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ROLE OF BLOOD CULTURE FOR SEPSIS IN THE EMERGENCY DEPARTMENT

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ABSTRACT

Introduction

Sepsis is a major cause of emergency medicine department (EMD) admission. It is associated with high morbidity and mortality. The rapid identification of sepsis and initiation of treatment play critical roles in the optimal management of patients with bloodstream infections and their survival. In our study, we tried to find out the prevalence of positive blood culture in the emergency department and its role in identifying the severity and prognosis of sepsis.

Methods

2-year prospective survey of 80 septic patients who were admitted to the EMD of a tertiary care centre in South India. Chi-square test was done to find the association between mortality and the blood culture.

Results

In our study population, the mean age was 56.99 ± 16.329 years. 59% of patients had severe sepsis and 41% developed septic shock. The mortality rate of patients admitted with severe sepsis and septic shock are 23.4% and 87.9% respectively. 45% of blood culture-positive cases had severe sepsis and 55% of cases had septic shock on admission to EMD. There is no statistically significant correlation between blood culture and severity of sepsis. ($p = 0.238$) Patients were followed up for 45 days. We did not find any statistically significant correlation between blood culture-positive cases and mortality. ($p = 0.197$)

Conclusion

Sepsis is a medical emergency. Prompt and effective treatment should be initiated as early as possible. In patients with sepsis, initiation of prompt antibiotics is the critical step for treating these life-threatening infections. Obtaining a blood culture in the EMD can be a time-consuming procedure as it needs to be done meticulously with all aseptic precautions. Hence, if there is a clinical suspicion of sepsis, most appropriate antibiotics should be started as early as possible according to the local antibiogram. Antibiotics should not be delayed for blood culture sampling in EMD.

Key words: Sepsis, Septic Shock, EMD – Emergency Medicine Department, Antibiotics

ORIGINAL ARTICLE

Introduction

Sepsis is a deleterious systemic host response to infection leading to severe sepsis (acute organ dysfunction secondary to suspected or documented infection) and septic shock (severe sepsis plus hypotension not reversed with fluid resuscitation).[1,2] Sepsis is a major cause of emergency medicine department (EMD) admission. It is associated with high morbidity and mortality.

The Indian Intensive care case mix and practice patterns (INDICAPS), which was conducted over 124 ICUS, across 17 states in India including 4209 patients has shown that 26% of intensive care admission is due to sepsis and out of that the mortality rate is as high as 42.20%.[3] Even in INDICAPS II study, the ICU mortality for patients in sepsis remains high.[4] Sepsis is a burden. Prompt and effective management is crucial in patients with sepsis and even more aggressively in patients with septic shock. [1,2]

Blood cultures should be obtained in patients with features of sepsis before initiating antimicrobial therapy.[1,5] Blood culture helps in identifying the organism causing sepsis. This will help in providing a specific therapy targeting the causative organism, hence resulting in better treatment and reduced hospital stay for the patient. In patients with sepsis, antibiotics are the critical tools for treating these life-threatening infections.

In our study, we planned to evaluate the prevalence of positive blood culture in patients presenting with sepsis in EMD and its role in identifying the severity and prognosis of sepsis.

Methods

Prospective observational study was conducted on 80 patients who came to the EMD, in a tertiary care hospital in South India with features suggestive of sepsis.

Inclusion criteria:

1. Age older than 18 yrs.
2. Suspected infections
3. Two or more criteria of Sepsis[2]

Patients referred from other hospitals with features of sepsis on parental antibiotics were excluded from the study. According to the surviving sepsis campaign bundle, all patients with sepsis, that come to the emergency department were screened for sepsis and included in the study according to the inclusion criteria. Routine blood workup along with blood culture was drawn within 1 hour of admission into the EMD and then antibiotics were initiated as per the guidelines. [2,6] Severity of the sepsis was categorized into Severe Sepsis and Septic Shock on admission to the ED. The sample size was calculated based on the results of the study parameters observed in an earlier publication and with 95 percentage confidence and 20% allowable error, the minimum sample size comes to 68. [7] But in our study, we have included 80 patients. Survivors and Non-survivors were the outcome variables. Statistical analysis was conducted using SPSS version 20. Chi-square test was done to find the association between mortality and the blood culture.

Results

80 patients who fulfilled the inclusion criteria and exclusion criteria's were included in the study. In our study population, the mean age was 56.99 ± 16.329 years and 70% were males 30 % were female. All the patients were categorized depending on the severity during the presentation into severe sepsis and septic shock. In our study population, 59% patients had severe sepsis and 41% developed septic shock.

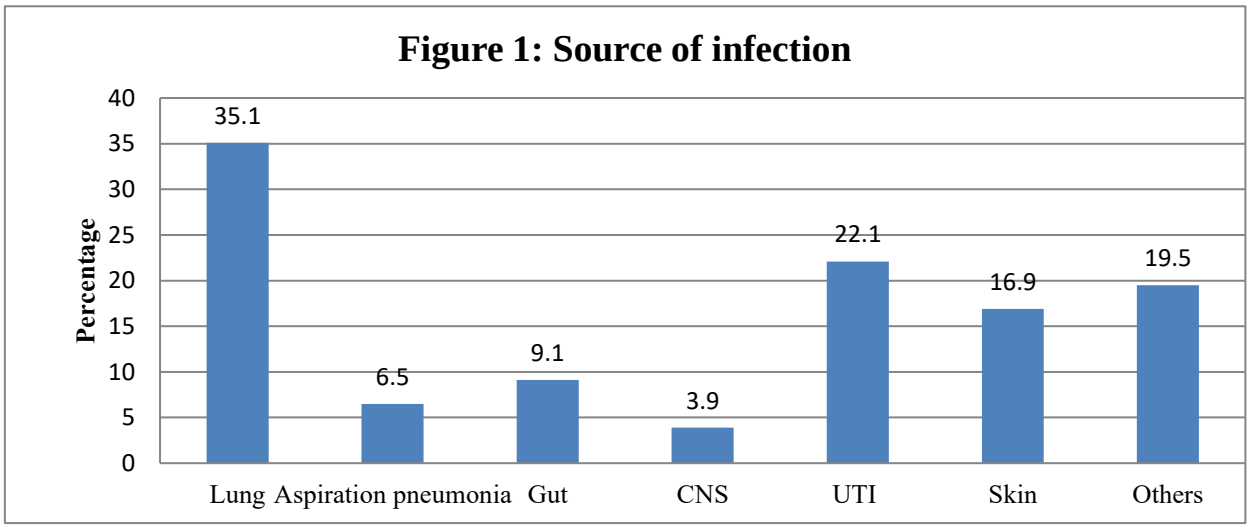
In a 45-day follow up, 40 patients expired and 40 patients survived, out of the 80 cases that we enrolled in the study. We had 47 cases in the severe sepsis category, out of which 23.4% expired

and 76.6% survived. The mortality rate of patients admitted with severe sepsis and septic shock are 23.4% and 87.9%, respectively. We were able to find a statistical correlation ($p < 0.001$) between severity of the disease and the prognosis. (Table 1)

Table 1 : Severity of the disease and Prognosis

	Prognosis (% ge)			Odds	95% C.I. for	
	Expired	Alive	P value	Ratio	Lower	Upper
Severe Sepsis (47)	23.4	76.6	<0.001	23.727	6.836	82.361
Septic Shock (33)	87.9	12.1				

In those patients admitted with sepsis to the EMD, 3.8 % of cases, an obvious source of infection could not be identified clinically. 16.3 % cases presented with multiple sources of infection and 80% cases single source of infection was identified. Out of which the most frequent sources of infection was the lungs (35.1%), followed by urinary tract infection (22.1%). (Figure 1: Source of infection)



In our study, positive blood culture was obtained in only 25% cases in our study and 75% had negative blood culture. Out of those with positive blood culture, 45% had severe sepsis and 55% cases had

septic shock on admission to ED. There is no statistically significant correlation between blood culture and severity of sepsis. (p = 0.238). (Table 2)

Table 2: Comparison between blood culture and severity of sepsis

			Severity of Sepsis		P Value
			Severe Sepsis	Septic Shock	
Blood culture	Negative (60)	75%	63.3%	36.7%	0.238
	Positive (20)	25%	45.0%	55.0%	

The average time that is taken after admission to the emergency department with a clinical diagnosis of sepsis, to administer the full dose of antibiotics therapy after drawing blood culture and after antibiotic test dose was 76.1 minutes. Around 16.25% cases received full dose antibiotics (after diagnosis of sepsis, blood culture sampling and antibiotic test dose) within 60 mts (1 hr) of presentation to the ED with the earliest being within 48 minutes of presentation to the ED.

Majority of the patients (65%) with positive blood culture expired in the 45 days follow up when compared to 45% mortality in blood culture negative category. We did not find any statistically significant correlation between blood culture positive cases and mortality. (p = 0.197) (Table 3)

Table 3: Comparison between blood culture and prognosis

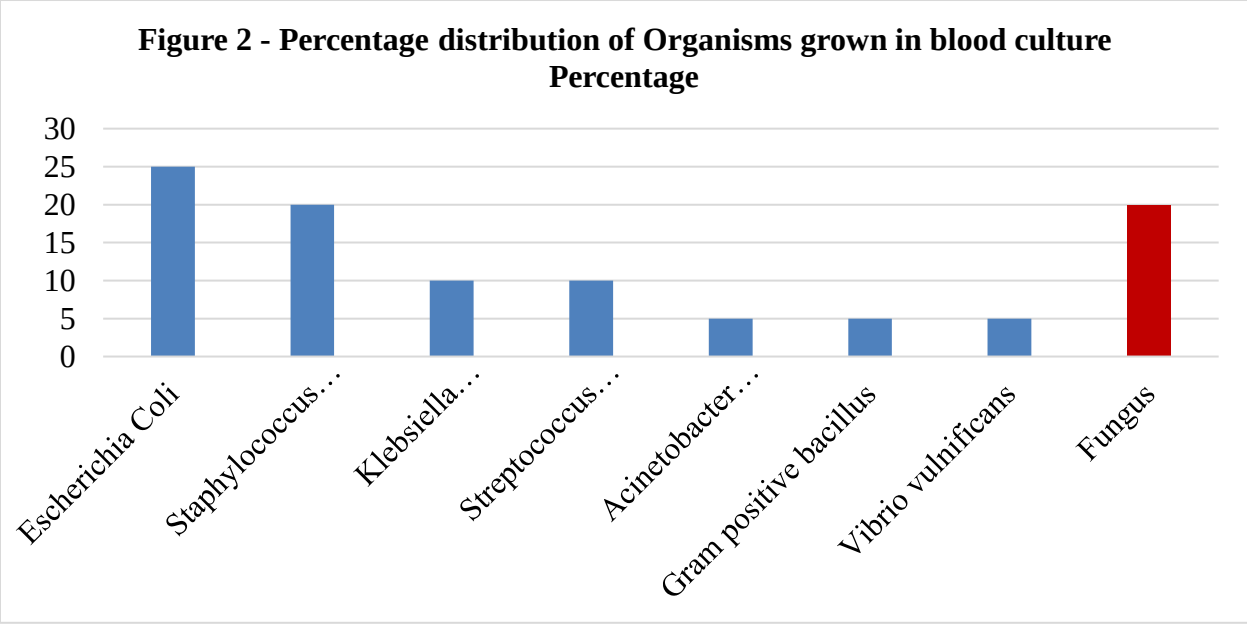
			Mortality		P Value
			Expired	Alive	
Blood culture	Negative (60)	75%	45.0%	55.0%	0.197
	Positive (20)	25%	65.0%	35.0%	

65% cases with positive blood culture had a prolonged hospital stay compared with 66.7% in blood culture negative category. But we did not find any statistically significant correlation between both. (p = 1.000) (Table 4)

Table 4: Comparison between blood culture and length of hospital stay

			Length of Hospital Stay		P Value
			≤7 days	>7 days	
Blood culture	Negative	60	33.3%	66.7%	1
	Positive	20	35.0%	65.0%	

The most common organism that was encountered was Escherichia coli (25%), followed by Staphylococcus aureus (20%). Fungus was also present in 20% cases. 35% organisms were Gram Positive with cocci of 30% and bacilli of 5% and 45% were gram negative bacilli and 20 % had fungi sepsis. (Figure 2 - Percentage distribution of Organisms grown in blood culture)



Discussion

Blood culture is an important method of identifying the causative organism. In sepsis, the primary and the most important treatment includes initiation of prompt antibiotic as early as possible along with source control. [1, 2] Blood culture must be drawn before initiating antibiotic therapy as most studies have recommended that even a single dose of antibiotics over a period of time, may reduce the ability of blood culture to show a positive result, which can also in turn increase the cost and length of stay for the patient. [8, 9]

According to the surviving sepsis campaign bundle, all patients with sepsis, blood culture were to be drawn within 1 hour of identification of sepsis and then antibiotics were initiated as per the guidelines. [1, 2] Normally, most intravenous antibiotics require a test dose. After the test dose, we would need to wait for 30 minutes to start initiating a full dose. The completion of full dose may depend on whether the antibiotic is given as a bolus or as an infusion. Moreover, as per the sepsis guidelines, at least two (2) sets of blood cultures should be obtained (each set includes one (1) aerobic and one (1) anaerobic bottle) and each set of blood cultures are to be drawn from two separate venepuncture sites at approximately 0 – 30 minutes apart in an aseptic environment. [10] From these it is clear, that drawing blood for blood culture need to be done very meticulously and is a time-consuming procedure. In our study, following all these guidelines, even when the best care is provided, the average time that is taken after admission to the emergency medicine department to completion of the full dose of 1st antibiotics following evaluation of the patient, diagnosis of sepsis, stabilisation of patient, drawing blood culture and providing antibiotic test dose as required as per guidelines have been 76.1 minutes. Earliest time for the same was 48 minutes. So, one of the most important treatment strategies for management of sepsis, the initiation of full dose of prompt antibiotic, took more than 60 minutes (1 hour) for over 83.75% patients even though test dose was initiated within the stipulated time.

In our study, only in 25% cases, we were able to identify an organism with the help of blood culture. In a study published by Mountain et al, have shown that out of the 218 patients included in the study, only 13% were blood culture positive and out of which only 2.8% blood culture positive reports influenced the management.[11] According to Tabak et al, out of the 165,593 blood specimens which were collected, of which, 9.5% gave positive cultures.[12] In another study published by Brun et al, have shown that blood culture is able to detect bacteremia in only 50% of the cases.[13] On an average the time taken for blood culture report (to detect an organism or to say culture is negative) is 24 – 48 hours. So even though we delay the administration of the antibiotics for drawing a sterile blood culture, only less than 1/4th patients' blood culture report comes back for a positive organism growth and also those reports were obtained only after 24-48 hours. So if we could administer those first dose antibiotics as soon as the diagnosis of sepsis is made, and before the drawing of cultures, it would be more effective for the management of patients in sepsis.

Moreover, in our study 3.8% patients the infection site is never identified. Even though clinical and laboratory evaluation was in favour of sepsis, neither imaging studies nor blood culture analysis could not rule in the presence of an infection. There are also patients with an unconfirmed infection, as source of infection may not be identified and whose cultures are negative and still shows features of sepsis, multi organ failure in a similar proportion of the patients whom an infection have been confirmed. Various studies have shown that, blood cultures can also give false negative and also false positive results.[14, 15]

Presence of a blood culture positivity shows that the organism is within the blood stream and is circulating throughout the body. Septicaemia can indeed contribute to the severity of the condition and also poor prognosis.[16] Marco et al in their study found out that blood cultures have a role in deciding on the severity of the disease.[14] In our study, in patients with positive cultures, 65% patients

expired within 45 days, this could be considered as a mortality predictor, even though we did not find any statistically significant correlation between positive blood culture and severity of sepsis and also with mortality. The reduced number of patients with positive blood culture report would have contributed to this.

In our study, we could see a similar incidence in gram positive and gram negative organisms as sources of sepsis. We also found around 20% cases with fungi sepsis. Invasive fungal infections is indeed a great concern. Studies have highlighted and emphasized the importance of gram negative bacteria to induce sepsis and septic shock when compared to gram positive organisms.[17] Todi et al, 2010 have shown 72.45% patients having gram negative sepsis.[18] As per the INDICAPS II study, the microbial pattern of infections shows a lesser predominance of gram-positive bacteria (13.6%) compared to a higher predominance of gram negative bacteria (75%) and 9.7% are fungi unlike the EPIC II data showing much higher proportions of the latter two. [4] So the importance of both gram positive and gram negative cause of sepsis should be of concern and prompt antibiotics therapy should be initiated accordingly according to local antibiogram.

Delay in initiation of antibiotics could worsen a patient in sepsis. Blood culture definitely has a role in guiding for an organism specific treatment. But as discussed, their role in ED is debatable. Even after drawing blood culture within 1 hour and then initiating antibiotics, we were not able to find any statistical significant correlation between blood culture with severity of sepsis nor with mortality or length of hospital stay. The blood culture and sensitivity report will be available only after 24 to 48 hrs. Platinum minute and the golden hour concepts which we use in Trauma is also important in Sepsis. In case of severe sepsis and septic shock, each minute counts, we feel that antibiotic administration should not be delayed. If you have a clinical suspicion of sepsis, the first dose of a broad-spectrum antibiotic should be initiated as early as possible according to the local antibiogram

and this can be immediately followed with blood culture sampling. In cases, where an antibiotic test dose is mandatory, we could give the test dose first, followed by blood culture sampling under aseptic precaution and subsequently once the stipulated duration for the test dose is completed, antibiotics full dose can be administered instead of drawing blood culture and then giving antibiotic test dose. During the course of treatment, we could deescalate the treatment according to the acute phase reactants or the culture report. These steps we take could make sure that antibiotics which is considered as one of the most important lifesaving intervention is sepsis is administered more effectively in a timely manner.

Limitations

In our study, even though we excluded patients on prior antibiotics, few of the patients would have been initiated on antibiotics which they are not aware of and for which no documentation is available according to them from outside hospital. A large multicentric study to compare blood culture results before and after antibiotic administration would be helpful to understand whether blood cultures turn negative even with a single dose of antibiotics

Conclusion

Sepsis is a medical emergency. Prompt and effective treatment should be initiated as early as possible. In sepsis, antibiotic and source control is the most effective treatment of choice. If there is a clinical suspicion of sepsis, most appropriate antibiotics should be started as early as possible according to the local antibiogram. As per this study, initial blood culture from emergency room does not have a role in predicting severity, mortality and length of hospital. Hence, antibiotic initiation should not be delayed for blood culture sampling in Emergency medicine department. However body fluid cultures including blood culture are an important tool to identify the organism causing sepsis and it will help

to escalate or deescalate antibacterial treatment in specialties like critical care and infectious disease, which could be considered to be drawn after the first dose of antibiotics is administered.

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