



Bacteremia among Febrile Under Five Children at Makole Health Centre, Dodoma City, Tanzania

Cecilia Lucas Msafiri^{1*}, Athanase Lilunguru², Francisca Kimaro³ and Cecilia K. Ng'weshemi⁴

¹Maternal and Child health, University of Dodoma Hospital, Tanzania

²Department of Obstetrics and Gynecology, University of Dodoma, Tanzania

³Department of Pediatrics and Child Health, University of Dodoma, Tanzania

⁴Head of Department of Public Health, University of Dodoma, Tanzania

*Corresponding Author: Cecilia Lucas Msafiri, Maternal and Child health, University of Dodoma Hospital, Tanzania.

Received: October 22, 2018; Published: December 03, 2018

Abstract

Background: In developing countries, febrile illnesses are the major cause of morbidity and mortality among children and is the most common reason for hospitalization. Viral infections, bacteremia, and malaria are among the commonest causes of fever in developing countries. Bacteremia has a high mortality among non-malarial febrile illnesses in African children. Understanding prevalence of bacteremia among febrile under-five children in Dodoma will help to prepare empirical treatment guidelines for management of febrile illnesses in children.

Methods: An analytical cross-sectional study conducted at Makole Health Centre, involving 130 under-five children with the body temperature above 37.5°C. Thorough history taking, physical examinations, and blood for culture and sensitivity were done.

Results: Prevalence of bacteremia was 10.8%, *Staphylococcus aureus* was commonly isolated (42.9%), *Escherichia coli* and *Salmonella typhi* found to contribute 28.6% and 21.4% respectively, while *Proteus* species were not common (7.1%).

Results: Bacteremia is not common cause of fever among under-five children in Dodoma-Tanzania, commonly isolated bacteria among febrile children was *S. aureus*.

Keywords: Bacteremia; Febrile Illnesses; Underfive; Children; Dodoma

Introduction

GNB: Gram-Negative Bacteria; IMCI: Integrated Management of Childhood Diseases; MRDT: Malaria Rapid Diagnostic Test; SPSS: Statistical Product and Service Solutions; UDOM: University of Dodoma; UNICEF: United Nations Children's Fund; UTI: Urinary Tract Infections; WHO: World Health Organization

Introduction

Every year, 6.3 million children die before they reach their fifth birthday; many during the first year of life, Sub-Saharan Africa contributed roughly half (49.6%, 3.113 million) of under-5 deaths worldwide in 2013 [1].

Febrile illness is the major cause of morbidity and mortality among children after neonatal period and is the most common reason for hospitalization [2]. In Tanzania fever is the main

symptom reported by parents it accounts 71.5% in Ifakara and 63% Dar es salaam among children admitted (Bosman and Programme, 2013).

Viral infections, bacteremia, and malaria are the commonest cause of febrile illness in children in developing countries. Whilst most episodes of viral infections are self-limiting, bacteremia can be life threatening if not properly managed as can be complicated by septic shock and death. Due to the lack of diagnostic test in Sub Saharan Africa, clinicians rely on clinical judgment; therefore, most cases of febrile illness were treated as Malaria. Recently studies suggested that Malaria is not the common cause of fever in under-five children [4,5]. Majority of febrile illnesses are due to self-limiting viral infections. A study conducted in outpatient Tanzanian children found 70.5% had viral infections [4]. With malaria transmission declining in many parts of Africa, there is increasing awareness that most of the febrile illnesses are due to

other infectious diseases some of which are life-threatening, that must be identified and treated appropriately [6].

Therefore, while there is still a need to create community awareness regarding non-malaria fevers and to develop diagnostic criteria for non-malarial febrile illnesses in primary care setting, in order to improve diagnosis and management of these diseases in developing countries [4,7], it is important to define the cause of fever instead of just treating febrile illnesses empirically as recommended by Integrated Management of Childhood illness. There is lacking coordinated approach for management of febrile illnesses while deaths due to infections causing fever in children such as bacteremia are increasing [8]. The management of fever needs to take into account the toxicity, immune status, and age of the patient as well as source of infection.

Bacteremia has emerged as a major cause of non-malarial febrile illnesses among African children, with high mortality occurring in first 48 hours of hospitalization [9]. The blood bacterial infections are the most serious situation, a study conducted at Muhimbili National hospital found mortality rate of 35% among children with bacteremia [10] therefore timely detection and identification of bloodstream pathogen is important.

The majority of health facilities in Sub-Saharan Africa, have limited laboratory capacity to find etiologies of febrile illness, including bacteremia, the blood culture technique remains the standard criteria for the diagnosis of bacterial infections. However blood culture is limited in our setting by being resource extensive and the results take a long time.

Prevalence of bacteremia among hospitalized children in Africa is found to be 8.3%, ranging from 3.3% to 19.9%, the lowest found to be Kenya with the prevalence of 3.3% [11]. In Tanzania a study done at Bugando Medical Centre found a prevalence of bacteremia among admitted febrile children of 6.6% [12]. In the United Kingdom bacteremia is very low, estimated to be 1.42 in every 1000 children [6].

The most common pathogenic bacteria isolated among inpatient children in many parts of Sub-Saharan Africa, are gram-negative bacteria mainly non-typhoidal *Salmonella*, *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Escherichia coli* although few gram-positive bacteria like *Staphylococcus aureus* isolated [13]. With the introduction of Pneumococci Conjugate Vaccine in the United Kingdom, there was annual reduction rate of 10.6% in

infections prevented by vaccine and the annual increase of 6.7% in Gram-Negative Bacteria (GNB) [14].

Surveillance of prevalence and etiology of bacteremia among febrile under-five children is critical in guiding health care workers towards appropriate management of febrile illnesses. The study aimed to describe prevalence and etiology of bacteremia among febrile under five children at Dodoma City.

Materials and Methods

Study design: Analytical cross-sectional, laboratory investigation (blood for culture and sensitivity).

Study area: The study was conducted at Makole Health Centre, Dodoma- Tanzania.

Study population: All febrile children aged 1 month to 59 months involved.

Inclusion criteria: Children aged from 1- 59 months, measured axillary body temperature of > 37.5°C were included in the study.

Exclusion criteria: Children who were confirmed to be having malignancy and tuberculosis.

Sample size: Sample size were calculated by using of Kish and Leslie formula, by using prevalence of 9.1% according to the study done at Kilombero Morogoro, Tanzania by Lengeler [1]. The total of 130 febrile under - five children were included.

Sampling technique: Random sampling method was used to get the required sample size.

Data collection tools and techniques: A semi structured questionnaire and physical assessment was used to gather information, also Blood for culture and sensitivity was taken at enrolment.

Laboratory procedure: About 1 - 3 mls of venous blood specimen were collected aseptically by a trained laboratory technician by using standard BACTEC pediatrics blood culture bottles. The venipuncture site was disinfected with 70% isopropyl alcohol and allowed to dry prior to drawing blood, a single blood culture bottle was used per patient. The blood culture bottle was incubated in a BACTEC 9050 automated blood culture system. BACTEC 9050 series of blood culture instruments, are designed for the rapid detection of microorganisms in clinical specimens and detects positive cultures based on CO₂ production. A positive reading

indicated the presumptive presence of viable microorganisms in the vial. Bottles were considered negative if a bottle did not show any bacteria growth after 8 days. Blood cultures flagged as a positive was to undergo gram stain on being sub cultured onto standard media MacConkey ager, blood agar and chocolate ager. Following an overnight incubation at 37°C, isolated colonies were identified by using convectional biochemical tests. The antibiotics susceptibility assessment were determined by the Kirby Buaer disc diffusion method for *in vitro* drug susceptibility for pathogenic bacteria isolates according to clinical laboratory standard institute (CLSI). The Kirby Buaer disc test used standard interpretative criteria and used antibiotic disc for locally available antibiotics used for management common childhood illnesses. The following antibiotic used ampicillin, chloramphenicol, ceftriaxone, ciprofloxacin, gentamicin, erythromycin, Clindamycin, Cefuroxime, tetracycline and penicillin to determine susceptibility test.

Data handling and data analysis: Raw data collected by the researcher were processed before carrying out the analysis. Processing included the elimination of unusable, ambiguous answers, and contradictory data were detected and corrected or omitted when necessary. After correcting errors, the researcher formulated a coding scheme which was used for summarizing and analyzing the information given to the researcher. Then data was stored in soft and hard copies. Data were entered and analyzed using SPSS Version 20. Means, median, range and standard deviation calculated for continuous variables. Bar chart and pie chart used to display the data. Frequencies and percentages were calculated to obtain the prevalence, and etiology of bacteremia among febrile under five children.

Results and Discussion

Social demographic characteristics of febrile under five children: A study recruited total of 130 febrile under-five children were outpatient at the pediatric department at Makole Health Centre. Results show that majority 74 (56.9%) were aged from 12 to 35 months with the mean age of 23.45 months, with the standard deviation of 12.43 which range from 1 month to 54 months. Most children 72 (55.4%) were males and 48 (44.6%) were females. Majority of guardians 92 (70.8%) were aged between 18 to 35 years while only 2 (1.5%) were less than 18 years. The majority of respondents 123 (94.6%) were the biological mother of the febrile under five children, while 5.4% comprised of others (father, grandmother and aunt) and 88 (67.7%) were married and the majority lived in the urban area. The level of education among

guardians 61 (46.9%) had the primary education with only 7 (5.4%) had tertiary education level.

Variable	Number (%)
Febrile under five children	
Age	
1 to 11 months	27(20.8%)
12 to 35 months	74 (56.9%)
36 to 60 months	29 (22.3%)
Sex	
Females	58 (44.6%)
Males	72 (55.4%)
Complete immunization	
Yes	128 (98.5%)
No	2 (1.5%)
Demographic characteristics of caretakers	
Age	
< 18 years	2 (1.5%)
18 to 35 years	92 (70.8%)
> 35 years	36 (27.7%)
Sex	
Males	2 (1.5%)
Females	128 (98.5%)
Education level	
No education	36 (27.7%)
Primary education	61(46.9%)
Secondary education	26 (20.0%)
Tertiary education	7 (5.4%)
Occupation status	
House wife	82 (63.1%)
Petty business	39 (30.0%)
Employed	9 (6.9%)
Relation with the child	
Mother	123 (94.6%)
Others	7 (5.4%)
Marital status	
Married	88 (67.7%)
Single	24 (18.5%)
Cohabiting	18 (13.8%)
Residence	
Urban	105 (80.8%)
Rural	25 (19.2%)

Table 1: Social demographic characteristics, among biological mother and febrile under five children N = 130.

Prevalence of bacteremia among febrile under five children attending Makole Health Centre, Dodoma Municipality

A total of 130 febrile under five children were tested for blood culture, only 14 (10.8%) children had bacteremia (positive blood culture) while 116 (89.2%) febrile children, showed no bacterial growth on blood culture. The prevalence of bacteremia was higher among the children of the aged group of 1- 11 months (57.1%) than the age group of 12 - 35 months (28.6%) and 36 -59 months (14.3%). Males (57.1%) children were more infected than females (42.9%). Majority of children with bacteremia were from the rural area (64.3%). A large proportion of children with bacteremia presented with cough symptoms (64.3%), had MRDT negative results (87.7%) and were malnourished (85.7%) (Figure 1).

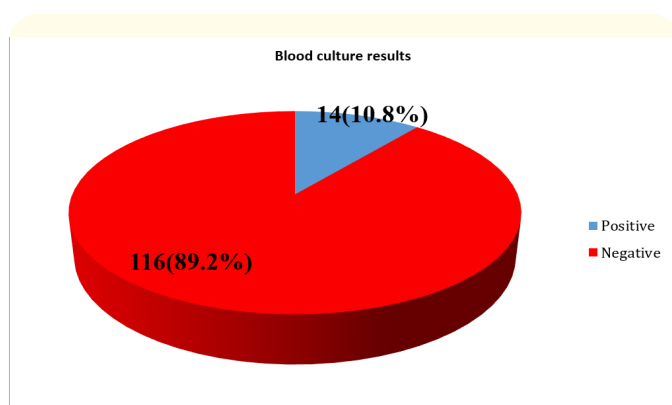


Figure 1: Prevalence of bacteremia.

Etiology of Bacteremia, among febrile under five children at Makole Health centre, Dodoma Tanzania

Among the 130 febrile under five children, 14 children had positive blood culture where *Staphylococcus aureus* isolated from 6 children (42.9%), *Escherichia coli* and *Salmonella typhi* found to contribute 28.6% and 21.4% respectively, while *Proteus* species were found only in 1 (7.1%) children as illustrated in figure 2.

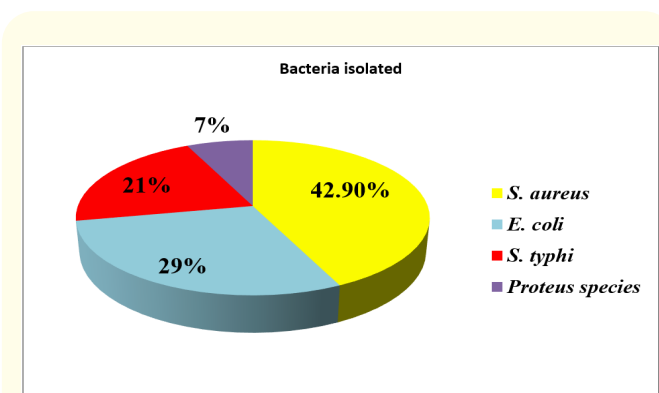


Figure 2: Distribution of causative bacteria.

Discussion

The study was carried out to determine the prevalence and etiology of bacteremia among febrile under-five children with bacteremia. It involved history taking, clinical assessment and laboratory test. A total of one hundred and thirty febrile under five children were included in the study. The study has found out that bacteremia was not a common cause of fever among febrile under five children, attending at Makole Health Centre, Dodoma Tanzania, The prevalence of bacteremia was 10.8% therefore, and fever could be attributed to other causes like viral and fungal infections due to the introduction of bacteria preventable vaccines. A study conducted to assess the causes of fever in outpatient Tanzanian children has found 70.5% of children with fever were due to viral infection while bacteremia contributed only 22% [1].

The current study has found the prevalence of bacteremia to be 10.8%, similar results found with other studies conducted in Pemba and Morogoro, with the prevalence of 8% and 9.1% respectively [2,3]. The results are slightly higher than other studies conducted in Kenya and Ghana where prevalence of 3.3% and 3.1% respectively was reported [4,5]. The differences can be explained that Dodoma Region has high prevalence of malnutrition [6] which predispose the child to infections and may increase burden of bacteremia. The results contrast with the results found in India where a high prevalence of bacteremia (23.1%) observed [7,8]. However study done in Italy found very low prevalence of bacteremia as compared to African countries [9], the high prevalence of African countries can be contributed to high prevalence of immunosuppression due to malnutrition and other infectious disease like HIV/AIDS and measles leading to bacteremia.

Differences in results could be because Indian study was conducted in children admitted to the pediatric ward, include newborn and children suspected with sepsis and setting was tertiary care Hospital, whereby children admitted there could have the serious bacterial infection and could have been treated for other infection at primary health care settings.

Due to the small sample size of children with bacteremia, the study was not able to show factors associated with bacteremia, however, there was a tendency of bacteremia to be higher in males as compared with females, similar findings were reported in a study conducted in India [7]. Our study identified more children with bacteremia were infant, those living in rural area, and were malnourished. The reasons for infants were more affected with bacteremia than another age group, could be due to their immature immune system as compared to other older age group.

This study has found children from rural were more affected, this could be due to inaccessible to health facilities, poor social economic status, health-seeking behavior and low level of education of their care takers. Similar results were reported that the proportion of positive blood culture decreased with urbanity and higher social economic status [4].

Our study revealed that malnourished children were more affected, this could be due to the fact that malnourishment predisposes a child to infections, a similar result was documented by Kibuuka, et al. done at Bugando [10]. Other studies found fever duration of 2 or more weeks, incomplete vaccination, prior treatment with antimalarial, low education of primary care takers, high body temperature and high neutrophils counts were predictors of bacteremia [5,10,11] which were not done in our study due to a small number of children with bacteremia.

This study has revealed that the under-five febrile children were mostly affected by *Staphylococcus aureus* (43%) and *E. coli* (29%) while *Salmonella typhi* (21%) and *Proteus species* (7%) were not the common cause of bacteremia. The same results found in Uganda that, *Staphylococcus aureus* was the commonest cause of bacteremia which contributed to 43% of bacteria isolated [10].

Results are contrasted with the study conducted in Ghana whereas Non typhoidal *Salmonella* (33.3%) and *Salmonella typhi* (25%) were mostly isolated pathogen among children present with fever in the outpatient department. The differences in etiology could be explained as per Sothman, et al. 2015 study included all children below fifteen years. Mehrotra study conducted in North India has found the *Klebsiella* species organism were the most common organism which was 44.4% followed by *Staphylococcus aureus* (14.8%) [8]. Azzari, et al. in a study done in Italy found *S. pneumoniae* was confirmed to be one of the more frequent pathogen responsible for bacteremia, with over 80% of cases attributable to the pathogen followed by *H. influenza* [9]. The differences could be the differences in geographical location, seasons, the timing of vaccination and health status of children included in the study.

The systematic review reported that the most common pathogenic bacteria isolated among inpatient children in many parts of Sub-Saharan Africa, are gram-negative bacteria mainly non-typhoidal *Salmonella*, *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Escherichia coli* although a few gram-positive bacteria isolated like *Staphylococcus aureus* [12]. Differences in observation reported with our study can be explained that our

study included febrile under five children at outpatient department and not admitted children, also a high coverage of vaccination status among under five children could be the reasons.

Conclusion

There is a low prevalence of bacteremia among febrile under five children at Dodoma City and *Staphylococcus aureus* were found to be the commonest cause of bacteremia among febrile under-five children.

Acknowledgements

I would like to acknowledge Mr. Toba Nguvila for the financial support in conducting the research.

Conflict of Interest

None.

Bibliography

1. Lengeler C., et al. "Beyond Malaria - Causes of Fever in Outpatient Tanzanian Children". *New England Journal of Medicine* 370 (2014): 809-817.
2. Lundgren IS., et al. "Bacteremia and Malaria in Tanzanian Children Hospitalized for Acute Febrile Illness". *Journal of Tropical Pediatrics* 61.2 (2014): 81-85.
3. Thriemer K., et al. "The Burden of Invasive Bacterial Infections in Pemba, Zanzibar". *PLoS One* 7.2 (2012): e30350.
4. Sothmann P., et al. "Urbanicity and Paediatric Bacteraemia in Ghana - A Case-Control Study within a Rural- Urban Transition Zone". *PLoS One* 10.9 (2015): e0139433.
5. Onchiri FM., et al. "Low Bacteremia Prevalence Among Febrile Children in Areas of Differing Malaria Transmission in Rural Kenya: A Cross-Sectional Study". *Journal of the Pediatric Infectious Diseases Society* 5.4 (2015): 385-394.
6. Report F and Centre N. "Ministry of Health and Social Welfare Tanzania National Nutrition Survey 2014" (2014).
7. Tiwari DK., et al. "A Study on the Bacteriological Profile and Antibigram of Bacteremia in Children Below 10 Years in a Tertiary Care Hospital in Bangalore, India". *Journal of Clinical and Diagnostic Research* 7.12 (2013): 2732-2735.
8. Mehrotra A and Mishra S. "Determination of the Causative Agents of Bacteremia in Children under 5 Years and their Susceptibility Pattern to the Antibiotics". *Global Journal of Medical Research* 14.1 (2014).

9. Azzari C., *et al.* "The burden of bacteremia and invasive diseases in children aged less than five years with fever in Italy". *Italian Journal of Pediatrics* 41 (2015): 92.
10. Kibuuka A., *et al.* "Bacteremia among Febrile Ugandan Children Treated with Antimalarials Despite a Negative Malaria Test". *American Journal of Tropical Medicine and Hygiene* 93.2 (2015): 276-280.
11. Christopher A., *et al.* "Bacteremia and resistant gram-negative pathogens among under-fives in Tanzania". *Italian Journal of Pediatrics* 39 (2013): 27.
12. Hildenwall H., *et al.* "Causes of non-malarial febrile illness in outpatients in Tanzania". *Tropical Medicine and International Health* 21.1 (2016): 149-156.

Volume 2 Issue 1 January 2019

© All rights are reserved by Cecilia Lucas Msafiri, *et al.*