median and interquartile range (IQR). Frequency distributions and percentages were calculated for categorical variables.

RESULTS

We identified 48 *S. maltophilia* isolates. However, 28 isolates were excluded because of contamination or insufficient clinical data. Finally, only 20 isolates from the 12 patients with clinically documented infection were included. No colonization was evident prior to the onset of infection in these 12 patients. The median age was 28 months (range: 3.1 to 187.3 months). The female-to-male ratio was 1:1. All patients had at least one underlying disease, which were primarily immune deficiency and congenital heart disease. Surgery was performed in four patients and prior antimicrobial therapy was noted in ten patients within 30 days prior to the onset of bacteremia.

The median antibiotic number and the rate of use of carbapenems were 3 (range: 0-7) and 66.7 % (n = 8), respectively, within 30 days prior to onset. In total, five patients were considered immunosuppressed. None of our patients were neonates. Six patients were admitted to the intensive care unit (ICU), and four required mechanical ventilation (*Table 1*). Total parenteral nutrition (TPN) was administered to two patients at 14 days of onset. Ten patients had medical devices (eight central venous catheters [CVCs], three tracheostomy tubes, and one cardiac pacemaker). Ten patients (83.3 %) had hospital-acquired infections and two had community-acquired infections (patient 7 and patient 10). The central-line–associated bloodstream infection was the main infectious source (in eight patients). Pneumonia was identified in two patients (patient 3 and patient 11) with *S. maltophilia* bacteremia. *S. maltophilia* was also isolated from respiratory specimens from these two patients, in one at the onset of bacteremia and in the other 21 days later. Two patients had bacteremia of unknown origin.

The median value for white blood cell counts was 6900/μL (range: 200-20,100/μL). Two patients were neutropenic (< 500 cells/mm^3) and six were thrombocytopenic (< 150,000/μL). The median albumin level was 3.4 g/dL (range:1.3-4.3 g/dL) and three were under 2.5 g/dL at the onset of bacteremia.

Polymicrobial bacteremia occurred in four patients. The pathogens found concurrently with *S. maltophilia* included *Enterococcus faecalis, Streptococcus parasanguinis, Staphylococcus epidermidis,* and *Enterobacter cloacae*. The median length of hospitalization was 60.5 days (range: 5-170 days; IQR: 36.5-75.7 days), and the median length of hospitalization after the positive culture

result was 21.5 days (range: 1-61 days, IQR: 8.7-48 days).

The duration of bacteremia ranged from 4 to 25 days, with a median of 8 days. Overall, 4 patients received appropriate empiric antimicrobial therapy. The duration between the first positive blood culture and administration of appropriate treatment was ≤ 72 hours in only five patients. Of all eight CVCs, five were removed during antibiotic treatment for *S. maltophilia*. Persistent bacteremia occurred in two patients one who started appropriate therapy at 48-72 hours and the other at > 72 hours. All occurrences of persistent bacteremia had community-acquired *S. maltophilia* infection, and no prior antimicrobial therapy was noted within 30 days before onset. The patients who developed persistent bacteremia survived. Four patients had also been diagnosed with sepsis, and three of them experienced septic shock.

The median duration of treatment was 15.5 days (range 0-37 days; IQR: 5.5-22.5 days). The most frequently used antimicrobial agent was ciprofloxacin (six patients) for *S. maltophilia* infection. Antibiotic susceptibility testing was performed on all isolates (*Table 2*).

The mortality rate was 33.3 % (n = 4). In three of the four fatal cases, *S. maltophilia* was regarded to have had a direct role in death, and only one of these patients had received appropriate treatment in the first 24 hour after the onset of bacteremia. Additionally, two of them were associated with pneumonia. All three of the non-survivors due to bacteremia had undergone prior treatment with carbapenem 30 days before *S. maltophilia* infection.

DISCUSSION

In the current study, all the patients had at least one underlying disease, including immunosuppressive conditions. The previous rate of use of antimicrobial therapy (83 %) and the median antibiotic number (3) were high within 30 days prior to onset of *S. maltophilia* bacteremia. The most common previously used antibiotic was

TABLE 1. *Patient history of antibiotic use and other clinical characteristics*

Patient	Site	Antibiotics within 30 days prior to onset	Mechanical ventilation	Sepsis/Septic shock
1	Central venous catheter and peripheral blood	Ampicillin sulbactam	No	No
2	Peripheral blood	Meropenem, vancomycin, amikacin, caspofungin	Yes	No
3	Peripheral blood	Meropenem	No	Sepsis
4	Peripheral blood	Ceftriaxone, gentamicin, clindamycin, ornidazole, fluconazole	Yes	Septic shock
5	Central venous catheter and peripheral blood	Meropenem, teicoplanin, amikacin, metronidazole, caspofungin	No	Septic shock
6	Central venous catheter and peripheral blood	Meropenem, vancomycin, amphotericin B	Yes	No
7	Central venous catheter and peripheral blood	None	No	No
8	Central venous catheter and peripheral blood	Imipenem, teicoplanin, amikacin, ciprofloxacin fluconazole	No	No
9	Central venous catheter and peripheral blood	Meropenem, fluconazole, amphotericin B	No	No
10	Central venous catheter and peripheral blood	None	No	No
11	Peripheral blood	Meropenem, imipenem, vancomycin, amikacin, ciprofloxacin, trimethoprim-sulfamethoxazole, fluconazole	Yes	Septic shock
12	Central venous catheter and peripheral blood	Meropenem, amikacin	No	No

carbapenem, followed by aminoglycosides. The occurrences of prolonged hospital stay and ICU stay, the presence of indwelling devices, including CVCs, and the use of immunosuppressive therapy were similar to those described in the literature.[1,2]

S. maltophilia exhibits intrinsic resistance to many available broad-spectrum antibiotics, including carbapenems and aminoglycosides.[4] The use of broad-spectrum antibiotics, and especially carbapenems, can suppress the overgrowth of many pathogens, and this selection pressure can facilitate overgrowth of *S. maltophilia*.[4] In addition, *S. maltophilia* is an environmentally opportunistic pathogen, and this situation may lead to colonization by this organism. Over the past decades, *S. maltophilia* infections have become important nosocomial infections, especially those associated with bacteremia.[1,2]

Another risk factor for *S. maltophilia* infection is long-term hospitalization.[2] Latzer et al., found that the median length of stay prior to the time of *S. maltophilia* isolation was 40 days (range 23.5-59 days) in critically ill children. Their patients who did not survive were those who, at the time of culture acquisition, had already had a prior longer length of stay (50 days in non-survivors vs. 18.5 in those who survived, p=0.002).[10] As a result, *S. maltophilia* should be considered a breakthrough infection including bacteremia in the pediatric population receiving broad-spectrum antibiotics during a prolonged hospital stay.[4]

The presence of an indwelling CVC is a risk factor for biofilm formation with direct or indirect contact on various surfaces, such as glass, plastics, and host tissues. Biofilm formation is a significant feature of S. *maltophilia*.[1,2] The significance of catheter removal in the treatment of catheter-related *S. maltophilia* BSI is unclear as well as some studies have suggested removal of the central line

TABLE 2. *Patient bacteremia duration, treatment, antibiogram, and prognosis*

Patient	Duration of bacteremia*	Treatment	Trimethoprim-sulfamethoxazole **	Levofloxacin **	Ciprofloxacin **	Outcome
1	4 days	Trimethoprim-sulfamethoxazole	S	S	S	Discharged
2	8 days	Ciprofloxacin	S	S	S	Discharged
3	No control blood culture	Ciprofloxacin	-	S	S	Exitus (*** 5th day)
4	12 days	Trimethoprim-sulfamethoxazole	S	S	S	Exitus (*** 20th day)
5	No control blood culture	Ciprofloxacin	R	R	-	Exitus (*** 2nd day)
6	9 days	Ciprofloxacin	S	S	S	Discharged
7	23 days	Trimethoprim-sulfamethoxazole and ciprofloxacin	S	S	S	Discharged
8	6 days	Trimethoprim-sulfamethoxazole and ciprofloxacin	S	I	-	Discharged
9	5 days	Ciprofloxacin	S	I	S	Discharged
10	25 days	Levofloxacin	S	S	R	Discharged
11	No control blood culture	No	S	I	R	Exitus (*** 1st day)
12	7 days	Ciprofloxacin	S	S	S	Discharged

***Duration between first positive and negative cultures**
****Antimicrobial susceptibility, S: Sensitive R: Resistant, I: Intermediate**
*****After first positive culture**

in addition to antibiotic therapy.[2,11]

S. maltophilia may be associated with polymicrobial infections. Araoka et al., reported a higher mortality rate related to bacteremia in cases of mixed infection with enterococci.[2,12] Furthermore, polymicrobial infections with *S. maltophilia* and other organisms, such as *Enterobacter cloacae*, may result in the emergence of antibiotic resistance, as this species carries resistance plasmids or transposons.[13]

S. maltophilia commonly causes respiratory tract infections and bacteremia. Approximately 11 % of cystic fibrosis patients are colonized by *S. maltophilia*.[2] *S. maltophilia* is also a cause of ventilator-associated pneumonia.[1] The prevalence of *S. maltophilia* infections was 1.2 % among children ≤7 years and 1.4 % among children ≤18 years old in SENTRY studies conducted in 1998-2003 and in 2004.[1] Pneumonia with bacteremia is associated with a higher mortality when compared with catheter-related bloodstream infection. *S. maltophilia* may cause pulmonary hemorrhage, especially in adult patients with hematologic diseases.[14] In the present study, *S. maltophilia* was regarded to have a direct role in the deaths of three of the fatal cases. The deaths of two of the non-survivors were associated with pneumonia. *S. maltophilia* can adhere to human bronchial epithelial cells, and biofilms can be formed on lung cells.[2] *S. maltophilia* also produces StmPr1 protease, which has been implicated in the damage and destruction of lung tissue resulting from *S. maltophilia* invasion.[15]

Studies on the treatment options for *S. maltophilia* infections, including bacteremia, are limited in the pediatric population.[10] In the current study, the most frequently used antimicrobial agent was ciprofloxacin, followed by trimethoprim/sulfamethoxazole (TMP/SMX). Latzer et al., found that a combination of ciprofloxacin and TMP/SMX significantly extended the survival time and that ciprofloxacin provided a significantly longer survival time than TMP/SMX when either was given as a monotherapy in their critically ill pediatric patients.[10]

The present study is one of the few studies of *S. maltophilia* bacteremia in childhood. The clinical features of *S. maltophilia* bacteremia in our study were similar to those reported in the current literature. Notably, two of our non-survivors were associated with pneumonia. This opportunistic pathogen should therefore be viewed as a breakthrough agent for bacteremia in pediatric patients with underlying disease who have been exposed to broad-spectrum antibiotics during long-term hospital stay.■

REFERENCES

1. Chang YT, Lin CY, Chen YH, Hsueh PR. Update on infections caused by Stenotrophomonas maltophilia with particular attention to resistance mechanisms and therapeutic options. *Front Microbiol.* 2015; 6:893.
2. Brooke JS. Stenotrophomonas maltophilia: an emerging global opportunistic pathogen. *Clin Microbiol Rev.* 2012; 25(1):2-41.
3. Jeon YD, Jeong WY, Kim MH, Jung IY, et al. Risk factors for mortality in patients with Stenotrophomonas maltophilia bacteremia. *Medicine (Baltimore).* 2016; 95(31):e4375.
4. Ebara H, Hagiya H, Haruki Y, Kondo E, Otsuka F. Clinical Characteristics of Stenotrophomonas maltophilia Bacteremia: A Regional Report and a Review of a Japanese Case Series. *Intern Med.* 2017; 56(2):137-42.
5. Wu PS, Lu CY, Chang LY, Hsueh PR, et al. Stenotrophomonas maltophilia bacteremia in pediatric patients-- a 10-year analysis. *J Microbiol Immunol Infect.* 2006; 39(2):144-9.
6. Furuichi M, Ito K, Miyairi I. Characteristics of Stenotrophomonas maltophilia bacteremia in children. *Pediatr Int.* 2016; 58(2):113-8.
7. Clinical and Laboratory Standards Insitute. Performance Standards for Antimicrobial Susceptebility Testing: Nineteenth Informational Supplement. M100-S19. Wayne, Pa: CLSI; 2009.
8. Clinical and Laboratory Standards Insitute. Performance Standards for Antimicrobial Susceptebility Testing: Twenty-First Informational Supplement. M100-S21. Wayne, Pa: CLSI; 2011.
9. CDC. Bloodstream Infection Event (Central Line-Associated Bloodstream Infection and Non-central-Line-Associated-Bloodstream-Infection). 2019. [Acceso: 24 de octubre de 2019]. Disponible en: https://www.cdc.gov/nhsn/pdfs/pscmanual/4psc_clabscurrent.pdf
10. Tokatly Latzer I, Paret G, Rubinstein M, Keller N, et al. Management of Stenotrophomonas maltophilia Infections in Critically Ill Children. *Pediatr Infect Dis J.* 2018; 37(10):981-6.
11. Naidu P, Smith S. A review of 11 years of Stenotrophomonas maltophilia blood isolates at a tertiary care institute in Canada. *Can J Infect Dis Med Microbiol.* 2012; 23(4):165-9.
12. Araoka H, Baba M, Yoneyama A. Risk factors for mortality among patients with Stenotrophomonas maltophilia bacteremia in Tokyo, Japan, 1996-2009. *Eur J Clin Microbiol Infect Dis.* 2010; 29(5):605-8.
13. Juhász E, Krizsán G, Lengyel G, Grósz G, et al. Infection and colonization by Stenotrophomonas maltophilia: antimicrobial susceptibility and clinical background of strains isolated at a tertiary care centre in Hungary. *Ann Clin Microbiol Antimicrob.* 2014; 13:333.
14. Kim SH, Cha MK, Kang CI, Ko JH, et al. Pathogenic significance of hemorrhagic pneumonia in hematologic malignancy patients with Stenotrophomonas maltophilia bacteremia: clinical and microbiological analysis. *Eur J Clin Microbiol Infect Dis.* 2019; 38(2):285-95.
15. Windhorst S, Frank E, Georgieva DN, Genov N, et al. The major extracellular protease of the nosocomial pathogen Stenotrophomonas maltophilia: characterization of the protein and molecular cloning of the gene. *J Biol Chem.* 2002; 277(13):11042-9.

ANNEX

DEFINITIONS

Previous antimicrobial therapy: intramuscular and intravenous administrations of antibacterial drugs more than 48 h within 30 days before detecting blood culture-positivity.[1]

Duration of bacteremia: the time in days between the first positive and the first negative blood culture.[1]

Polymicrobial bacteremia: identification of two or more bacterial species in multiple blood culture bottles of samples collected within 24 h. [2]

Concomitant infection: isolation of an organism other than *S. maltophilia* within 1 week of the first positive blood culture. [2]

If *S. maltophilia* or an identical causative pathogen was isolated from a patients' clinical specimen (including contaminated blood culture) within 30 days before the onset of bacteremia, it was recorded as a previous isolation of *S. maltophilia* or previous isolation of an identical pathogen.[3]

Persistently positive blood culture: isolation of *S. maltophilia* from subsequent blood cultures taken 2 days from the treatment. [4]

Immunosuppressed patient: who receiving chemotherapy or radiotherapy for malignancies, immunosuppressive therapies with a daily dose ≥ 20 mg prednisolone-equivalent steroid (≥14 days) monoclonal antibodies, antimetabolite drugs or T cell inhibitors within the preceding 30 days of the positive blood culture, neutropenia.[4]

CVC and mechanical ventilation: use within 48 h before first positive blood culture.[4]

Community-acquired bacteremia: bacteremia that occurred within 48 hours of admission and in patients who did not meet the criteria for healthcare-associated bacteremia. [2,5]

Healthcare-associated bacteremia: bacteremia that occurs in a patient who has stayed in a nursing home, has been admitted to a hospital within the previous month, received hemodialysis, or has been treated as an outpatient with intravenous antibiotics or chemotherapy within the previous 2 weeks. [2,5]

Hospital-acquired bacteremia: a positive blood culture obtained from patients hospitalized for > 48 hours after admission. [2,5]

Sepsis and septic shock: according to the international consensus definitions. [6]

Removal of the CVC: when this was performed no later than 5 days after blood cultures were drawn.[2]

Empirical therapy: administration of antibiotics at the onset of symptoms of bacteremia. [7]

Adequate treatment: targeted administration of at least one antimicrobial agent to which *S. maltophilia* was susceptible in vitro[2] and appropriate empiric therapy was defined as microorganism susceptibility to one of several antimicrobial agents administered within 72 hours after the onset of bacteremia. [8]

Response to treatment: either as the resolution of all clinical manifestations of bacteremia or by a follow-up blood culture that was negative for *S. maltophilia* during treatment. [9]

Failure of treatment: persistence or progression of the clinical signs and symptoms of bacterial infection and/or blood cultures that were positive for *S. maltophilia* during treatment.[9]

***S. maltophilia* related death**: it occurred within 7 days of the positive culture and if clinical signs and symptoms of the infections were documented in the medical record when the patient died and was considered that the patient would not have died in the absence of bacteraemia.[10]

REFERENCES

1. Kagen J, Zaoutis TE, McGowan KL, Luan X, Shah SS. Bloodstream infection caused by *Stenotrophomonas maltophilia* in children. *Pediatr Infect Dis J.* 2007; 26(6):508-12.
2. Jeon YD, Jeong WY, Kim MH, Jung IY, et al. Risk factors for mortality in patients with *Stenotrophomonas maltophilia* bacteremia. *Medicine (Baltimore).* 2016; 95(31):e4375.
3. Kim SH, Cho SY, Kang CI, Seok H, et al. Clinical predictors of *Stenotrophomonas maltophilia* bacteremia in adult patients with hematologic malignancy. *Ann Hematol.* 2018;97(2):343-50.
4. Furuichi M, Ito K, Miyairi I. Characteristics of *Stenotrophomonas maltophilia* bacteremia in children. *Pediatr Int.* 2016; 58(2):113-8.
5. CDC. Bloodstream Infection Event (Central Line-Associated Bloodstream Infection and Non-central Line Associated Bloodstream Infection). 2019. [Acceso: 25 de octubre de 2019]. Disponible en: https://www.cdc.gov/nhsn/pdfs/pscmanual/4psc_clabscurrent.pdf
6. Mathias B, Mira JC, Larson SD. Pediatric sepsis. *Curr Opin Pediatr.* 2016; 28(3):380-7.
7. Lakatos B, Jakopp B, Widmer A, Frei R, et al. Evaluation of treatment outcomes for *Stenotrophomonas maltophilia* bacteraemia. *Infection.* 2014; 42(3):553-8.
8. Wang CH, Lin JC, Lin HA, Chang FY, et al. Comparisons between patients with trimethoprim-sulfamethoxazole-susceptible and trimethoprim-sulfamethoxazole-resistant *Stenotrophomonas maltophilia* monomicrobial bacteremia: A 10-year retrospective study. *J Microbiol Immunol Infect.* 2016; 49(3):378-86.
9. Boktour M, Hanna H, Ansari S, Bahna B, et al. Central venous catheter and *Stenotrophomonas maltophilia* bacteremia in cancer patients. *Cancer.* 2006; 106(9):1967-73.
10. Mutlu M, Yilmaz G, Aslan Y, Bayramoglu G. Risk factors and clinical characteristics of *Stenotrophomonas maltophilia* infections in neonates. *J Microbiol Immunol Infect.* 2011; 44(6):467-72