ORIGINAL ARTICLE

Rate of Blood Culture Contamination as an Indicator of Quality of patient care - a retrospective study

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ABSTRACT

Background: Blood cultures are one of most important diagnostic tool and indicator of quality of care. Contamination of blood samples is not only challenging to make accurate diagnosis but also results in undue use of antibiotics and wastage of hospital resources. This also poses a potential risk to patient's life. American Society of Microbiology recommends annual blood culture contamination rate to be less than 3%.
Aim: To estimate the rate of blood culture contamination and the factors contributing to it.
Method: Blood cultures records from 1st Jan to 31st Dec, 2019 in the microbiology laboratory of Fatima Memorial Hospital, Lahore were evaluated retrospectively.
Results: Annual rate of blood culture contamination was 5%. Maximum number of contaminants was found in the months of June, July and August with highest in July where contamination rate reached to 13.6%. The highest number (56.9%) of study population was children under 5 years of age. Thepredominant isolate was Coagulase negative Staphylococcus (90.2%). The highest blood contamination (32.9%) was observed in Pediatric emergency and ICU succeeded by medical outdoors (16.9%).
Conclusion: Annual rate of blood culture contamination at FMH was more than the acceptable international range. The highest rate was observed during summer season. Pediatric units reported the maximum number of contaminants. Comprehensive plan of training the relevant personnel is required with strict monitoring to minimize contamination.
Keywords: Blood culture, Contamination, Coagulase negative Staphylococcus (CoNS)

INTRODUCTION

Despite of all advances in treatment and patient care, bacteremiaremains a leading cause ofmorbidity and mortality[1]. Blood culture is the most sensitive method for the detection of blood stream infections[2]. It is a significant life-saving investigation in septicemia depicting true bacteremia[3]. Timely detection of bacteremia via blood culture is essential to start appropriate antibiotics that results in better clinical outcomes incritically ill patients[4]. A False positive report will result in misuse of this diagnostic investigation[2].

Estimation of blood culture contamination rate is widely used as a quality index for blood cultures[5]. Majority of bacterial contaminants are the bacteria that are commonly present on human skin.This normal skin flora frequently represents contamination when grown in a blood culture[6]. *Coagulase-negative Staphylococcus (CoNS), Propionibacterium spp., Micrococcus*, *Bacillus* spp. [not *B. anthracis*], *Corynebacterium spp*. [diphtheroid], and alpha-hemolytic *Streptococci* are the most common skin contaminants isolated from blood culture[7]. Normal skin flora of the patient is a major problem in blood culture contamination with serious challenges to both clinicians and laboratory staff. False or contaminated blood cultures raise difficulties in interpreting the actual positive blood cultures.This leads to unnecessary exposure of antimicrobials and extended hospital stay resulting in additive financial burden[7,8]. To differentiate a true blood stream infection from a contaminant, various parameters such as the species of the isolated organism, number of positive culture sets, time to growth must be considered. These parameters should also be corelated with the patient's clinical presentations and other laboratory abnormalities such as raised inflammatory markers and elevated leukocyte count[9].

Since the blood culture contamination rate is a significant marker of quality, regular monitoring is mandatoryto keep it within the international standards. Acceptable blood contamination rate is <3% benchmark set by American Society of Microbiology and Clinical and Laboratory Standards Institute[5,10,11,12]. Important factors affecting blood culture contamination include improper antiseptic measures, poor collection technique and lack of dedicated phlebotomists[13]. Several studies revealed that proper antiseptic measures and regular training of phlebotomists can limit the contamination rate within the recommended international range[14,15].

MATERIALS AND METHODS

This retrospective observational study was conducted at Fatima Memorial tertiary care teaching hospital in Lahore. After approval from institutional review board, all the blood culture samples received during study period were included. After following the laboratory protocols, culture bottles were immediately incubated in automated blood culture machine, the BacT/Alert system (Biomerieux, Germany). Positive blood cultures were subsequently inoculated on solid agar (Blood, Chocolate & MacConkey agar) and incubated. For bacterial identification and antimicrobial susceptibility testing Vitek2C automated system was used. All isolates that were potential pathogens were excluded. The microorganisms constituting resident skin flora and isolated from onlyone bottle (either aerobic or anaerobic) were considered for further processing.

The blood culture contamination rate was calculated by dividing the total number of contaminated blood cultures by the total number of blood cultures collected during the study period using international standards[7]. The required data were incorporated in Excel sheet and analyzed using SPSS 23.

RESULTS

A total of 7076 blood culture samples were received in the microbiology laboratory in one year. Among all these blood cultures, 356(5%) samples appeared contaminated (false positive). Blood culture contamination was higher in summer season from June–September with peak rate reaching to 737(13.6%) in July (Table 1). In this study, maximum contaminants 203(56.9%) were isolated from pediatrics' population falling in age-group of 1-5 years followed by 56(15.7%) in adults of more than 25 years of age (Table 2). Among all hospital units, the greatest blood culture contaminants 117(32.9%) were from pediatrics ICU and Emergency followed by the medical units 16.9% (60) and neonatology 14.6% (52) (Figure1). The most common isolate was *Coagulase-negative Staphylococcu* (*CoNS*) with 321(90.2%) cases, followed by *Bacillus* species 14(3.9%), *Corynebacterium diphtheriae* 11(3.1%) and *Micrococcus* species with 10(2.8%) cases (Table 3). The most predominant species of *Coagulase-negative Staphylococcus* isolated was *Staphylococcus epidermidis* with 117(36.4%) cases.

Table 1: Rate of blood culture contamination per month.

Month	Total Blood Cultures	Contaminants	% age
Jan	473	8	1.7
Feb	496	22	4.4
Mar	569	30	5.2
April	744	13	1.7
May	773	28	3.6
June	614	47	7.6
July	737	100	13.6
Aug	726	45	6.1
Sep	547	31	5.6
Oct	551	13	2.3
Nov	417	15	3.6
Dec	429	4	0.9
Total	7076	356	5.0

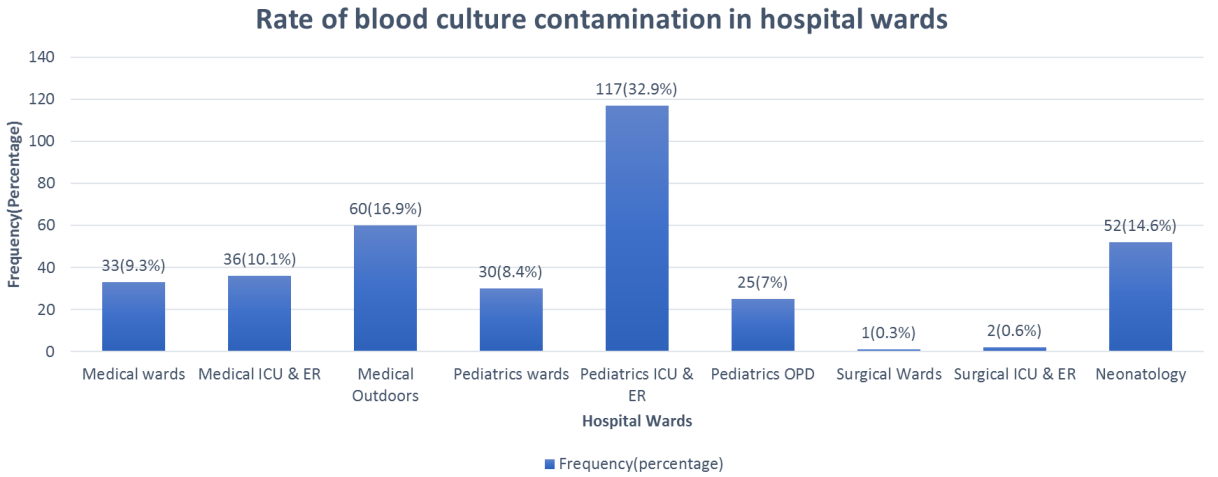
Table 2: Age-wise rate of blood culture contamination

Age groups	Frequency	% age
Less than 1 month	3	0.8
1 month-5 years	203	56.9
6 years-10 years	52	14.6
11 years-15 years	19	5.3
21 years-25 years	15	4.2
More than 25 years	56	15.7
Total	356	100

Table 3: Frequency of organisms isolated from contaminated blood cultures

Organism	Frequency	% age
Micrococcus	10	2.8
CoNS	321	90.2
Bacillus species	14	3.9
Corynebacteriumdiphtheriae	11	3.1
Total	356	100

Figure.1: Rate of blood culture contamination in various hospital departments.



DISCUSSION

Blood culture contamination rate is an essential indicator for good quality patient care. Its low rate will limit the unnecessary use of antimicrobial and subsequently their side effects. For that reason, blood culture contamination should be regularly observed to maintain this rate within the recommended international range.

All the blood culture reports during the study duration were analyzed to determine the annual contamination rate along with the common isolates contributing to such rate in a major hospital in Lahore. International standards of blood culture contamination recommended by American Society of Microbiology is 3% or less[10,11]. The annual blood culture contamination rate was 5% in our study which is higher than the international accepted range. To reduce the rate of blood culture contamination, a single protocol must be

designed and strictly implemented with standard collection and aseptic techniques[16].

Blood contamination can be markedly reduced by identifying the departments and months that have higher rates. Regarding times, it was observed that the rate was significantly higher in summer season with the highest 13.6% in July. A similar study done at King Khalid University Hospital in KSA also documented their maximum rate in summer season[7]. Another study done in Korea reported their peak rate in the month of August[3]. The best way to curtail the blood culture contamination is to determine its reasons and manage accordingly. Though several factors were involved but the shortage of trained staff seemed to be a major cause for such high rates of contamination in summer season.

We further analyzed this factor of contamination in different age groups and found that the most affected population with highest rates of blood culture contamination 56.9% (203) were the children < 5 years of age. A similar correlation of age group with contamination rate was observed in various studies[3,17]. Patient compliance, difficulty in venipuncture and avoiding multiple pricks are the main problems a phlebotomist face while drawing pediatric blood samples. These factors significantly contribute in raising the rates of contamination[7,3]. Hence, pediatric intensive care units and emergency were contributing highest number of contaminants 117(32.9%) in this study[18].

According to Chukwuemeka IK and colleagues, *CoNS* was the most predominant contaminant in a Nigerian hospital[6]. This aspect was in accordance to our study where the most common bacteria isolated was *CoNS* 90.2% (321), followed by *Bacillus* species 14(3.9%), *Corynebacterium* species 11(3.1%) and *Micrococcus* species 10(2.8%).

CONCLUSION

It was a retrospective study with deficient clinical history on the received laboratory requisite form making it a major limitation in collecting all the possible contributing factors. Departments such as pediatrics and ER with higher rates of blood culture contamination should be targeted and intervened to improve the quality and reduce the contamination rate. Future studies with implementation standard practices of blood sampling with recommended antiseptics, phlebotomy area site visits, regular training of staff with close observation are recommended.

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