Prevalence of Positive Blood Cultures in the Emergency Department of a Tertiary Hospital: A Retrospective Single-Centre Study

Osama Barakat, Muath Alsafrani, Hassan Alasmari, Faisal Alasmari, Abdullah Alzahrani, Reem Barakat, Wedad Alzahrani, and Ali Alsaheel

***Abstract*—Background: Blood cultures (BCs) are frequently ordered during the course of investigation in emergency departments (EDs). However, there are few studies examining the clinical value of BCs and the prevalence of positive BCs in the adult ED.**

Objective: This study aimed to determine the prevalence of positive BCs, as well as to specify the most commonly isolated microorganism, in the ED of a single tertiary care centre in Saudi Arabia.

Methods: This was a retrospective study conducted by reviewing patient charts to obtain all BCs collected in our ED over the course of one year. Out of 214,566 ED visits over the period from 1 July 2021 to 30 June 2022, a total of 1034 blood cultures were collected. The study was conducted in the ED of a teaching hospital in Taif, Makkah Region, Saudi Arabia, that has 500 beds for adults.

Results: The most commonly isolated organisms were Staphylococcus hominis (19.8%), Staphylococcus epidermidis (14.1%), Escherichia coli (9%), Klebsiella pneumoniae (8%), Staphylococcus capitis (7.3%), and Staphylococcus aureus (5.6%). Methicillin-resistant Staphylococcus aureus (MRSA) and Pseudomonas aeruginosa were isolated from 3.4% and 1.1% of positive blood cultures, respectively. In the context of antimicrobial sensitivity, the organisms isolated from positive BCs in this study showed the highest sensitivity to vancomycin (57.6%). This was followed by levofloxacin (48.6%), linezolid (48%), gentamycin (41.8%), amoxicillin clavulanate (39.5%), and clindamycin (39%). The highest prevalence of antimicrobial resistance was to ampicillin (42.4%). Resistance to clindamycin, azithromycin, piperacillin-tazobactam, and imipenem was 22%, 8.5%, 3.4% and 0.6%, respectively.

Conclusion: The prevalence of positive blood cultures in the ED of this tertiary hospital was high. The most commonly isolated organisms were Staphylococcus hominis, Staphylococcus epidermidis, Escherichia coli, and Klebsiella pneumoniae. Vancomycin elicited the highest antimicrobial sensitivity, followed by levofloxacin.

***Index Terms*—Blood Culture, Emergency Department, Prevalence, Saudi Arabia.**

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I. Introduction

Sepsis is a progressive disease caused by a dysregulated inflammatory cascade, leading to organ dysfunction and circulatory compromise in severe cases. The diagnosis of bloodstream infections (BSIs), which frequently rank among the top seven causes of death, requires blood cultures (BCs) [1]. Even when the primary disease is one with a low likelihood of association with bacteraemia, such as pneumonia or cellulitis, BCs are often taken in the emergency department (ED) from patients with suspected infections. As a result, the ED's positive blood culture yield is minimal.

Despite the frequent collection of blood cultures during the course of investigation in the ED, there

remain few studies that examine the clinical value of BCs, and few published criteria for obtaining BCs [1].

The true positive rate has been modest (1.8-5%) in the few trials conducted in adult ED populations, and only 0.5-4.8% of those studies have produced clinically meaningful results [2-4]. In the majority of investigations, almost similar false-positive rates have been discovered, which have drawbacks. The only study to quantify this, conducted in a paediatric ED, demonstrated considerable unfavourable effects of false-positive BCs in terms of staff time, and resource [5]. No studies have been conducted to detect the prevalence of positive BCs in the ED setting; our study therefore aimed to determine the prevalence of positive BCs and to specify the most commonly isolated microorganism in the ED of a single tertiary centre in Saudi Arabia

II. Methodology

This was a retrospective study, conducted by reviewing patient charts to obtain all BCs collected in our ED over the period between 1 July 2021 and 30 June 2022. A total of 1034 blood cultures were collected in that time. It was carried out in the ED of a teaching hospital in Taif, Makkah Region, Saudi Arabia, with a 500-bed capacity. The hospital covers adult medical and surgical specialities, with the exception of burns, obstetrics, and gynaecology, and is one of three significant hospitals providing care for Taif's population of 1.7 million. Every year, the ED sees about 200,000 patients, of whom 45% are admitted. The study population was comprised entirely of patients who had BCs taken in the ED during the study period; both those admitted to the hospital and those who were discharged from the ED were included.

Four of the authors handled the task of data collection, and the record of each patient in the research population was thoroughly reviewed. Patients' demographics, culture indication, chief complaint at presentation, BC result, and antibiotic culture sensitivity were all collected.

Microsoft Excel 2010 was used to enter the data, which was then translated from Arabic to English and coded for statistical analysis using Statistical Package for Social Science (SPSS) version 21.0. The research is exempt from ethical review.

III. Results

Of 214,566 visits during the study period, 1034 BC samples were collected.

The mean age of the patients 69 ± 21 years. Males and females constituted 60% and 40% respectively, and 88.7% were Saudi. The chief complaint leading to BC collection was classified per symptom; the most common symptoms were fever (29.4%), neurological symptoms (6.2%), and respiratory symptoms (5.1%). The prevalence of positive BCs among the collected samples was 17.1% (n=177).

The most commonly isolated organisms were Staphylococcus hominis (19.8%, n=35), Staphylococcus epidermidis (14.1%, n=25), Escherichia coli (9%, n=16), Klebsiella pneumoniae (8%, n=14), Staphylococcus capitis (7.3%, n=13), and Staphylococcus aureus (5.6%, n=10). Methicillin-resistant Staphylococcus aureus (MRSA) and Pseudomonas aeruginosa were isolated from 3.4% (n=6) and 1.1% (n=2) of positive blood cultures, respectively.

In the context of antimicrobial sensitivity, the isolated organisms showed the highest sensitivity to vancomycin (57.6%). This was followed by levofloxacin (48.6%), linezolid (48%), gentamycin (41.8%), amoxicillin clavulanate (39.5%) and clindamycin (39%). The highest antimicrobial resistance was to ampicillin (42.4%). Resistance to clindamycin, azithromycin, piperacillin-tazobactam, and imipenem was 22%, 8.5%, 3.4% and 0.6%, respectively.

IV. Discussion

The prevalence of positive BCs in the ED of this tertiary centre in Taif was high when compared with those of the several studies in the literature, which ranged from 1.8% to 5% [2-4]. Blood cultures must be weighed against more costly and clinically useful tests such as skin lesion samples, urine and joint fluid cultures, and more direct tests like cerebrospinal fluid Gram stain and culture [4].

Despite insufficient studies on the ordering of BCs in adult EDs, the few publications that have been published generally state that these tests are over-ordered, frequently result in a low impact on patient management, and frequently have a high false-positive rate [2-4].

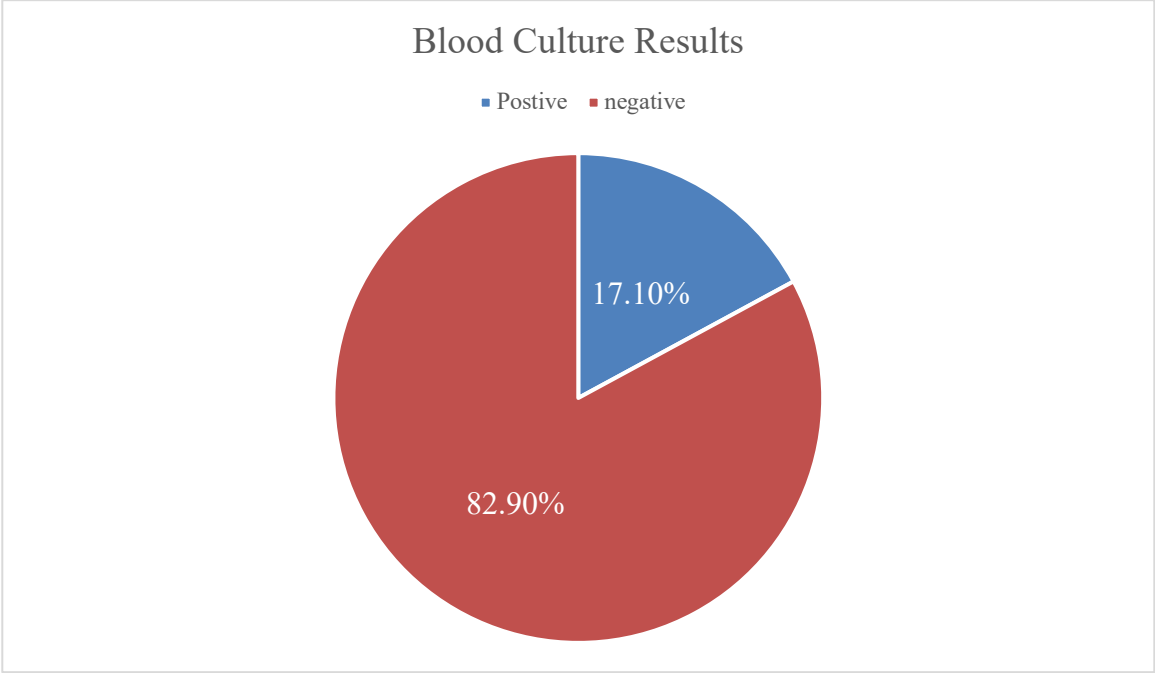

Figure 1. Prevalence of positive blood cultures among the collected samples in the studied centre.

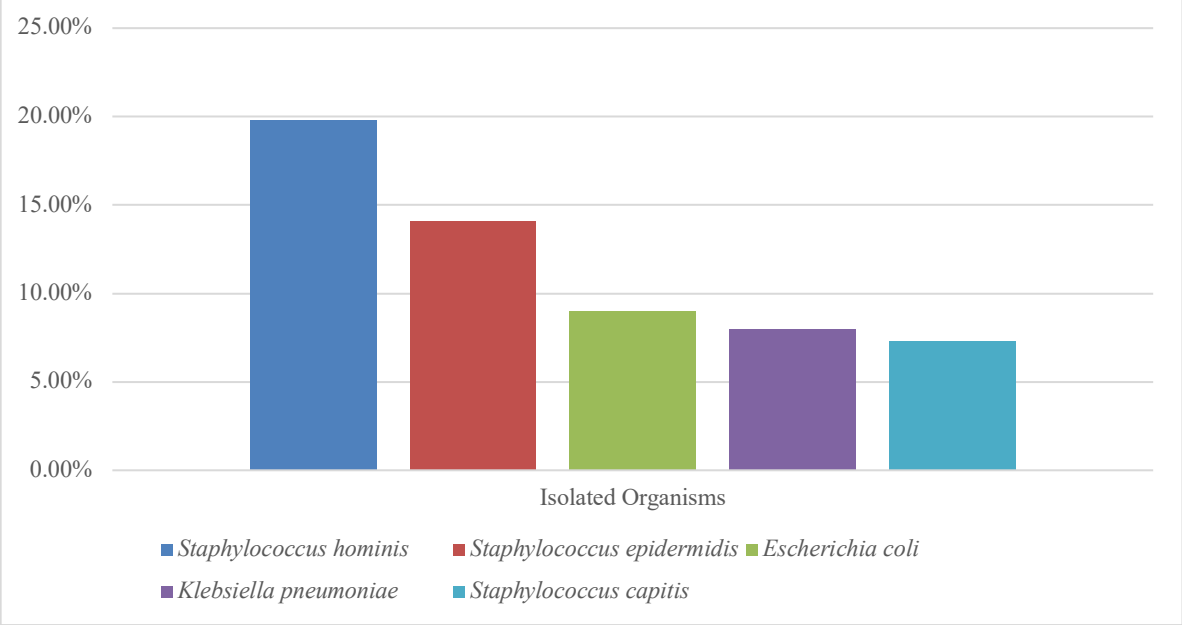

Figure 2. The most commonly isolated organisms from blood cultures in a tertiary hospital in Taif, Saudi Arabia

In contrast, our study found that the confirmed prevalence of positive BCs is sufficient reason to order BCs for every sepsis-suspected patient. The prevalence could be attributed to several factors, such as the physician's gestalt, or the ED system and structure.

Additional studies, mostly from paediatric EDs, have focused on the circumstances in which BCs are most unlikely to be helpful. Their results suggest that BCs should not be collected from patients with urinary tract infections, cellulitis, or community-acquired pneumonia, because they showed that in such patients, the collection of BCs is not helpful in changing their management", or "the collection of BCs has no effect on their management [3, 5- 6]. On the other hand, it is interesting to note that in our study, BCs were most frequently ordered for these three groups, whose symptoms included fever, neurological symptoms and respiratory symptoms. In cases of sepsis, meningitis, osteomyelitis, septic arthritis, endocarditis, peritonitis, pneumonia associated with severe sepsis/HCAP, and fever of unknown cause, BCs are recommended [8–15,16]. Furthermore, blood cultures should typically be ordered in the ED for any patient who is critically unwell or has a high chance of developing continuous bacteraemia [1].

A study conducted on a paediatric population reported that all 10 patients with a confirmed pathogen on BC had the same organism cultured from midstream urine [6], while Ramos et al. [3] observed that BCs changed treatment most often when the diagnosis was not a urinary tract infection. Given these results, it is difficult to defend the continued collection of BCs in this circumstance.

In our study, the most common pathogens in the positive BCs were Staphylococcus hominis, Staphylococcus epidermidis, Escherichia coli, Klebsiella pneumoniae, Staphylococcus capitis, and Staphylococcus aureus. MRSA and Pseudomonas aeruginosa were also isolated. In the literature, BCs that contain Staphylococcus aureus, Streptococcus pneumoniae, group A streptococci, Haemophilus influenzae, Pseudomonas aeruginosa, and Candida species typically result in a true positive [17, 18].

Meanwhile, the growth of Viridans streptococci and enterococci in cultures may represent either real pathogens or contamination. There is a greater chance that many BCs collected from different lines will be truly positive [19, 20,21]; this method can raise the proportion of accurately positive blood cultures.

Our study has several limitations. This was a retrospective chart review-based study, and systematic bias in data retrieval cannot be avoided in such research. Furthermore, we are a tertiary referral centre for adult patients only, with a high level of acuity and a high mean age (66 years). This means that, compared with many community hospitals, our patient group is different. Our patients' true-positive BC rates are probably greater than those in the ED of other hospitals, because they are older, have more comorbid conditions, and are sicker overall. This is a confounding factor that may affect the results of our study.

V. Conclusion

The prevalence of positive blood cultures in the ED of our tertiary hospital was high in comparison with the literature review. The most commonly isolated organisms were Staphylococcus hominis, Staphylococcus epidermidis, Escherichia coli, and Klebsiella pneumoniae. Sensitivity was highest to vancomycin, followed by levofloxacin.

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