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Original Research Article

Knowledge and practice among the pediatric post graduate residents regarding the technique of blood culture sampling

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ABSTRACT

Background: Errors in sampling during blood culture, may lead to contaminants or poor yield which result in faulty reports increasing patient's suffering, endanger patient safety and increasing cost of health care. Optimal knowledge about the sampling method for important microbiological test like blood culture translates into appropriate practices. Authors objectives was to assess the knowledge and practice of the Pediatric resident doctors, regarding sterile technique during blood culture collection. The change in the knowledge of the residents during blood culture sampling with regards to maintaining asepsis after watching educational video was evaluated.
Methods: A quasi experimental, questionnaire based study with pre–post intervention, involved post graduate resident's knowledge and practice regarding the sterile technique during blood culture collection. The data analyzed using paired t test and Chi-square Test.
Results: 18(60%) participants accepted that they have collected blood culture not maintaining complete asepsis at some time in past. The reasons for the same were lack of knowledge 14 (46.66%), no assistance from staff for the procedure 14 (46.66%), non-availability of sterile gloves 4 (13.33%), non-availability of antiseptic solution 4(13.33%), time consuming 8 (26.66%).
Conclusions: Ultimately, blood culture contamination is a complex, challenging problem that requires a multidisciplinary approach. Regular teaching modules for the health personnel and ensuring environment conducive to correct practises would definitely help in improving the sampling practises for aseptic procedures.

Keywords: Aseptic, Blood culture, Knowledge, Practises, Post graduate resident, Sampling

INTRODUCTION

The patients are hospitalized with varied problems, among these, infectious etiologies have a substantial role. The infections may be acquired in community or may be hospital acquired. In wake of emerging multi resistant strains, blood culture with antibiotic sensitivity pattern plays a crucial part optimal management of critical patients. Blood culture is the most sensitive method for the detection of bacteremia and fungemia.[1,2] There exists different guidelines to perform blood cultures. According to the Clinical and Laboratory Standard Institutes (CLSI), blood culture is defined as a blood specimen that is submitted for bacterial or fungal culture irrespective of the number of bottles or tubes into which the specimen is divided or distributed.[3] However, false-positive blood culture results occur when a contaminant organism that is not present in the patient's bloodstream is grown in a blood culture specimen. Contamination can happen at different levels during the procedure. Blood cultures are a highly user-dependent diagnostic test. Depends not only on the nature of underlying infectious process, but also on

technique and timing of specimen acquisition. Proper aseptic technique has been shown to decrease the rate of contaminants.[4,5]

Another, complicating issue is increase in use of central venous catheters, which increases the risk of bacteremia added to this is difficulty in interpretation of reports in view of colonization of lines. In general, target rates for contamination are set at a maximum of 2% to 3% in adults; however, reported rates vary widely between institutions, from 0.6% to over 6%.[6,7] These have clinical and financial implications. The clinical uncertainty associated with the interpretation of ambiguous culture results is costly, as has been demonstrated in a number of studies of both adult and paediatric patients.[8-11] Bloodstream infections (BSI) and their clinical correlates (sepsis and septic shock) are a major cause of morbidity and mortality worldwide.[12]

For the patient the consequences may include misdiagnoses, unnecessary or prolonged antibiotic administration as well as increased length of hospital stays. On the other hand, the hospital budget may increase because of possibility of the need for additional blood culture and another diagnostic test. It also increases the workload of the laboratory.

Therefore, there is a need to improve the standard of blood culture- taking technique, and in turn, improves both the quality of patient care as well as judicious resources Utilization.[13] The onus is on the nursing and medical staffs to be responsible for safe and effective blood sampling.

Our study will be regarding this aspect of evaluating knowledge and practices amongst the residents during blood culture collection and to improve their knowledge and practices with the help of an educational video regarding correct technique of blood culture collection and precautions to be taken during the procedure.

The objectives of the study was to assess the baseline knowledge and practice of the resident doctors regarding sterile technique during blood culture collection. We also observed the change in the knowledge about blood culture sampling with regards to maintaining asepsis after watching educational video about precautions for sterile blood collection technique for blood culture sample. The secondary objectives was to assess reasons for deficiency in the practice of blood culture sampling.

METHODS

The Study assessed the knowledge and practices about blood culture techniques among the paediatrics post graduate residents. It was Quasi Experimental questionnaire based study, conducted over duration of 12 months from September 2018 to September 2019.Convenience sampling method was followed. Institutional Ethics Committee (IEC) permission was taken. Pediatric resident doctors working in Paediatric departments of a tertiary care institute (including Paediatric ward, PICU and NICU), who were willing to be part of the study were included in the study. Those post graduate students, who did not consent for questionnaire or who did not complete all three parts of study (pre-test, intervention and post-test) were excluded. Study consisted of three parts. Initially the baseline knowledge and practice regarding sterile technique during blood culture collection were noted through a Pre-test questionnaire. After this, an intervention in the form of educational video depicting blood culture sampling with regards to maintaining asepsis was shown to the participants.[14,15] Post viewing of the educational video, regarding guidelines for sterile blood culture sampling technique for Paediatric patients, the participants were administered Post-test questionnaire. A questionnaire was used to assess the pre and post intervention knowledge and practice regarding the sterile techniques during the blood culture collection among resident doctors. Questionnaires were tested for content validity by five experts (Faculties from Microbiology, Pathology and Public Health) and as per their suggestion changes were incorporated in the pre and post-test Questionnaire.

The demographic details and baseline knowledge of the participants were noted. The change in the knowledge and practices of the resident doctor regarding sterile technique during blood culture collection after watching educational video was documented by post-test questionnaire

Statistical analysis

The answers recorded in the form of Yes or No response. And all the responses were tabulated. To analyze the overall knowledge, scoring I method was used. Correct answer for each question was scored one and incorrect or unsure answers were scored zero. Score of <8 was poor response; 8-12 was Fair response while >12 score was considered Good response.

Data Collected was entered in Microsoft Excel. Data is represented in frequencies and percentages. Mean and standard deviation of quantitative variables is shown. Appropriate statistical tests are applied using SPSS software version 21 for analysis. Chi square test was used for association and student's t-test was used for comparison between the pre-test and post-test results as applicable.

RESULTS

Total 30, Paediatric Post Graduate Residents participated in our study. All were in age group of 23 to 29 years, 17 were males and 13 were females.

Details of responses of all participants in pre and post Test shown in (Table 1 and Table 2).

Out of 30 participants in our study 27(90%) reported that they were trained in the blood culture sampling procedure. The majority 28(93.3%) reported that they learnt it by observing their seniors and colleague. 8(66.67%) participants reported that they know six steps of hand washing.

Table 1: Responses of resident doctors for knowledge questions.

Question Number*	Pre-test correct answer (N=30)	%	Post-test correct answer (N=30)	%
1. Have you been previously trained in blood culture sampling?	27	90.00%	27	90.00%
2. How were you been previously trained in blood culture sampling technique? i) By observing and helping seniors	28	93.33%	25	83.33%
2. ii) Explained orally by colleagues	0	0%	0	0%
2. iii) Audio-visual aids	08	26.66%	30	100%
4. Do you know six steps of hand washing? Y/N	20	66.67%	30	100%
5. Is it important to clean hand before procedure? Y/N	27	90.00%	30	100%
6. What is the most appropriate method of collection of blood for blood culture?	21	70.00%	30	100%
8. What is the correct technique of preparation of skin site?	25	83.33%	30	100%
9. Do you know the amount of blood needed for blood culture in paediatric and adult patients?	10	33.33%	25	83.33%
10. Time limit between collections of each blood culture if two blood cultures are to be collected of one patient e.g. Suspected infective endocarditis?	16	53.33%	22	73.33%
11. The correct duration of Contact time (CT) for povidone iodine is?	9	30.00%	26	86.67%
14. Blood culture bottle top cleaning(correct No) i) Do you clean the bottle top before putting collected blood sample in the culture bottle? Y/N	27	90.00%	25	83.33%
14. ii) Does cleaning the bottle top helps in decreasing risk of contamination during blood culture collection? Y/N	23	76.66%	23	76.66%
15. If you have to collect multiple blood samples along with blood culture which one you collect first? i) blood culture sample ii) other blood tests	27	90.00%	30	100%
17. Are you aware that improper technique of blood culture can result in i) False positive reports ii)Antibiotic misuse iii) Antibiotic Resistance iv) All of the above	23	76.66%	30	100%
*Question number denotes the serial number as it appears in pre and post-test questionnaire.				

There were18(60%) participants accepted that they have collected blood culture not maintaining complete asepsis at some time in past.

The reasons for the same were lack of knowledge 14(46.66%), no assistance from staff for the procedure 14(46.66%), non-availability of sterile gloves 4(13.33%), non-availability of antiseptic solution 4(13.33%), time consuming 8(26.66%).

It is observed that the 25 residents (83.33%) had poor or fair knowledge in Pre-Test while only 5(16.67%) residents had good knowledge regarding blood culture sampling procedure While in post-Test only 3 residents (10%) had fair knowledge while the rest 27 residents (90%) had good knowledge. So, using Chi-square Test Highly significant association is seen between the training given and scores before and after the watching the educational video ($p< 0.001$) (Table 3).

Table 2: Responses of resident doctors for practice questions.

Question number	Pre-test correct answer (n)	%	Post-test correct answer (n)	%
7. Do you use sterile tray for the procedure? Y/N	13	43.33%	28	93.33%
12 Do you wait for the spirit to dry before pricking?	24	80.00%	30	100%
13. Precautions regarding contact of collector with skin after cleaning: i) Do you take precaution to avoid touching your hand to the skin once cleaned with antiseptics? Y/N	26	86.66%	30	100%
13. ii) Do you change the gloves if you happen to touch the skin/repalpate vein site cleaned with antiseptics? Y/N	19	63.33%	28	93.33%
16. Do you use existing peripheral lines /cannula to obtain blood cultures? Y/ N	28	93.33%	30	100%
18. Have you ever collected blood culture not maintaining complete asepsis/N	18	60.00%	18	60.00%
19 If Yes, why? i) Lack of knowledge of proper technique	14	46.66%	14	46.66%
19. ii) No assistance for the procedure by staff	14	46.66%	14	46.66%
19. iii) Non availability of sterile gloves	4	13.33%	4	13.33%
19. iv) Non availability of antiseptic solution	4	13.33%	4	13.33%
19. v)Time consuming	8	26.66%	8	26.66%
#Question number denotes the serial number as it appears in pre and post-test questionnaire.				

Table 3: Association between knowledge and practice in pre-test and post-test.

Total Score	Pre test	Percentage	Post test	Percentage	Change
Poor	5	16.67%	0	0%	-5
Fair	20	66.66%	3	10.00%	-17
Good	5	16.67%	27	90.00%	+22
Total	30	100%	30	100%	
X^2= 32.69, p<0.001					

Chi square test: Highly Significant Association found

Table 4: Difference in the knowledge of residents in pre and post-tests.

	N	Mean	Std. deviation
Pre-test Score	30	10.40	1.940
Post Test Score	30	13.90	1.062
p<0.001			

One-Sample t test: Highly significant difference found.

Highly significant difference is seen between the mean scores of pre-test and post-test in the knowledge of resident doctors ($p < 0.001$) (Table 4).

All the residents responded in post-test that they think the educational video will improve the technique of blood culture collection by them in future and they also responded that they will be able to explain their colleagues, juniors and staff, proper technique of blood culture.

DISCUSSION

There are very few studies on knowledge, attitude and practice of doctors on blood culture among medical doctors in India, especially the studies with post intervention assessment are very scares.

In our study we had 30 participants. It was observed that the 25 residents (83.33%) had poor or fair knowledge in Pre-Test while only 5(16.67%) residents had good knowledge regarding blood culture sampling procedure. Our findings are contrary to finding in a cross sectional KAP study conducted by Ojid et al, they found Forty-eight (54.5%) out of the 88 doctors studied had good knowledge regarding blood culture, 34(38.6%) moderate knowledge and 6(6.8%) poor knowledge.[16] This can be due to our study population being post graduate residents, while above mentioned study included consultant doctors. In another study by Jorge P Parada they have

found out that years of training and specialty of medical training does affect knowledge, attitude and practices of physicians. They reported better knowledge in 3rd year post graduate students and knowledge of physicians from infectious disease department and from emergency department was more than other medical and surgical departments.[17]

In our study only 10(33.33%) resident doctors had the knowledge of volume of blood required in blood culture bottle for Paediatric and adult patients in pre-test. In the study by Ojid et al, they had found 28.6% participants agreed that volume of blood sampled affects quality of result, the rest either disagreed or were not sure.[16] Several studies have confirmed that the higher the volume cultured, the higher the rate of detection of bloodstream infection, reporting increase in yield from 0.64.7% per extra ml of blood cultured.[18,19] Inadequate volume of blood is a common problem observed during blood culture sampling.

The knowledge regarding contact time of povidone iodine in our study was appropriate in 9(30%) participants in pre-test, and 10 (33.33%) resident doctors reported they don't wait for the spirit to dry before pricking for blood culture sampling. While another study by Raupach-Rosin et al, KAP on Blood culture sampling in Germany revealed 69.3 % participants did not wait always for 60 seconds after skin disinfection as suggested by German guidelines.[20]

In post Test this knowledge regarding blood volume increased to 25(83.33%). These findings are similar to study by Connell et al. They reported that only 46.0% of blood from infants and children submitted for culture in their centre had adequate volume of blood.[21] However after an educational intervention, there was a significant increase in the proportion of adequate volume of blood collected to 63.9% (21). The recommended blood volume of blood sampled for blood culture at different ages are, for newborns 0.5-1ml, for infants1-2ml, for 1-12 years 2-5ml and >13years 10 to 20ml.[22]

In study by Hanan Ramzy Ahmed Atalla And Warda Mohamed Henedy, regarding effectiveness of structured teaching program on knowledge and practice regarding blood specimen collection among nurses, revealed that obvious improvement in parameters of strategies after blood collection to avoid complications (57.4%) followed by safety aspects during blood collection parameter (46.5%) and there is little improvement in measures to improve prominence of vein parameter (45.1%) and inspection of vein parameter (30%).[23]

Thus 18(60%) participants accepted that they have collected blood culture not maintaining complete asepsis at some time in past. The reasons for the same were lack of knowledge 14(46.66%), no assistance from staff for the procedure 14(46.66%), non-availability of sterile gloves 4(13.33%), non-availability of antiseptic solution 4(13.33%), time consuming 8(26.66%).

The limitations of this study include small sample size. The strength of the study is intervention conducted in the form of audiovisual training which was perceived by the post graduate residents as very useful exercise.

Blood culture is a most essential diagnostic tool for detection of blood stream infections. The knowledge of best practices for blood culture sampling is lacking in significant proportion of Health care providers. Thorough understanding of various aspects like appropriate timing of blood collection, skin preparation, impact of volume sampled can significantly improve the accuracy of blood culture reports. Strict reinforcement of guidelines for blood culture sampling technique should be ensured in each department. Various educational modalities conducted at regular intervals, would be instrumental to bridge the knowledge gap and thereby improve the practice of aseptic methods among the health care providers.

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ANNEXURE I

Knowledge and practice among the Paediatric Post Graduate residents regarding the technique of blood culture sampling.

Name: (optional)

Age:

Gender:

Department:

Date of joining the department:

Questionnaires (Pre-test)

1. Have you been previously trained in blood culture sampling?
   (Yes / No)

2. How were you been previously trained in blood culture sampling technique?
   i) By observing and helping seniors
   ii) Explained orally by colleagues
   iii) Audio-visual aids
   iv) Other method

3. How many blood culture collections you have done before (approximately)?

4. Do you know six steps of hand washing?
   (Yes/No)

5. Is it important to clean hand before blood culture sampling?
   (Yes/ No)

6. What is the most appropriate method of collection of blood for blood culture?
   l. venepuncture ii. peripheral Intravenous cannulation iii. central venous catheter

7. Do you use sterile tray for the procedure?
   (Yes/ No)

8. What is the correct technique of preparation of skin site?
   i) From centre to periphery
   ii) From periphery to center
   iii) Zigzag technique
   iv) None of the above

9. Do you know the amount of blood needed for blood culture in pediatric and adult patients?
   (Yes /No)
   If Yes, mention blood volume required:

10. Time limit between collection of each blood culture if two blood cultures are to be collected of one patient eg. Suspected infective endocarditis?
    i) 2mins ii) 5mins iii) 15mins iv) 30mins

11. How much is the duration of Contact time (CT) for povidone iodine ?

12. Do you wait for the spirit to dry before pricking?
    (Yes/No)
13. Precautions regarding contact of collector with skin after cleaning:
    a) Do you take precaution to avoid touching your hand to the skin once cleaned with antiseptics?
       (Yes/No)

b) Do you change the gloves if you happen to touch the skin/repalpate vein site cleaned with antiseptics? (Yes/No)

14. Blood culture bottle top cleaning
    i) Do you clean the bottle top before putting collected blood sample in the culture bottle? (Yes/No)

    ii) Does cleaning the bottle top helps in decreasing risk of contamination during blood culture collection? (Yes/No)

15. If you have to collect multiple blood samples along with blood culture which one you collect first?
    i) blood culture sample ii) other blood tests

16. Do you use existing peripheral lines /cannulae to obtain blood cultures?
    (Yes/ No)

    If Yes, How you take it, what precautions you take?

17. Are you aware that improper technique of blood culture can result in ---
    i) False positive reports ii)Antibiotic misuse iii) Antibiotic Resistance
    iv) All of the above

18. Have you ever collected blood culture not maintaining complete asepsis Yes/No

19. If Yes, why?
    i) Lack of knowledge of proper technique
    ii) No assistance for the procedure by staff
    iii) Non availability of sterile gloves
    iv) Non availability of antiseptic solution
    v)Time consuming
    vi)Any other- specify

ANNEXURE II

Knowledge and practice among the Paediatric Post Graduate residents regarding the technique of blood culture sampling.

Name: (optional)

Age:

Gender:

Department:

Date of joining the department:

Questionnaires (Post-test)

1. Have you been previously trained in blood culture sampling?
   (Yes / No)

2. How were you been previously trained in blood culture sampling technique?
   i. By observing and helping seniors
   ii. Explained orally by colleagues
   iii. Audio-visual aids
   iv. Other method

3. How many blood culture samplings you have done before (approximately)?

4. Do you know six steps of hand washing?
   (Yes/No)

5. Is it important to clean hand before procedure?
   (Yes / No)

6. What is the most appropriate method of collection of blood for blood culture?
   i. venepuncture ii. Peripheral Intravenous cannulation iii. Central venous catheter

7. Do you use sterile tray for the procedure?
   (Yes/ No)

8. What is the correct technique of preparation of skin site?
   i. From centre to periphery
   ii. From periphery to centre
   iii. Zigzag technique
   iv. None of the above

9. Do you know the amount of blood needed for blood culture in paediatric and adult patients?

10. Time limit between collections of each blood culture if two blood cultures are to be collected of one patient eg. Suspected infective endocarditis?
    i) 2mins ii) 5mins iii) 15mins iv) 30mins

11. The correct duration of Contact time (CT) for povidone iodine is 1.5 - 2 min ? Yes/No

12. Do you wait for the spirit to dry before pricking?
    (Yes/No)

13. Precautions regarding contact of collector with skin after cleaning:
    a) Do you take precaution to avoid touching your hand to the skin once cleaned with antiseptics?

(Yes/No)

b) Do you change the gloves if you happen to touch the skin/repalpate vein site cleaned with antiseptics? (Yes/No)

14. Blood culture bottle top cleaning
    i) Do you clean the bottle top before putting collected blood sample in the culture bottle? (Yes/No)
    ii) Does cleaning the bottle top helps in decreasing risk of contamination during blood culture collection? (Yes/No)

15. If you have to collect multiple blood samples along with blood culture which one you collect first?
    i) Blood culture sample ii) other blood tests

16. Do you use existing peripheral lines /cannulae to obtain blood cultures?
    (Yes/ No)
    If Yes, How you take it, what precautions you take?

17. Are you aware that improper technique of blood culture can result in ---
    i) False positive reports ii) Antibiotic misuse iii) Antibiotic Resistance
    iv) All of the above

18. Have you ever collected blood culture not maintaining complete asepsis?
    (Yes/No)

19. If Yes, why?
    i) Lack of knowledge of proper technique
    ii) No assistance for the procedure by staff
    iii) Non availability of sterile gloves
    iv) Non availability of antiseptic solution
    V) Time consuming
    vi) Any other- specify

20. Do you think this educational video regarding aseptic non-touch technique and handouts will improve the technique of blood culture collection by you in future?
    (Yes/No)

21. Will you be able to explain your colleagues, juniors and staff, proper technique of blood culture?
    (Yes/No)

22. Any suggestions