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Rapid Detection of Microorganisms by Automated Blood Culture System: Experience of 3220 cases of Blood Culture

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Abstract

Background: Blood culture is important for diagnosis of various diseases and isolation of micro-organisms. **Objective:** The purpose of the present study was to assess the rapid detection of microorganisms by automated blood culture system. **Methodology:** This retrospective study was conducted in the Department of Microbiology at Dhaka National Medical College, Dhaka, Bangladesh and IBN Sina D. Lab & Consultation center, Doyagonj, Dhaka, Bangladesh from January 2020 to December 2020 for a period of one year. All the patients presented with suspected cases of blood stream infection were selected as study population. Blood samples were collected from suspected cases. **Results:** A total of 3220 blood samples were collected from patients. Among them, bacteria were isolated 372(11.55%) cases. The most common isolated organisms were *Salmonella typhi* 276(74.2%), *Salmonella paratyphi* A 52(14%), *Escherichia coli* 21(5.6%), *Pseudomonas* species 14(3.8%), and *Staphylococcus aureus*, 9(2.4%). *Salmonella typhi* is the most common organisms and showed sensitivity pattern to imipenem 97.82% colistin 88.41%, amikacin 76.81% and ciprofloxacin 49.28%. **Conclusion:** In conclusion *Salmonella typhi*, *Salmonella paratyphi* A and *Escherichia coli* are the most common isolated bacteria from the blood stream infection. [*Bangladesh Journal of Infectious Diseases, June 2022;9(1):3-6*]

Keywords: Rapid detection; microorganisms; automated blood culture system

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Introduction

Recommended frequency of blood cultures are enteric fever, acute sepsis, meningitis, pneumonia, pyrexia of unknown origin (PUO), bacterial endocarditis, Osteomyelitis, bracellosis and so on. Various methods are available for blood culture such as conventional methods, semi-automated methods and automated methods. Automated blood culture system a blood culture system that uses mechanical system to incubated, agitate or monitor blood culture bottles for microbial growth. The methods of bacterial isolation take more than 48 hours[1].

The purpose of the present study was to assess the rapid detection of microorganisms by automated blood culture system.

Methodology

Study Settings and Population: This retrospective study was conducted in the Department of Microbiology at Dhaka National Medical College, Dhaka, Bangladesh and IBN Sina D. Lab & Consultation center, Doyagonj, Dhaka, Bangladesh from January 2020 to December 2020 for a period of one year. All the patients who were presented with suspected cases of blood stream infection were selected as study population.

Study Procedure: The blood samples were collected aseptically from both sexes and different age groups. All blood samples were placed in blood culture machine. Positive blood culture samples were inoculated in blood agar, chocolate agar and MacConkey agar media. All plates were incubated at 37^0C aerobically for 24 hours. After incubating, plates were checked for presence of suspected organisms. All the micro-organisms were identified by their colony morphology, staining character, pigment production, motility, oxidase, catalase, TSI and MIV, citrate tests[2]. Isolated bacteria were tested for antimicrobial susceptibility by disc diffusion method using Muller Hinton agar media - against different antimicrobial agents[3].

Statistical Analysis: Statistical analysis was performed by Statistical Package for Social Sciences (SPSS) version 22.0. Qualitative data were expressed as frequency and percent. The quantitative data were expressed as mean with standard deviation.

Ethical Clearance: All procedures of the present study were carried out in accordance with the principles for human investigations (i.e., Helsinki Declaration) and also with the ethical guidelines of the Institutional research ethics. Formal ethics approval was granted by the local ethics committee.

Results

A total of 3220 blood samples were collected from patients. From the 3220 samples, bacteria were isolated 372(11.55%) cases (Table 1).

Table 1: Distribution of Samples of the Study

Culture Result	Frequency	Percent
Positive	372	11.6
Negative	2848	88.4
Total	**3220**	**100.0**

The most commonly isolated bacteria from blood culture was *Salmonella typhi* which was 279(74.2%) cases followed by *Salmonella paratyphi* A, *Escherichia coli*, *Pseudomonas* Species and *Staphylococcus aureus* which were 52(14.0%) cases, 21(5.6%) cases, 14(3.8%) cases and 9(2.4%) cases respectively (Table 2).

Table 2: Distribution of Isolated Bacteria in Blood Samples (n=372)

Isolated bacteria	Frequency	Percent
Salmonella typhi	276	74.2
Salmonella paratyphi A	52	14.0
Escherichia coli	21	5.6
Pseudomonas Species	14	3.8
Staphylococcus aureus	9	2.4

Escherichia coli showed high degrees of sensitivity to colistin (71.42%), imipenem (61.90%), tazobactam plus piperacillin (52.38%), *Pseudomonas* species showed high degrees of sensitivity to imipenem (71.45%), amoxicillin plus clavulanic acid (57.14%) and ciprofloxacin (57.14%). On the other hand, staph. aureus showed high degree of sensitivity to imipenem (88.89%), amoxicillin plus clavulanic acid (88.89%), Gentamycin (55.56%) respectively (Table 3).

Table 3: Sensitivity Pattern of Isolated Bacteria to Different Antimicrobial Drugs

Antimicrobial drugs	E. coli (n=21)		Pseudomonas SPP.		Staph. aureus	
	Sensitive	Resistant	Sensitive	Resistant	Sensitive	Resistant
Amikacin	5 (23.81%)	16 (76.19%)	3 (21.43%)	11 (78.5%)	3 (33.33%)	6 (66.6%)
Azithromycin	2 (9.52%)	19 (90.48%)	1 (7.14%)	13 (92.86%)	1 (11.11%)	8 (88.89%)
Ceftazidime	4 (19.05%)	17 (80.95%)	6 (42.86%)	8 (57.14%)	5 (55.56%)	4 (44.44%)
Ceftriaxone	5 (23.81%)	16 (76.19%)	4 (28.57%)	10 (71.43%)	1 (11.11%)	8 (88.89%)
Cephradine	3 (14.29%)	18 (85.71%)	0 (00%)	14 (100%)	4 (44.44%)	5 (55.56%)
Cefixime	2 (9.52%)	19 (90.48%)	4 (28.57%)	10 (71.43%)	5 (55.56%)	4 (44.44%)
Cefuroxime	4 (19.05%)	17 (80.95%)	0 (00%)	14 (100%)	5 (55.56%)	4 (44.44%)

Antimicrobial drugs	E. coli (n=21)		Pseudomonas SPP.		Staph. aureus	
	Sensitive	Resistant	Sensitive	Resistant	Sensitive	Resistant
Ciprofloxacin	6 (28.58%)	15 (71.42%)	8 (57.14%)	6 (42.86%)	2 (22.22%)	7 (77.78%)
Colistin	15 (71.42%)	6 (28.58%)	6 (42.86%)	8 (57.14%)	8 (88.89%)	01 (11.11%)
Doxycycline	11 (52.38%)	10 (47.62%)	8 (57.14%)	6 (42.86%)	5 (55.56%)	4 (44.44%)
Cotrimoxazole	9 (42.86%)	12 (57.14%)	6 (42.86%)	8 (57.14%)	4 (44.44%)	5 (55.56%)
Gentamycin	7 (33.33%)	14 (66.67%)	3 (21.43%)	11 (78.57%)	5 (55.56%)	4 (44.44%)
Imipenem	13 (61.90%)	8 (38.10%)	10 (71.45%)	4 (28.57%)	8 (88.89%)	1 (11.11%)
Nalidixic acid	9 (42.86%)	12 (57.14%)	7 (50%)	7 (50%)	3 (33.33%)	6 (66.67%)
Tazobactam - Piperacillin	11 (52.38%)	10 (47.62%)	10 (71.45%)	4 (28.57%)	7 (77.78%)	2 (22.22%)
Amoxicillin-Clavulanic acid	9 (42.86%)	12 (57.14%)	8 (57.14%)	6 (42.86%)	8 (88.89%)	1 (11.11%)

Table 4: Resistance pattern of *Salmonella typhi* and *Salmonella paratyphi* A to different antimicrobial drugs

Antimicrobial drugs	E. coli (n=21)		Pseudomonas SPP.	
	Sensitive	Resistant	Sensitive	Resistant
Amikacin	212 (76.81%)	64 (23.19%)	46 (88.46%)	6 (11.54%)
Azithromycin	240 (13.04%)	36 (86.96%)	10 (19.23%)	42 (80.77%)
Ceftazidime	148 (53.62%)	128 (46.38%)	22 (42.37%)	30 (57.69%)
Ceftriaxone	263 (95.29%)	13 (4.7%)	31 (59.62%)	21 (40.38%)
Cephradine	93 (33.70%)	183 (66.38%)	11 (21.15%)	41 (78.85%)
Cefixime	198 (71.74%)	78 (28.26%)	21 (40.38%)	31 (59.62%)
Cefuroxime	177 (64.13%)	99 (35.87%)	12 (23.08%)	40 (76.92%)
Ciprofloxacin	136 (48.28%)	140 (50.72%)	22 (42.31%)	30 (57.69%)
Colistin	244 (88.41%)	32 (11.59%)	42 (80.77%)	10 (19.23%)
Cotrimoxazole	135 (48.91%)	141 (51.08%)	22 (42.31%)	30 (57.69%)
Gentamycin	190 (68.84%)	86 (31.16%)	34 (65.38%)	18 (34.62%)
Imipenem	270 (97.83%)	6 (2.17%)	47 (90.38%)	5 (9.62%)
Nalidixic acid	39 (14.13%)	237 (85.87%)	12 (23.08%)	40 (76.92%)
Tazobactam-Piperacillin	236 (85.51%)	40 (14.49%)	27 (51.92%)	25 (48.08%)
Amoxicillin-Clavulanic acid	242 (87.68%)	34 (12.32%)	40 (76.92%)	12 (23.08%)

Salmonella typhi showed high degrees of sensitivity to Imipenem (97.83%), Ceftriaxone (95.29%) and amoxicillin plus clavulanic acid (87.68%) respectively. *Salmonella paratyphi* A showed high degrees of sensitivity to imipenem (90.38%), amikacin (88.46%) and colistin (80.77%) respectively (Table 4).

Discussion

Blood cultures are the standard diagnostic method. Conventional blood culture method often yields poor result because of low bacterial load and increased chance of contamination. Therefore, various automated blood culture techniques have been in use since last two decades like Bacteck, Bac Alert and FAM methods.

In this study, 372(11.5%) bacteria are isolated, among the 3220 blood samples, among them *Salmonella typhi* is the most common organism 276(74.2%). On the other hand, Staph. aureus is 9(2.4%).

Escherichia coli showed high degrees of sensitivity to colistin (71.42%), imipenem (61.90%), tazobactam plus piperacillin (52.38%), *Pseudomonas* species showed high degrees of sensitivity to imipenem (71.45%), amoxicillin plus clavulanic acid (57.14%) and ciprofloxacin (57.14%). On the other hand, staph. aureus showed high degree of sensitivity to imipenem (88.89%), amoxicillin plus clavulanic acid (88.89%), Gentamycin (55.56%) respectively. *Salmonella typhi* showed high degrees of sensitivity to imipenem (97.83%), Ceftriaxone (95.29%) and amoxicillin plus clavulanic acid (87.68%)

respectively. *Salmonella paratyphi* A showed high degrees of sensitivity to imipenem (90.38%), amikacin (88.46%) and colistin (80.77%) respectively. Similar results have been published by Roy et al[5].

Conclusion

Rapid detection of micro-organisms by automated blood culture system is now available. Blood culture are the standard diagnostic method. Large amount of blood (10-20 ml) is used. They are positive in 60-80% of patients with typhoid fever.

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None

Conflict of Interest
The authors have no conflicts of interest to disclose

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Contribution to authors:
Islam MB, Yusuf MA conceived and designed the study, analyzed the data, interpreted the results, and wrote up the draft manuscript. Khan MS, Islam S contributed to the analysis of the data, interpretation of the results and critically reviewing the manuscript. Yusuf MA involved in the manuscript review and editing. All authors read and approved the final manuscript.

Data Availability
Any inquiries regarding supporting data availability of this study should be directed to the corresponding author and are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate
Ethical approval for the study was obtained from the Institutional Review Board. As this was a retrospective study the written informed consent was not obtained from all study participants. All methods were performed in accordance with the relevant guidelines and regulations.

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