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AN OBSERVATIONAL STUDY ON BACTERIAL CONTAMINATION OF BLOOD AND BLOOD COMPONENTS IN A TERTIARY CARE REFERRAL TEACHING HOSPITAL BLOOD BANK, ANDHRA PRADESH, SOUTH INDIA.

Immunohaematology

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ABSTRACT

Despite considerable efforts directed towards reducing transmissible pathogens, transfusion transmitted bacterial infection remains one of the common cause of complications associated with transfusion. Reports from studies conducted in various countries are showing a high incidence of bacterial contamination of donor blood. There are no studies indicating the prevalence of bacterial contamination of blood and its components in Andhra Pradesh. In the present study an analysis of blood and blood component microbiological cultures in our tertiary care referral teaching hospital blood bank from January, 2015 to July ,2018 was performed. A Total of 652 blood and blood component samples were submitted for bacterial and fungal culture. Out of which 20 (3.0%) samples were found to be positive for different bacterial agents. The probable cause for contamination may be due to cutaneous bacteria followed by asymptomatic bacteremia in donors.

KEYWORDS

Bacterial contamination,Whole human Blood, Blood Components, Bacterial culture.

INTRODUCTION

Blood bank and transfusion services collect, process, store and provide human blood intended for transfusion. Although, ideally blood transfusion is a safe process (i.e. that saves lives and improves the quality of life in a large range of clinical conditions), there are a number of risks associated with transfusion. Allogeneic blood for transfusion is a potential source of infection by a variety of known and unknown transmissible agents such as syphilis, diseases caused by *Streptococcus* spp., tuberculosis (TB), and human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV), and human T-cell lymphotropic virus (HTLV) infections [1]. Considerable efforts (National policies, improved donor selection and newer screening techniques) directed towards reducing transmissible pathogens have yielded a major reduction of viral agents especially in developed countries [2]. Given the reduction of viral transmission via allogeneic blood, the low but known risk of bacterial contamination has emerged as the greatest residual threat of blood transfusion [1]. Approximately 57% of all transfusion-transmitted infections and 16% of transfusion-related deaths have been associated with bacterial contamination [3]. In the United States, bacterial contamination of blood accounts for as many as 500 to 750 deaths annually [4], and between 1986 and 1991, bacterial contamination accounted for 15.9% of all transfusion related fatalities [5]. Blood and blood components may be exogenously contaminated as a result of defective blood bags or collection equipment, by contamination of the blood at the time of collection or during processing or storage. Collected blood may also be endogenously contaminated as a result of an asymptomatic bacteremia in the donor or as a result of inadequate disinfection of the venepuncture site of the donor. Taking into consideration the high demand for blood transfusion service,the high prevalence of infections, and high fatalities from bacterial sepsis, we analyzed the prevalence of bacterial contamination of blood and blood components in our tertiary care referral teaching hospital blood bank, Andhra Pradesh, India and made an attempt to identify possible preventive measures.

MATERIALAND METHODS

This is a prospective and retrospective observational study conducted at Department of Transfusion Medicine attached to a tertiary care referral teaching hospital, Andhra Pradesh, India during the period from January,2015 to July,2018. During the period of study, a total of 652 stored units of screened whole human blood and blood components such as Packed red blood cells (PRBC),fresh frozen plasma (FFP) and random donor platelets (RDP) were randomly sampled.. All expired blood units were not utilised for bacterial culture.. Each unit of blood was mixed before sampling and the tubing was cleaned with 70% alcohol and cut with sterile scissors to remove any clotted blood. 30 mL of blood and blood components was drawn from the closest end to the bag with a sterile syringe and needle and dispensed into Brain-Heart Infusion (BHI) broth aseptically in a laminar airflow cabinet. The broths were incubated at 4^0C, 22^oC and 37°C up to 14 days before they were discarded. After 14 days of incubation if any growth is observed, sterile loopfuls of broth were sub-cultured on to blood agar and Mac Conkey agar plates and incubated aerobically for 18-24 hours at 37°C. The identities of bacteria growing on the culture plates were determined by colonial morphology, Gram and spore stains; as well as standard biochemical tests.The data was collected from culture reports and analyzed.

RESULTS

A Total of 652 WB and blood component samples were submitted for culture for bacterial and fungal growth. Out of 2,608 cultures performed for these 652 samples (3 different temperatures for bacteria and one for fungi) 163 samples each are WB, PRBC, FFP, RDP respectively. Out of which 20 (3.0%) samples were found to be positive.

Out of 163 samples each of WB and blood components subjected for culture, culture positive rate of 3.8%(7), 2.7%(5), 2.7%(5), 1.6%(3) were found for PRBC, RDP, WB, FFP respectively in descending order of frequency. Staphylococci was found to be the commonest organism cultured followed by Pseudomonas, Coagulase Negative Staphylococci (CONS), E Coli, Klebsiella, Micrococci, Citrobacter in the descending order of frequency at various temperatures in blood and blood components (Table 1).

Table 1: List of bacteria detected after blood culture

S.No	Component	Temperature	Bacteria Isolated
1	WB	4 ˚C	CONS
2	WB	22 ˚C	Pseudomonas
3	WB	4 ˚C,22 ˚C	CONS
4	WB	4 ˚C	CONS
5	WB	37 ˚C	CONS
6	WB	4 ˚C,22˚C	Staphylococcus aureus
7	PRBC	4 ˚C	CONS
8	PRBC	22 ˚C	Pseudomonas
9	PRBC	22 ˚C	Escherichia Coli

10	PRBC	37 ˚C	Pseudomonas
11	PRBC	22 ˚C	Staphylococcus aureus
12	PRBC	37 ˚C	Staphylococcus aureus
13	FFP	37 ˚C	Pseudomonas
14	FFP	22 ˚C	Micrococcus
15	FFP	22˚C	Klebsiella
16	RDP	22 ˚C,37 ˚C	Citrobacter, Staphylococcus aureus
17	RDP	22˚C	Micrococcus
18	RDP	22 ˚C	Staphylococcus aureus
19	RDP	37˚C	Staphylococcus aureus
20	RDP	37˚C	Staphylococcus aureus

WB= whole human blood, PRBC= packed red blood cells, , FFP= fresh frozen plasma, RDP= random donor platelets, CONS= coagulase negative staphylococci

In the present study, bacterial growths were not detected at all temperatures despite culture of the same sample (Table 1). CONS & Staphylococci remained the most common organism in WB, PRBC, RDPs while Pseudomonas, Micrococci, Klebsiella were found in FFP. No fungal growths were found in any of the samples during the present study.

DISCUSSION

Bacterial sepsis from a contaminated blood component is a rare but potentially serious complication of blood transfusion. Timely recognition and appropriate management of a septic transfusion reaction can be critical to the well-being of the patient. Knowledge of the prevalence of bacterial contamination of blood for transfusion and the sources or the causes of contamination is important for the planning of preventive measures at blood transfusion centres and the reduction of transfusion transmitted bacterial infections. The characterization of the bacterial isolates, types of blood or components contaminated and the antibiotic sensitivity pattern could be of public health importance and impact on clinical practice.

During the present study, bacterial growths were not identified in all cultures run at different temperatures. The probable causes for lack of growth at all temperatures could be due to bacterial species itself, optimum temperature requirement for corresponding bacteria to grow and laboratory contamination .

During the present study, none of the units sent for culture were transfused and all were discarded. Hence there were no cases of bacterial sepsis, septic shock or death, post transfusion detected in the present study. However in some studies, the risk of fatality from a bacterially contaminated platelet unit, is at 7 per million units, which is 20-fold greater than the risk of HIV transmission. The fatality rate from a bacterially contaminated red cell unit, at about 1 per million units, also exceeds the HIV transmission rate [6]. In the US, bacterial contamination is considered the second most common cause of death overall from transfusion (after clerical errors) with mortality rates for platelet-related sepsis ranging from 1:20,000 to 1:85,000 donor exposures [7].

Bacterial contamination was found to be prevalent in 3% of units tested in the present study. Similar studies conducted in different countries reported prevalence rates - Uganda 3.5% [8], Nigeria 8.8%[9], Kenya 7%[10], United States 0.2% [11], United Kingdom 0.15%[12] and in France 0.1%[13] (Table 2). The probable reasons for the difference of prevalence may be due to demographic, socio-economic status in different countries, protocols followed in various centres.

Table 2: Prevalence of bacterial contamination in Whole Human Blood and Blood Components abroad and in India

S.No	Year of publication	Place	Author	Prevalence (in percentage)
1	2000	Bordeaux cedex, France	Perez P et al [13]	0.1
2	2001	Atlanta, Georgia, USA	Kuehnert MJ et al [12]	0.15
3	2002	All hospitals of UK & Ireland	Love EM et al [11]	0.2
4	2009	Mombasa, Kenya	Hassall O et al [10]	7
5	2011	Ile-Ife, Nigeria	Bolarinwa AR et al [9]	8.8
6	2013	Mbarara,South Western Uganda	Matte AGB et al [8]	3.5
7	2019	Tirupati, Andhra pradesh,India	Present study	3

UK= United Kingdom, USA= United States of America

The commonest organism isolated in the present study is Staphylococcus aureus, despite the use of diversion pouch which decreases the contaminating cutaneous bacterial colonization in blood and blood components. The second probable cause being Gram negative organisms like Pseudomonas, E coli, Klebsiella which may be due to donor asymptomatic bacteremia. Similar reports were found in the BACTHEM study conducted within the French Hemovigilance Network, where in skin contaminant bacteria like Staphylococcus epidermidis, Propionibacterium acnes were the most common organisms identified [12]. In addition, in certain studies, high rate of drug resistance was observed for isolated bacterial strains in growths cultured from blood and blood components [14].

In blood banking and transfusion medicine, our paramount concern is to improve transfusion safety for patients, in an attempt to achieve a zero-risk blood supply. Unlike other recent threats (existing or theoretical) to blood safety like transfusion transmissible viral infections, bacterial contamination still exists as a significant threat to blood supply and can cause life threatening complications like bacterial sepsis, septic shock. The role of Transfusion Medicine fraternity is ever increasing in bacterial testing and usage of safe procedures during blood collection. Bacterial contamination and its associated transfusion infections can be reduced tremendously by careful screening of blood donors by questions related to bacterial and parasitic infections, careful preparation of phlebotomy sites of donors' skin using improved skin disinfection methods and and using blood collection bags having diversion pouches.

LIMITATIONS OF THE STUDY

1. It is a single centre study.
2. The effect of duration of storage on blood culture positivity was not studied.
3. The reason for blood culture positivity could not be affirmed and the most probable cause based on the organism detected was mentioned.
4. Antibiotic sensitivity pattern was not performed.

CONCLUSION

Bacterial contamination due to Staphylococci remains a common occurrence during phlebotomy. The second probable cause for contamination may be asymptomatic bacteremia in donors.

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