Original Article

Central Venous Catheter Tip Culture with Blood Cultures versus Blood Cultures Alone in Identification of Organisms in Patient with Sepsis in ICU

CVC tip cultures with CVC blood cultures versus CVC Blood Cultures Alone in ICU

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ABSTRACT

Objective: To compare CVC tip cultures with CVC blood cultures versus CVC blood cultures alone in identification of organisms in patients with sepsis admitted in Intensive Care Unit.

Study Design: Retrospective Cohort study

Place and Duration of Study: This study was conducted at the Medical Intensive Care Unit of Aga Khan University Hospital, Karachi from Jan, 2021 to Dec, 2021.

Materials and Methods: Severe septic patients >18 years of age admitted in ICU with CVC inserted and atleast one CVC blood culture sent, were included and patients with previously known culture/organism on ICU arrival were excluded. SPSS v25.0 was used for data analysis. Frequency and percentages were reported for qualitative data while mean and standard deviation was reported for quantitative data.

Results: Total 139 patients were included in the study with mean age of 53.45 ± 16.17 years with mean duration of CVC was 5.76 ± 2.89 days. Most common source of sepsis was respiratory system with 57(41%) of cases.%). 73(52.5%) patients had improved and the mortality was around 66(47.5%). 49(35.3%) patients CVC tip cultures were sent along with CVC blood cultures from which 49 CVC tip 27(55%) were positive for organism growth while 22 (45%) were negative and 11(22%) patients had CVC blood cultures positive. In 90 patients only CVC blood cultures were sent, 28(31%) were positive for any organism growth. Most common organism in our study was Acinetobacter.

Conclusion: CVC tip cultures were effective predictors for identification of organisms in septic patients when combined with CVC blood cultures rather than using CVC blood cultures alone

Key Words: Central Venous Catheter, Sepsis, Intensive care unit

Citation of article: Arif MS, Ahmed AS, Shamim S. Central Venous Catheter Tip Culture with Blood Cultures versus Blood Cultures Alone in Identification of Organisms in Patient with Sepsis in ICU. Med Forum 2022;33(7):21-25.

INTRODUCTION

Sepsis is a life-threatening organ dysfunction caused by a dysregulated host response to infection(1). Eventually it leads to a complex syndrome characterized by progressive circulatory collapse, resulting in renal and respiratory failure and abnormalities in coagulation, plus profound and unresponsive hypotension.

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Received: February, 2022
Accepted: April, 2022
Printed: July, 2022

Sepsis is a major cause of morbidity and mortality in modern intensive care units (ICUs)(2, 3). It is one of the leading cause of mortality in the third world countries due to limited resources of medications and intensive care equipment available to people. Antimicrobial resistance has become one of the major concerns due to use of multiple antibiotics judiciously and new multi-drug resistant strains are emerging being difficult to treat (4). Only limited numbers of antibiotics are now available making treating resistant organisms difficult especially in the third world countries. Bilal et al showed the increasing prevalence of highly resistant organism that has increased in the past decade in Pakistan (5). Central venous catheter (CVC) is used in care of critically ill patients to receive fluids and medicines. These intravascular devices act as vehicle for entry of microorganisms that colonize the skin adjacent to the site of entry or they may serve as foreign bodies, leading to catheter related blood stream infections. Central line associated blood stream infections are a major risk factor for blood streamed infections. Several factors, such as those related to the patient (i.e. immunodeficiency, renal replacement

therapy), central-venous catheter (CVC) use (prolongedcatheterization, type of catheter material, and anatomical site of catheter insertion), and healthcare practice (poor barrier methods during catheter insertion and handling) have been shown to increase the risk of CVC infection [6].

Catheter related blood stream infection (CR-BSI) or Central line associated blood stream infection (CLABI) have been termed as a leading cause of preventable health care associated infections (HAIs) as well as catheter related infections which have led to longer days of hospitalizations, substantial mortality and raising the hospital economic costs of health-care provision [7]. CVC tip culture had been used in the past for the demonstration of CR-BSI/CLABI but its use has become limited due to low positive predictive value diminishing the ability to adequately attribute catheter as a source of infection [8]. A study showed the dwindling utilization of CVC tip catheter over the last decade for the purpose of management of CR-BSI [9]. Patient who are in sepsis often not demonstrate any organism in their blood cultures and culture negative sepsis is an important and relatively under studied condition. Phua et al demonstrated culture negative sepsis to be 41.5% in a study done in intensive care unit[10]. Due to the emergence of multi drug resistant organism CVC tip culture might be a useful tool in identification of organism in case of culture negative sepsis as well as positive cases so that earlier detection of organisms and timely appropriate antibiotics can be initiated. The aim of this study is to check the usefulness of CVC tip culture sent along with CVC blood cultures for identification of organism in patients with sepsis admitted in the intensive care unit so that treatment can be initiated early as per cultures.

MATERIALS AND METHODS

This single-centered retrospective cohort study was conducted at the Medical Intensive Care Unit of Agha Khan University Hospital. The duration of study was one year (from January 2021 to December 2021). Patients above the age of 18 years, of either gender, admitted in the ICU of the hospital during the study period, diagnosed with severe sepsis having CVC inserted and at least one CVC blood culture sent were included in the study, while patients with previously known organisms before being admitted into ICU were excluded from the study. Since this research was an observational study with reviewing of retrospective data using non-probability sampling technique, and since no intervention was carried out, therefore the study did not require direct patient consent and exemption was given from ethical department.

Data Collection Procedure: Approval was taken from the hospital ethical research committee. According to the inclusion criterion, medical records of all fulfilling patients were retrieved from the Medical ICU including case log entries from hospital's database. The patient's data included their demographic data, diagnosis, frequency of blood cultures obtained via CVC and CVC tip cultures and the organism isolated, all were collected retrospectively from the hospital data system and documented. The healthcare provider, patient and staff's identification all were kept confidential and anonymous.

Data Analysis: Data analysis was done using SPSS version 25.0. For qualitative data frequency and percentage were reported while mean and standard deviation were reported for quantitative variables. The differences in-between organism reported on CVC tip culture in comparison to CVC blood culture was tested by applying chi-square test keeping p-value of <0.05 as statistically significant.

RESULTS

Total of 139 patients were included in the study as per inclusion criteria [Figure I]. Mean age of the patients was 53.45 ± 16.17 years. 88 (63 %) of patients were males while 51 (36.7 %) were females. The overall mean duration of CVC was 5.76 ± 2.89 days. The primary source of sepsis most commonly was the respiratory system comprising to 57(41%) of the total cases. Other sources included gastrointestinal 17(12.2%), renal / urological 15 (10.8%), central nervous system 12(8.6%), musculoskeletal and skin 11(7.9%), hematological 10(7.2%), cardiovascular 9(6.5%), viral with superimposed sepsis 6 (4.3) and others 2(1.4%)[Figure 2]. Out of the total 139 patients 73(52.5%) patients had improved and the mortality was around 66(47.5%) [Table I].

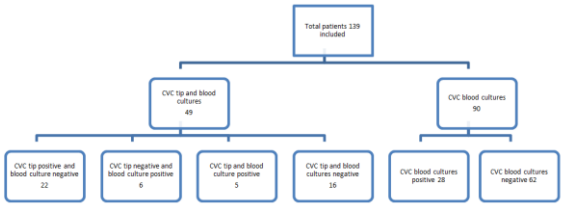

Figure No.1: Flow diagram showing the number of patients and their positivity rate

Table No.1: Baseline demographics of patients included in the study (n=139)

Variable		Mean	Standard deviation
Age (years)		53.45	16.17
Duration of Central Venous Catheter (days)		5.76	2.89
		Freq-uency	Age (%)
Gender	Male	88	63.3
	Female	51	36.7
Diagnosis	Respiratory	57	41

	Musculoskeletal + Skin	11	7.9
	GIT	17	12.2
	Renal/Urology	15	10.8
	CNS	12	8.6
	CVS	09	6.5
	Hematological	10	7.2
	Viral infection	06	4.3
	Other	02	1.4
Patient Outcome	Improved	73	52.5
	Expired	66	47.5

Table No.2: Frequency of organisms cultured in-between CVC tip culture and CVC Blood Culture (combined and separately) (n=139)

Variables		On CVC Tip Culture + CVC Blood Culture	Only CVC Blood Culture
Cultures done		49 (35.3 %)	90 (64.7 %)
Organism cultured only on CVC Tip Culture		27 (55 %)	-
Organism cultured only on CVC Blood Culture		-	28 (31 %)
Outcomes	Improved	24 (49 %)	49 (54.4 %)
	Expired	25 (51 %)	41 (45.6 %)

In 49(35.3%) patients CVC tip cultures were sent along with CVC blood cultures and in 90(64.7%) patients only CVC blood cultures were sent. Out of the 49 CVC tip 27(55%) were positive for organism growth while 22 (45%) were negative. Out of the 49 patients 22(44.89%) patients had only CVC tip culture positive, 6(12.24%) patients had CVC tip culture negative but CVC blood culture positive, 5(10.20%) patients had both positive and 16(32.65%) patients had both negative. In the 90 patients in whom only CVC blood cultures were sent 28(31%) were positive for any organism growth [Table 2, 3]. In the combined group the mortality was around 51% while 49% patients improved while in the CVC blood culture only group mortality was 45.6% while 54.4% patients had improved [Figure 3].

The most common organism growth on the CVC tip culture was Acinetobacter (5) followed by Klebsiella (3), Pseudomonas, Proteus, Roultella, Cornybacterium and Staphylococcus not Aureus growing 2 times. 22(45%) of the CVC tip cultures were negative. In comparison to CVC tip most common organism growth on CVC blood cultures was Acinetobacter (7) followed by Candida (5), while Pseudomonas, Vancomycin resistant Enterococcus and E.coli growing 3 times. Roultella and Staphylococcus grew 2 times, Salmonella, Bacteroides and Penicillium grew only once. 111 CVC blood cultures were negative (p value 0.7) [Figure 4].

Table No.3: Frequency of positivity in the combined CVC tip with CVC Blood Culture group (n=49)

Variables	Result
CVC tip positive and blood culture negative	22 (44%)
CVC tip negative and blood culture positive	6 (12.2%)
CVC tip and blood culture positive	5 (10.0%)
CVC tip and blood culture negative	16 (32.6%)

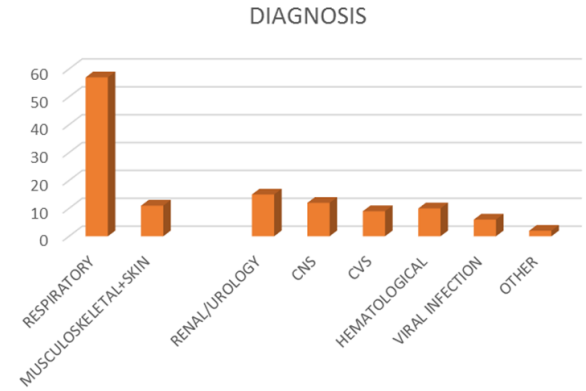

Figure No.2: Graphical representation of Primary source of Sepsis

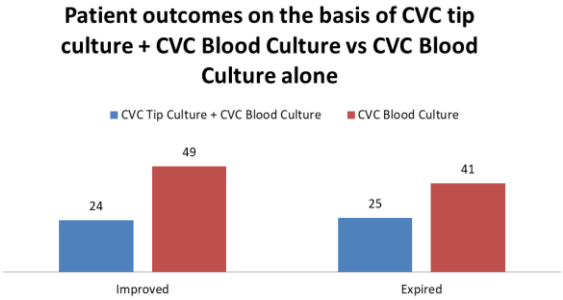

Figure No.3: Graphical representation of patient outcomes on the basis of CVC tip culture + blood cultures and CVC blood culture alone (n=139)

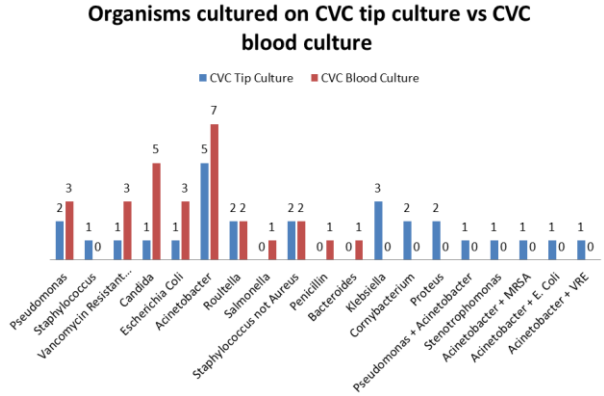

Figure No.4: Graphical representation of the Organism growth on CVC tip and Blood cultures

DISCUSSION

Central venous catheters are the most frequently used indwelling catheters used for resuscitation and have become necessary tools for the successful treatment of patients who are critically ill [11]. The results of our study showed significant variation in both culture positivity, frequency of cultures done and organism cultured in-between CVC tip cultures and CVC blood cultures. The mean age of patients in our study was 53.45±16.17 with 88(63.3%) patients being male and 51(36.7%) females. From total cultures observed were 49 CVC tip cultures along with CVC blood cultures and 90CVC blood cultures only, showing that higher frequency of organisms were cultured with CVC tip cultures (55%) as compared to CVC blood cultures (22%) when sent together while 31% of the time CVC blood cultures were helpful when sent alone. CVC tip cultures were effective predictors for early identification of organisms in septic patients and their outcomes especially when sent together with CVC blood culture rather than blood cultures alone as 44% of the time only CVC tip culture came positive in the combination group when compared to only 12.2% patients in whom CVC blood culture came positive.

Since culture negative sepsis has become one of an important factor when managing patient with sepsis or septic shock, antibiotics optimization and timely administration is very important. Gupta et al demonstrated culture negative sepsis to be 47.1% while in our study culture negative sepsis was 39.56%[12].

A study done regarding the intravascular catheter related infections the most common organisms observed were Staphylococcus aureus followed by Pseudomonas as compared to Acinetobacter followed by Klebsiella in our study[13].Another observational study done showed the most frequent organism causing catheter related blood stream infection to be Staphylococcus and least infection by Acinetobacter contrary to our study[14].

Although it is recommended that central lines have a pivotal role in resuscitating and both acute and long term caring of patients that are severely ill[15]. Nonetheless, CVCs can also become route by which micro-organisms gain access to already compromised immune system as in sepsis and burns patients. This can result in substantial mortality and morbidity. Sihler et al reported that for central line infection, CVC tip culture should be sent for proper evaluation of catheter related blood stream infection. The most common source of bacteremia in their study was respiratory system followed by the gastrointestinal tract, similar to our study[16].

The mortality of patients in intensive care units is generally increased as the number of days of central venous catheter increased. In a retrospective study done to evaluate the frequency and indications of central venous catheter insertions and their rate of infection and mortality, the mortality of patients was higher among those patients who required CVC for longer duration[17]. Similarly another study done on 103 patients admitted in ICU with CVC in place, mortality rate increased in patients requiring CVC for more than 7 days[18]. Similar findings were observed in our study.

This research was not free from limitations. Results derived from this study were drawn from a single tertiary care center, which might not be reflective of wider population of patients with sepsis. Furthermore, limited sample size was available for analysis, owing to the small percentage of sepsis patients that were administered CVCs. Further researches are required for ensuring the CVC tips cultures are routinely send for culture along with CVC blood cultures. This study only observed and analyzed CVC tip cultures with CVC blood cultures and CVC blood cultures alone in identifying the organisms so that they could be treated early and did not intervene treatment of sepsis on the basis of organism cultured as it was a retrospective review of data.

Despite these issues, nonetheless, our research has provided a vital preliminary analysis of the factors associated with CVC tip cultures and CVC blood cultures. This can aid as a stepping stone for further research.

CONCLUSION

According to the finding reported in our study, CVC tip cultures are effective predictors for early identification of organisms in patients with sepsis when combined with CVC blood cultures rather than using only CVC blood cultures. Further research is required to validate the findings of our study.

Author's Contribution:

Concept & Design of Study:	Muhammad Sohaib Arif
Drafting:	Amber Sabeen Ahmed
Data Analysis:	Samina Shamim, Amber Sabeen Ahmed
Revisiting Critically:	Muhammad Sohaib Arif, Amber Sabeen Ahmed
Final Approval of version:	Muhammad Sohaib Arif

Conflict of Interest: The study has no conflict of interest to declare by any author.

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