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RATE OF BLOOD CULTURE POSITIVITY

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Abstract

Introduction

Blood culture remains the reference standard for the diagnosis of bloodstream infections. Bloodstream infection (BSI) is a serious medical condition associated with a high mortality rate. There is variation in the rate of positive culture from different settings. Therefore the purpose of the present work is to determine the rate of culture-positive blood in our laboratory.

Method

Brain Heart Infusion Broth was provided by our lab. (Bethzatha Advanced Laboratory) for different hospitals and other health Institutions were inoculated with patient blood as recommended by the laboratory and were sent for isolation, identification, and antimicrobial susceptibility tests from August 21, 2023, to June 28, 2024. Standard bacteriological methods were used to subculture inoculum on primary isolation media, MacConkey, Blood Agar, Mannitol salt, and Nutrient Agar after 24 hours of incubation at 37^0c aerobically. Then proceeding subcultures were done until seven days. Bacterial colonies on MacConkey, Blood Agar, Manitol salt, and Nutrient Agar media were identified using standard biochemical testing methods.

Results

A Total of 386 blood cultures were sent to the Bethzatha Advanced Laboratory for isolation, identification of bacterial pathogens, and antimicrobial susceptibility tests. Out of these blood cultures, 92(23.8%) were positive. The most frequent isolates from gram-negative bacteria were *Klebsiella species* 15(16.3%), and the most dominant isolates from gram-positive bacteria were coagulase-negative staphylococcus (CoNS) species.

Conclusion

The present result demonstrated that the rate of positivity of blood culture in the present study is comparable to most reports on positivity of blood culture. Thus it is believed the present finding can give clues to clinicians on blood culture results in the present setting of hospitals and health institutions in Addis Ababa.

Keywords: blood culture, rate of positivity, bacterial isolates, antimicrobial susceptibility.

Introduction

Blood stream infection (BSI) is a serious medical condition associated with a high mortality rate, ranging from 14% to 37%, with the highest values registered in intensive care settings **[1,2]**. Diagnosis of BSI is established when the growth of one or more microorganisms (s) is obtained in a blood culture drawn from a patient with clinical signs of infection and the contamination has been ruled out. These infections are classified as primary, when no other site of infection is evident, or secondary when associated with clinical or microbiological confirmation of infection at a defined body site.

Blood cultures have become critically important **[3,4]**. The primary goals are maximum detection of true pathogens with minimal contamination and speedy delivery of results. Delays in blood culture (BC) results may delay the initiation of appropriate antibiotic treatment, increasing the risk of death **[5]**. Best practice standards have been proposed for various aspects of blood culturing **[4,5]**. Positive blood culture results can help a clinician's early diagnosis and start empirical antimicrobials at the correct time. Early detection of bacteremia followed by pathogenic microorganism identification and determination of antimicrobial susceptibility is important for guiding antibiotic therapy. The mortality rate of patients receiving appropriate therapy is considerably lower than that of patients treated with ineffective antibiotics **[5,6]**. Blood culture is the main tool used to identify causative pathogens **[4,5,6]**. Various factors affect the positivity rate of blood culture, including the timing of sample collection, skin antiseptic preparation, number of blood culture sets, blood volume inoculated in individual culture bottles number of organisms in the original samples, and culture media used **[5,6]**. Cultures obtained before antimicrobial therapy are recommended because antibiotic administration may interfere with bacterial growth **[6]**. Collection of at least 2 blood culture sets within a 24-hour period is recommended for the detection of BSI in adult patients **[6]**. Most blood cultures become negative even when there is an infectious agent because of several factors

mentioned **[5,6]**. However, isolation of etiologic agents from septicemia patients is crucial for the appropriate treatment.

There is a variation in the rate of positive culture from different settings. Reports from different works show the positivity rate of blood culture from 5% to 40% **[1]**. Since clinicians are very much concerned about the recovery of etiologic agents and have antimicrobial susceptibility tests done it is important for them to know whether culture results give true positivity or not. Therefore the purpose of the present work is to determine the rate of culture-positive blood in our laboratory.

Materials and Methods

Brain Heart Infusion Broth was prepared at Bethzatha Advanced Medical Laboratory, Addis Ababa, from commercial powder(Accumix, Express) in 50 ml and 25 ml volumes for adult and children Blood Culture respectively as recommended by Cheesbrohough (2006). These were provided to requesting Hospital Departments and Health institutions in Addis Ababa, Ethiopia. The blood cultures were sent to Bethzatha Advanced Laboratory from different hospitals and other health Institutions for isolation, identification, and antimicrobial susceptibility tests from August 21, 2023, to June 28, 2024. Standard bacteriological methods were used to subculture inoculum on primary isolation media, MacConkey, Blood Agar, Mannitol salt, and Nutrient Agar after 24 hours of incubation at 37^0c aerobically. Then proceeding subcultures were done until seven days. Bacterial colony on MacConkey, Blood Agar, Mannitol salt, and Nutrient Agar media were identified using standard biochemical testing methods. The retrospective data of these blood cultures over a year period was analyzed.

Results

A Total of 386 blood cultures were sent to the Bethzatha Advanced Laboratory for isolation, identification of bacterial pathogens, and antimicrobial susceptibility tests. Out of these blood cultures, 92(23.8%) were positive **(Table 1)**.

Table 1: Rate of Positive Blood Culture

BLOOD CULTURED	TOTAL	PERCENT
NEGATIVE BLOOD CULTURE	294	76.16
POSITIVE BLOOD CULTURES	92	23.8
TOTAL	386	100

The frequent bacterial isolates are given in Table 2 below. The most frequent isolates from gram-negative bacteria were *Klebsiella species* 15(16.3%), and the most dominant isolates were coagulase-negative staphylococcus (CoNS) species **(Table 2)**.

Table 2: Frequent Bacterial Isolates from Blood cultures from August 21, 2023, to June 28, 2024

GRAM-NEGATIVE- ISOLATES	NUMBER	PERCENT
Klebsiella Species	15	16.3
Pseudomonas Species	9	9.9
Citrobacter Species	4	4.3
Proteus Species	1	1
E. Coli	2	2.1
Enterobacter Spp.	2	2.1
Gram-Positive		
Acinetobacter	1	1
Staphylococcus Aureus	28	30.4
Coagulase Negative Staphylococci Species	30	32.6
TOTAL	92	99.5

The antimicrobial susceptibility pattern of the dominant isolates is given in Table 3. Intermediate susceptibility is added to the susceptibility result, thus only resistance and susceptibility are shown in **Table 3**. Of the *Klebsiella* isolates, 80% (12/15), 67%(10/15), and 60% (9/15) were respectively resistant to nalidixic acid, ampicillin, gentamicin, and tobramycin. Similarly, 67% (6/9) of *Pseudomonas species* were resistant to ampicillin and gentamicin.

Table 3: Antimicrobial susceptibility of the bacterial Isolates from Blood cultures from August 21, 2023, to June 28, 2024

ISOLATES	TOTAL	AMP		GEN		IMP		TOB		NA		CD		P		OX	
		R	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S
Kleb. Spp	15	10 (67)	5 (33)	10 (67)	5 (33)	6 (40)	9 (60)	9 (60)	6 (40)	12 (80)	3 (20)						
Pse.Spp	9	6 (67)	3 (33)	6 (67)	3 (33)	2 (22)	7 (78)	5 (56)	4 (44)	8 (89)	1 (11)						
Citrobact Spp	4	2 (50)	2 (50)	3 (75)	1 (25)	2 (50)	2 (50)	2 (50)	2 (50)	1 (25)	3 (75)						
E. Coli	2	1 (50)	1 (50)	1 (50)	1 (50)	1 (50)	1 (50)										
Enterob Spp	2	1 (50)	1 (50)	1 (50)	1 (50)	1 (50)	1 (50)										
Staph Aureus	28	11 (39)	17 (61)	13 46)	15 (54)	-	24 (86)	11 (39)	17 (61)		12 (43)	16 (57)	12 (43)	18 (64)	10 (36)	24 (86)	4 (14)
Coag –Ve Staph	30	22 (73)	8 (27)	14 (47)	16 (53)	8 (27)	20 (67)	14 (47)	16 (53)			15 (50)	15 (50)	26 (87)	4 (13)	23 (77)	7 (23)

NB: AMP, ampicillin, GEN, gentamicin, IMP, imipenem, TOB, tobramycin, NA, nalidixic acid, CD, clindamicine, P, penicillin, OX, oxacillin

Discussion

In the present study, we could observe a 23.8% positive rate of blood culture which is comparable to the 21.75% recorded by Khan et al **[8]** and the 21% positive blood culture reported by Belew *et al* **[3]** from Ethiopia. On the other hand, Fortinia *et al* **[1]** recorded a rate of true blood culture of 16% and Previsdomini *et al* **[12]** reported a rate of positive blood culture of 19% which is lower than the rate observed in the present study. Other workers **[10,11,13]** from Ethiopia and elsewhere found higher positive blood culture rates. Wasihun *et a*l **[10]** studied the bacteriological profile and antimicrobial susceptibility patterns of blood culture isolated from febrile patients in Mekelle Hospital, Northern Ethiopia reported 28%. Similarly, Kitila *et al* **[11]** from Addis Ababa, Ethiopia, reported 32.8 % positive blood culture, and Patel *et al* **[13]** carried out a cross-sectional observational study at Shree Krishna Hospital, Karamsad, Gujarat, India, found the rate of 31% positive blood culture, which are higher than our finding. The difference in the rate of positivity of blood culture in different laboratories may be due to differences in blood volume, antimicrobial treatment before sampling, time of taking a blood sample, contamination of blood culture, etc. Nevertheless, true positive blood culture is important to modify the treatment and management of patients **[1]**.

As septicemia is crucial resulting in prolonged hospital stay and in severe cases may cause death, clinicians badly need to know the causative pathogens and their antimicrobial susceptibility. In the present study we frequently (16%) isolated *Klebsiella species*, followed by *Pseudomonas species* (9.9%) from among gram-negative bacteria. The 16% isolation of Klebsiella species from blood culture in the present study is comparable to 14.02% **[2,3]** *Klebisella pneumonia* isolation by Kitila *et al* **[11]** from blood culture in Addis Ababa and Belew *et al* **[3]** from Northwest Ethiopia. From among gram-positive bacteria, *Staphylococcus aureus* was isolated from 28(30.4%) and this finding is also comparable to 26.7% isolation of *S. aureus* in the previous study and less frequent than 54 (37.5%) isolation *of S. aureus* from blood culture among febrile patients in Mekelle Hospital, Northern Ethiopia **[10]**. On the other hand, coagulase-negative staphylococci (CoNS) were more frequently 30(32.6%) isolated in the present study. This finding is also comparable to the isolation rate of 44 (30%) coagulase-negative staphylococci from blood culture among febrile patients in Mekelle Hospital, Northern Ethiopia **[10]**. A similar frequency of gram-positive bacteria from blood culture in Addis Ababa Regional Laboratory, Addis Ababa, Ethiopia, was reported by Kitila *et al* **[11]**. Khan *et a*l **[8]** studied microbial patterns and antibiotic susceptibility in blood culture isolates of septicemia-suspected children in the Paediatrics Ward of a Tertiary Care Hospital, in Pakistan, and reported that among their isolates, *S. aureus* (42.39%) were the most common pathogens.

The Antimicrobial susceptibility pattern of the bacterial isolates in the present study has shown multidrug resistance to commonly used antimicrobials. This finding agrees with other workers from Ethiopia **[3,11,10]** and from other parts of the world **[8].**

The positivity of Blood culture is affected by several factors such as the volume of the sample, organisms in the initial sample, exposure to antimicrobial treatment before sampling, etc. Thus, isolation of bacterial pathogens from patients with blood stream infections has several limiting factors that affect the rate of positivity of blood culture. On the other hand, blood culture may yield false positive results and may not represent a true etiologic agent of the infection because of the possibility of contamination

during sample taking or in the laboratory environment. Thus, it is very important to consider these critical factors all the way. In spite of these limitations, clinicians expect blood cultures to give true positive growth so that they can successfully treat patients with appropriate antimicrobial drugs.

While positive blood cultures are indicated to detect active bloodstream infection, positive blood culture results may occur due to the growth of contaminating microorganisms that may be introduced into the blood culture during either specimen collection or processing. A false positive blood culture does not represent true bloodstream infection, affecting the diagnostic value of the blood culture **[6,1,4]**. Positive results may also occur due to transient bacteremia, which may occur after a variety of daily activities such as tooth brushing or medical procedures involving manipulation of mucous membranes. In this case, microorganisms are present in the bloodstream for a short period of time before being cleared from the bloodstream **[6]**. Despite its limitations, blood culture remains the reference standard for the diagnosis of bloodstream infections.

Limitations

The present work did not differentiate the true positive from false positive culture, it is the presentation of total positivity observed from the retrospective data.

Conclusion

Despite the limitation mentioned above the present result demonstrated that the rate of positivity of blood culture in the present study is comparable to most reports on positivity of blood culture. Thus it is believed the present finding can give clues to clinicians on blood culture results in the present setting of hospitals and health institutions. Moreover, the results of culture and antimicrobial susceptibility demonstrated the dominant bacterial isolates and their antimicrobial susceptibility from blood culture in the present work. Despite the variation in the frequency of isolation of the etiologic agents, the bacterial isolates and their antimicrobial susceptibility pattern in the present study agree with those mostly reported from bloodstream infections. Most bacterial isolates in the present study were resistant to antimicrobials commonly used except for imipenem, so it is important to pursue a wise antimicrobial prescription with the help of antimicrobial susceptibility test results whenever possible in the treatment of patients with bloodstream infections.

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