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***Original Research Article***

# UTILIZING POINT-OF-CARE ULTRASOUND FOR ACCURATE IDENTIFICATION OF INFECTION SOURCE IN SEPTIC PATIENTS

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**Abstract:** *This study aimed to evaluate the point of care ultrasound to identify the sepsis source in septic patients. A prospective study was conducted in the Emergency Medicine Department of Shifa International Hospital from May 2021 to May 2022. A total of 200 patients who met the SSC criteria were included in the study. The source of sepsis was identified, followed by a diagnostic workup and treatment interventions (T0). The physician who performed the clinical assessment performed a point-of-care ultrasound within 10 minutes and recorded a POCUS-implemented diagnosis (T2). After patient discharge, two physicians blinded to POCUS results reviewed the patient data and recognized the septic source (T2). The source of sepsis was detected in 188 patients (94%), and 12 patients (6%), a specific source could not be identified. POCUS diagnosis detected septic sources in 140 patients with a 74.5% sensitivity. Compared to T2, clinical impressions after T0 had 47% sensitivity and 85% specificity, 90 identified sources, and 5 false positives. POCUS is an accurate and fast diagnostic tool to assess the cause of infection in septic patients compared to a standard workup.*

**Keywords:** Point of Care Ultrasound, Sepsis, Infection, Ultrasound

## Introduction

Sepsis is the body's improper reaction to infection can be highly fatal. In most patients, sepsis progresses to severe sepsis within 24 hours, or they experience septic shock soon after severe sepsis (Salomão et al., 2019). Its early detection and implementation of timely therapies have been reported to improve patient outcomes and prevent sepsis mortality (Huang et al., 2019). Research has proved that timely administration of antibiotics for septic shock is strongly associated with improved prognosis (Gyawali et al., 2019). According to the Surviving Sepsis Campaign guidelines, an effective antibiotic course should be administered within 3 hours of detecting septic symptoms, and the source of infection can be cleared within 12 hours (Evans et al., 2021). However, the imaging process takes too long in the Emergency Department and can cause delays in detecting the source of sepsis in patients. This highlights the need for a fast bedside procedure to readily detect the source of sepsis, leading to early diagnosis and treatment interventions. Point of care ultrasound effectively identifies the source of sepsis from the abdomen, lungs and pleura, soft tissue, and heart (Lee and DeCara, 2020).
Since no research has been done in Pakistan to test POCUS's effectiveness in identifying septic sources, this study evaluated the point of care ultrasound to identify the sepsis source in septic patients.

## Methodology

A prospective study was conducted in the Emergency Medicine Department of Shifa International Hospital from May 2021-May 2022. A total of 200 patients who met the SSC criteria were included in the study. All the participants provided their informed consent to become part of the study. The participants who refused to participate or did not provide consent were excluded. The hospital's ethical committee approved the study.
The patients were physically examined, and history was taken. They were also checked for arterial blood gases and lactate levels. The source of sepsis was identified, followed by a diagnostic workup and treatment interventions (T0). The physician that performed the clinical assessment performed a point-of-care ultrasound within 10 minutes and recorded a POCUS-implemented diagnosis (T2). Changes in the drug treatment were also noted. A standard workup, including laboratory tests and imaging, was done in all patients subsequently. After patient discharge, two physicians blinded to POCUS results reviewed the patient data and recognized the septic source (T2).
All the data was analyzed by SPSS version 23. Standard 2 × 2 contingency tables keeping T2 as a reference determined POCUS results' sensitivity, specificity, and authenticity. The student's t-test evaluated continuous variables, and dichotomous variables were assessed by performing the t2 test.

## Results

The mean age of patients was 65 years. One hundred-five patients (52.5%) were male 70 patients (35%) had severe sepsis or septic shock. The source of sepsis was detected in 188 patients (94%), and in 12 patients (6%), a specific source could not be identified. Sepsis in 80 patients (40%) was caused by pneumonia, and in 40 patients (20%) due to abdominal infections (Table I).
The source of infection was identified by standard workup in 1 hour in 40 patients (21.2%), 3 hours in 100 patients (53.2%), 6 hours in 70% of patients, and more than 24 hours in 16% of patients. POCUS diagnosis detected septic sources in 140 patients with a 74.5% sensitivity (Table II).

POCUS showed 76% accuracy, where the positivity ratio was 17.01, and the negativity was 0.30. POCUS diagnosis was obtained in all patients in 10 minutes. Its sensitivity was high for respiratory and abdominal infections (0.95 ± 0.02 and 0.80 ± 0.10, respectively) (Table III). Compared to T2, clinical impressions after T0 had 47% sensitivity and 85% specificity, 90 identified sources, and 5 false positives. Positivity was 4.05, and negativity was 0.64. The clinical impression had an accuracy of 53%, which POCUS improved by 23%

**Table I: Identification of septic sources**

| Source of sepsis | N (%) |
|---|---|
| **Respiratory** | |
| **Pneumonia** | 80 (40%) |
| **Abdominal** | |
| **Cholecystitis** | 12 (6%) |
| **Cholangitis** | 10 (5%) |
| **Appendicitis** | 7 (3.5%) |
| **Diverticulitis** | 7 (3.5%) |
| **Intra-abdominal abscess** | 4 (2%) |
| **Urinary tract** | |
| **Urinary tract infections** | 30 (15%) |
| **Hydronephrosis/Pyelonephritis** | 18 (9%) |
| **Endocarditis** | 3 (1.5%) |
| **Joint abscesses** | 2 (1%) |
| **Musculoskeletal abscesses** | 3 (1.5%) |
| **Hepatic abscesses** | 2 (1%) |
| **Meningitis** | 3 (1.5%) |
| **Others** | 7 (3.5%) |
| **Unidentified sources** | 12 (6%) |
| | |

**Table II: Comparison of sensitivity and specificity of point of care ultrasound diagnosis and final diagnosis**

| | Positive final diagnosis at t2 | Negative final diagnosis at t2 |
|---|---|---|
| **POCUS positive at t1** | 140 (74.5%) | 1 (8.3%) |
| **POCUS negative at t1** | 48 (26.5%) | 11 (91.6%) |

**Table III: Comparison of the sensitivity of point-of-care ultrasound diagnosis and final diagnosis concerning the septic source**

| Septic source | Mean sensitivity | 95% CI |
|---|---|---|
| **Respiratory** | 0.95 ± 0.02 | 0.92-0.99 |
| **Abdominal** | 0.80 ± 0.10 | 0.70-0.90 |
| **Urinary tract** | 0.29 ± 0.12 | 0.20-0.48 |
| **Endocarditis** | 0.49 ± 0.70 | 0-1.0 |
| **Joint abscesses** | 0.99 ± 0.0 | 1.0-1.0 |
| **Musculoskeletal abscesses** | 0.99 ± 0.0 | 1.0-1.0 |
| **Other** | 0.30 ± 0.29 | 0.04-0.65 |

## Discussion

This study evaluated the accuracy of point-of-care ultrasound for detecting septic sources in patients with sepsis in the emergency department. Emergency ultrasound has already been reported to be useful in diagnosing non-traumatic, undifferentiated hypotension (Atkinson et al., 2018; Javali et al., 2020; Leroux et al., 2021).

The full workup in our study revealed the septic source in 188 patients (94%), similar to previous studies. The sensitivity of point-of-care ultrasound was most for pneumonia (>90%), followed by soft tissue infection (80%) and appendicitis and diverticulitis (60%). These results comply with other studies with slight discrepancies in values of abdominal infection (Bughrara et al., 2020; Leopold et al., 2018; Shrestha and Srinivasan, 2018).

POCUS diagnosed almost all the sources of infection in a small period, i.e., 10 minutes, compared to standard workup that sometimes took longer than 6 hours to 24 hours to detect septic sites. The antimicrobial therapy administered after the standard workup was altered by 22% after POCUS and complied with the final diagnosis except in one case where the septic source was identified as a soft tissue abscess. However, after the final diagnosis, it was revealed that it was malaria.

POCUS was also able to rapidly identify the need for source control in 24% of patients in whom surgery or radiation was performed for hydronephrosis with ureteral stones or endoscopy for cholangitis (Alrawashdeh et al., 2022; Bassetti et al., 2020). In addition, its specificity may be able to identify the redundancy of microbial therapy in patients without infection, such as in the case of community-acquired pneumonia, where about 18% of patients were not diagnosed with any infection in the final diagnosis (Bjarnason et al., 2018; Shoar and Musher, 2020). Our study has some limitations. Our study was single-centered and non-randomized. Secondly, we did not assess the mortality in septic patients after the POCUS diagnosis.

## Conclusion

POCUS is an accurate and fast diagnostic tool to assess the cause of infection in septic patients compared to a standard workup.

## Declarations

**Data Availability statement**
All data generated or analyzed during the study are included in the manuscript.

**Ethics approval and consent to participate**
Not applicable

**Consent for publication**
Not applicable

**Funding**
Not applicable

## Conflict of interest

The authors declared absence of conflict of interest.

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