SURVEYING THE RATE OF CONFIDENTIAL BLOOD TRANSPORTATION AND SOLUTIONS TO ENHANCE THE QUALITY OF BLOOD TREATMENT AT THE CENTER FOR TROPICAL DISEASES OF NGHE AN FRIENDSHIP GENERAL HOSPITAL

Tram Que Anh[1], Hung Pham Viet[2], Dao Tran Anh[1]

Summary

Background: Contamination in blood cultures is a challenge to identify causative agents of infections. Which may complicate clinical indications, or prolong the time of diagnosis, and affect treatment outcomes.

Objectives: To determine the rate of contamination in blood cultures, and implement some interventions to improve the quality of blood cultures, to reduce proportion of blood cultures contamination below 3%.

Subjects and methodology: All Blood cultures of patients who were treated at the Center for Tropical Diseases, Nghe An Friendship General Hospital from October 2020 to March 2021.

Cross - sectional descriptive study.

Results: There were 1756 cultured blood samples; from October to December 2020: 894 samples, from March 1, 2021: 862 samples. Rate of positive culture was 25.7%, of which true positive 12.9%, contamination: 12.8%, true negative: 74.3%. Contamination before training was 16.1%, and decreased to 9.4%after training. Coagulase - negative *Staphylococci* bacteria caused 63.2% contamination, accounted higher proportion than Gram - positive bacilli as 21.2%.

Recommendation: We could not eliminate blood cultures contamination, but we could reduce the amount of contamination. Training in awareness and practice greatly reduces the prevalence of blood cultures contamination.

Key words: *Blood culture, contamination, sepsis.*

BACKGROUND

Sepsis is a severe acute infection, caused by circulating bacteria in the blood, presenting with systemic symptoms, which can lead to septic shock and multiple organ failure with a very high case fatality rate, from 20 - 50%[1]. It causes the death of millions of people every year worldwide[2].

A positive blood culture is the gold standard to diagnose sepsis. However, in many cases, blood cultures need to be repeated several times to approach diagnostic value[1,3]. The increase in the number of blood cultures (each set includes 1 aerobic bottle, 1 anaerobic bottle) will elevate the cost of true pathogens'determination.

A rapid accurate blood culture helps physicians to determine the cause of bacteremia, antibiotic susceptibility, exotoxins, etc. to make the most effective and specific adjustments inpatients'treatment[4]. However, currently, the Ministry of Health recommends only a set of blood cultures (but not mandatory as a minimum indication); also procedures of health insurance

(1)Nghe An Friendship General Hospital; (2)National Children's Hospital
Date of receipt: *September 27, 2021.*
Date of reviewed completions: *October 15, 2021.*
Accepted date for publication: *December 03, 2021.*
Responsibility for the scientific content of the article: *Tram Que Anh, Nghe An General Friendship Hospital.*
Tel: 0904568569. E-mail: tramlien@gmail.com

coverage caused the limitation of several sets in blood culture[1,4].

Currently, the Ministry of Health published specific guidelines about blood collection for culture, however, even with the best procedure, it is hard to reduce contamination rate less than 3%[3,5,6]. Contamination (or external contamination) can be understood as an isolated microorganism, from culture bottles, entered during the collection,and/or handling blood samples. Therefore, the contaminated agents were not the true cause of sepsis in the patient[3].

The main contaminating agents are skin commensal bacteria such as *Bacillus* spp., *Corynebacterium* spp., *Propionibacterium* spp., Non-coagulase *Staphylococci*, *Aerococcus* spp, *Micrococcus* spp[1,4].

Contamination in blood cultures isa challenge to identify causative agents of infections.Which may complicate clinical indications, or prolong the time of diagnosis, and affect treatment outcomes[4,6]. It also significantly increases the cost of treatment, including testing (plus 20%) and antibiotics (plus 39%)[6].

The Tropical Diseases Center of Nghean General Hospital receives and treats thousands of patients diagnosed with sepsis every year, with a corresponding number of blood culture indications. Therefore, the rate of contaminated blood culture is a hospital's serious concerning, it did not only affect the treatment outcome but also affect the brand's reputation with the Center. Furthermore, previously, the problem of blood cultures contamination at the Center for Tropical Diseases was not studied.

Because of these above reasons, we conducted this study with the goal: to determine the rate of contaminated blood cultures, and implement some interventions to improve the quality of blood cultures, towards the rate of contaminated blood cultures to be less than 3%.

SUBJECTS AND METHODS

Research subjects: All blood cultures of patients treated at the Center for Tropical Diseases, Nghe An General Friendship Hospital from October 2020 to March 2021.

Methodology: A cross - sectional descriptive study.

Criteria for selection of samples: All blood cultures of patients treated at the Center for Tropical Diseases with full information as prescribed by the Hospital.

Methods of collecting samples, culturing, monitoring and returning blood culture results: according to the blood culture process of the Ministry of Health[5].

Criteria for evaluating blood cultures contamination: single blood cultures were positive with microorganisms of skin or environment such as: coagulase-negative *Staphylococci*, *Corynebacterium* spp., *Bacillus* spp., *Propionibacterium* spp., *Streptococcusviridans*, *Lactobacillus* spp. Positive cultures will be discussed with the clinicians to compare the patient's condition, and make that final decision to identify and perform an antibiogram.

True positive: successful isolation of bacteria and confirmed as the cause of infection according to the guideline[4].

True negative: No microbial growth according to the blood culture monitoring procedure[4].

Survey on positive blood culture rate: Cross-sectional survey of all blood cultures of the Center for Tropical Diseases from October 2020 to March 2021 and determine the true positive and contamination rate by month.

Training on blood culture sampling procedures: After survey and evaluating the quality of blood cultures in October - December 2020, we organized training and reminding in collection techniques for all nurses at the Center for Tropical Diseases according to Ministry of Health's procedure[5], in which, focusing on sterilization handling and collection time.

Data collection and processing: Relevant data is collected and managed by statistical function of Labconn LIS. Data were processed using SPSS 20.0 software. The p value < 0.05 was considered to be statistically significant.

RESULTS

From October 2020 to March 2021, the Center for Tropical Diseases had 1756 cultured blood samples, of which 894 were collected from

October-December 2020 and 862 from March - March 2021.

We obtained the following results:

Table 1. Blood culture results

Blood culture results	Before training (October - December 2020)		After training (January - March 2021)		Total		p*
	n	%	n	%	n	%	
True positivity	100	11.2	127	14.7	227	12.9	0.027
Contamination	144	16.11	81	9.40	225	12.8	< 0.001
True negatives	650	72.7	654	75.9	1304	74.3	/
Total	894	100	862	100	1756	100	/

*Chi-square test

Overall positive blood culture rate was 25.7%, of which true positive 12.9%, contamination 12.8%, true negative 74.3%. Contamination before training was 16.1%, after training decreased to 9.4%, the difference was statistically significant ($p < 0.05$).

Changein the rate of blood culturecontamination

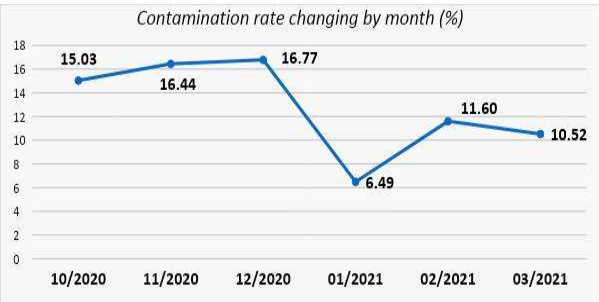

Figure 1. Contamination rate changingand decrease after training

The rate of contaminated blood culture after training decreased compared to before training.

Table 2. Relationship between contamination and incubation time (n = 1756)

Sampling time	Without contamination		With contamination		Total		*p
	N	%	n	%	n	%	
Oficial time	889	58.1	145	64.4	1034	58.9	0.069
On duty	642	41.9	80	35.6	722	41.1	
Total	1531	100	225	100	1756	100	

*Chi-square test

There was no statistically significant difference in sampling time (p>0.05).

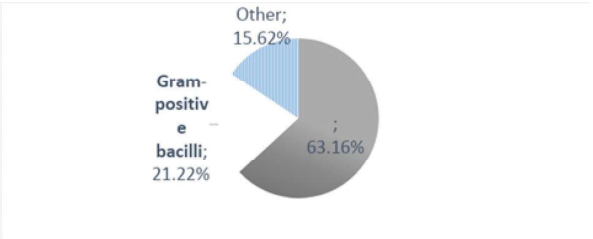

Figure 2. Proportion ofeach type of contaminating bacteria (n = 225)

Coagulase - negative *Staphylococci* caused 63.2% of contamination, was higher proportion than Gram - positive bacilli at 21.2%.

DISCUSSIONS

Blood cultures are important to detectthe presence of dangerous organisms in bloodstream. Blood culture results are often negative, however, a blood positive culture is is not easy to determine as the true cause of infection. Differentiontrue with false positive blood culture result is important, but is complicated by sereral factors. A positive blood culture can be a definitive diagnosis, if true, following by pathogen-specific therapy and good prognostic value[6]. Therefore, false - positive results can affect these values, costing and prolonging patient stay.

Contamination in blood cultures is inevitable, and rate are recommended not to exceed 3.0%[4,6,7]. Many previous studies showed that the rate of contaminated blood cultures ranged from 0.6 - 6.0%. However, this number could be higher. Resource of contamination can be microorganisms colonizing the patient's skin or, rarely, by the hands of healthcare workers[7]. In this study, the contamination rate was recorded at 2 time points (Tables 1, 2), before and after the training of sample collection procedure, with the pre - training rate as 16.1%, after training was 9.4%, much higher than 3% (asrecommended). In Vietnam, there are very few published studies on contamination in blood cultures, according to Mai Lan Huong (2011) at Bachmai hospital, the contamination was 3.4%[8]. A study by James Bentley in Scotland showed only 2% of contamination[9]. According to an independent study of four hospitals in the US (2020) reportedcontamination proportion from 1.5 - 3%[10].

In order to practice sampling quality blood cultures and reduce contamination, we conducted training on venipuncture. At the training session, we reviewed the theories of venipuncture, as well as emphasized the role of disinfection and the manipulations during sampling to ensure quality control. Along with sampling training, we also have new policies to encourage responsibility, such as rewards when the contamination rate is less than 3%. At the same time, there are also strict rules applied for whom didnot adhere with standard procedure,with contamination over 3%.

Initially, we achieved quite optimistic results, when the contamination rate decreased from 16.1% (before) to 9.4% after the training (Tables 1 - 2). Especially, in the first month after the training (January), the contamination rate decreased remarkedly as 6.5%. However, in the following months, the contamination rate increased to 11.6%, 10.5% respectively, in November and December 2020. With this result, we still have to work hard to reduce the contamination to the ideal level below 3%.

We hypothesized that working time might affect the incidence of outliers. However, the results showed no difference in contamination rates for samples taken during official and duty hours (Table 3). This proves that contamination was not due to limit of human resources (officialvs. duty time), and might be other factors.

In our study, coagulase - negative *Staphylococci*was the most contaminating agent with 63.2%, followed by Gram-positive bacilli 21.2%. This result was similar to the study of Mai Lan Huong (63.4%)[8]. The literature also shows that coagulase - negative *Staphylococci* and Gram-positive bacilli are common pathogens[4,6,7]. However, these bacteria probablyarecausative agents with confirmation by repeated blood cultures. Worldwide studies also introduced a number of factors to distinguish between contaminated and truly positive blood culture such as: species ofisolated bacteria, the number of positive in repeatation, number of positive bottles, time of bacterial growth, counting of growing colonies, clinical and laboratory data, culture source...[4,6,7,11]. Bacteria thosemostly cause of infection when isolated from blood include: *Staphylococcus aureus, Streptococcus pyogenes, Streptococcus agalactiae, S. pneumoniae, E. coli* and other members of the *Enterobacteriaceae*; *P. aeruginosa, Bacillusfragilis* and *Candida* species. In contrast, coagulase - negative *Staphylococci*, *Corynebacterium* spp, Bacillus spp (except

Bacillus anthracis), *Propionibacterium* spp, *Aerococcus* spp, *Micrococcus* spp often represent contaminated blood cultures[4,6,7,11].

CONCLUSIONS

- There were 1756 cultured blood samples for identification of pathogenic bacteria. Overall proportion of positive blood culture was 25.7%, of which true positive: 12.9%, contaminated: 12.81%, true negative: 74.3%.

- Contamination rate before training was 16.1%, after training reduced to 9.4%. Coagulase - negative *Staphylococci*causing contamination in 63.2%, accounting for a higher proportion than21.2%in Gram - positive bacilli.

RECOMMENDATION

We could not eliminate blood cultures contamination, but we could reduce amount of contamination. However, we have been able to reduce the prevalence of outliers, with supporting of training in awareness and practice, indeed. Continue to monitor the prevalence of contaminated blood cultures and implement them. solutions to reduce the contamination rate to less than 3%.

REFERENCES

6. Ministry of Health (2015). sepsis,accessed link http://kcb.vn/vanban/quyet-dinh-so-5642qd-byt-ngay-31122015-ve-viec-ban-hanh-tai-lieu-chuyen-mon-huong-dan-chan-doan-va-dieu-tri-mot-so-benh-truyen-nhiem.
7. Mervyn Singer and associates. (2016). "The third international consensus definitions for sepsis and septic shock (Sepsis-3)", Jama. 315(8), tr. 801-810.
8. ML Wilson and associates. (2007). "Principles and procedures for blood cultures", Approved guideline. 27, tr. 4-15.
9. Michael L Wilson and associates. (2007). "Principles and procedures for blood cultures; approved guideline", CLSI document M47-A. Clinical and Laboratory Standards Institute, Wayne, PA.
10. Ministry of Health (2017). Blood culture procedure by conventional methods; Blood culture procedure by automatic system, Practical manual of clinical microbiology testing techniques, Medical Publishing House, Hanoi, 85.
11. Keri K Hall and Jason A Lyman (2006). "Updated review of blood culture contamination", Clinical microbiology reviews. 19(4), tr. 788-802.
12. S Dargère, H Cormier and R Verdon (2018). "Contaminants in blood cultures: importance, implications, interpretation and prevention", Clinical Microbiology and Infection. 24(9), tr. 964-969.
13. Lan Hương Mai (2011). Causes of sepsis and antibiotic resistance levels of bacteria isolated at Bach Mai Hospital from January 1, 2011 to June 30, 2011, Master Thesis, Hanoi Medical University, Hanoi
14. James Bentley và các cộng sự. (2016). "A change of culture: reducing blood culture contamination rates in an Emergency Department", BMJ Open Quality. 5(1).
15. Diane C Halstead và các cộng sự. (2020). "Reducing blood culture 10. Diane C Halstead et al. (2020), "Reducing blood culture contamination rates: experiences of four hospital systems", Infectious diseases and therapy. 9(2), p. 389-401.
16. TJ Kirn and MP Weinstein (2013). "Update on blood cultures: how to obtain, process, report, and interpret", Clinical Microbiology and Infection. 19(6), p. 513-520.