Role of Speckle Tracking Echocardiography in the Diagnosis of Systolic and Diastolic Dysfunction in Patient with Septic Shock

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Abstract

Background:Sepsis is caused by an infection-induced dysregulation of the host immune system. Advanced echocardiography is being used to evaluate septic shock. Researchers studied 90 individuals with sepsis and septic shock at a single institution. Before patients were enrolled, they signed an informed consent form. The Banha University Faculty of Medicine's Ethics Committee authorised the research. Revision, coding and statistical analysis were performed on the acquired data. Patients with sepsis had a mean age of 60.43 years, while those with septic shock had a mean age of 61.15 years. When compared to the sepsis group, the septic shock group had a considerably greater heart rate, lactate, and the usage of vasopressors. The usage of vasopressors was linked to GLS. As a result, septic shock patients may be diagnosed with cardiomyopathy using a technique called speckle tracking echocardiography.

Key words: Sepsis, echocardiogram, SOFA score.

1. Introduction

Suspected infection and SOFA score change of 2 points after infection constitutes Sepsis [1]. One in every three to one in every six people who are hospitalised with sepsis or septic shock dies as a result of the condition [2]. - A prominent consequence of sepsis is myocardial damage [3]. As a result of sepsis, cytokine storm, lymphocyte apoptosis, neutrophil innate immunity loss, cardiomyopathy and disseminated intravascular coagulation may occur [4].

2. Subjects and methods

This study is a single center prospective study that was conducted on 90 patients with sepsis and septic shock. An informed consent was obtained from the patients. The study was approved by the local Ethics Committee of Faculty of Medicine, Banha University.

Exclusion criteria: Patients with heart failure or cardiomyopathy, patients with significant congenital heart disease orvalvular heart disease.All patients were subjected to history &clinical examination and Laboratory investigations,echocardiographywas done the first 24 hours of admission in ICU.

2.1. Statistical Analysis

The collected data were revised, coded, tabulated & statistically analysed.

3. Results

The mean age for patients with sepsis was 60.43 and 61.15 for septic shock.Among septic patients, 12 patients were diabetic while 2 patients were CKD.Among patients with septic shock, 16 patients were diabetic while 13 patients were CKD. Septic shock group had significantly higher CVP& higher frequency of vasopressor when compared to sepsis group **(table 1).**

Table (1) Source of sepsis among all studied cases.

Source of sepsis	Septic shock (n=60)	Sepsis (n=30)	*p*-value
Bed sores	8 (13.3%)	3 (10%)	0.649
UTI	7 (11.7%)	4 (13.3%)	0.819
Abd. Sepsis	0 (0%)	1 (3.33%)	1
Empyema	1 (1.67%)	2 (6.67%)	0.213
CRBSI	1 (1.67%)	1 (3.33%)	0.613
Inguinal abscess	0 (0%)	1 (3.33%)	1
Pneumonia	3 (5%)	2 (6.67%)	0.745
Septic arthritis	1 (1.67%)	1 (3.33%)	0.613
Surgical site infection	0 (0%)	1 (3.33%)	1
Aspiration pneumonia	2 (1.2 %)	2 (6.67%)	0.469
lung abscess	1 (1.67%)	0 (0%)	1
Pericardial effusion	0 (0%)	1 (3.33%)	1
Pyelonephritis	3(5 %)	0 (0%)	0.213
Perinephric abscess	0 (0%)	1 (3.33%)	1
Diabetic foot	3(5%)	2 (6.67%)	0.745
Osteomyelitis	1 (1.67%)	0 (0%)	1

Strangulated hernia	1 (1.67%)	1 (3.33%)	0.613
Surgical site infection	1 (1.67%)	1 (3.33%)	0.613
Mucormycosis	1 (1.67%)	0 (0%)	1
Septic Cholangitis	1 (1.67%)	0 (0%)	1
Infected decubitus ulcer	0 (0%)	1 (3.33%)	1
Chest infection	0 (0%)	1 (3.33%)	1
VAP	2(1.2%)	0 (0%)	1
CAP	1 (1.67%)	1 (3.33%)	0.613
SBP	2(1.2%)	0 (0%)	0.312
Infected femoral prosthesis	0 (0%)	1 (3.33%)	1
Puerperal sepsis	3(5%)	0 (0%)	0.213
Burst abdomen	1 (1.67%)	0 (0%)	1
Emphysematous GB	1 (1.67%)	0 (0%)	1
Pancreatitis	0 (0%)	1 (3.33%)	1
Brain Abscess	1 (1.67%)	1 (3.33%)	0.613
Abdominal sepsis	1 (1.67%)	0 (0%)	1
Infected Disc Prothesis	1 (1.67%)	0 (0%)	1
Secondary Bacterial Peritonitis	1 (1.67%)	0 (0%)	1
Fournier Gangrene	1 (1.67%)	0 (0%)	1
Rupture appendix	1 (1.67%)	0 (0%)	1
Leaking anastomosis	1 (1.67%)	0 (0%)	1
Infected hip prothesis	2(1.2%)	0 (0%)	0.312
Meningitis	1 (1.67%)	0 (0%)	1
Cholangitis	1 (1.67%)	0 (0%)	1
Bronchiectasis	1 (1.67%)	0 (0%)	1
Pancreatitis	1 (1.67%)	0 (0%)	1
Para ovarian abscess	1 (1.67%)	0 (0%)	1
Limb gangrene	1 (1.67%)	0 (0%)	1

Table (2) clinical parameters among patients.

	Septic shock (n=60)	Sepsis (n=30))	p-value
Heart rate (bpm)	103.58±17.045	85.80±7.554	<0.001
SBP (mmHg)	100.92±12.125	116.70±10.707	<0.001
DBP (mmHg)	61.83±9.476	70.80±7.604	<0.001
MAP (mmHg)	75.20±9.712	84.33±8.652	<0.001
CVP (cmH$_2$0)	9.10±3.820	7.83±3.611	0.135
Urine output (ml/hour)	55.25±21.675	77.20±20.030	<0.001

Table (3) Regression analysis for prediction of systolic and diastolic dysfunction in patients with septic shock.

	Diastolic dysfunction		Systolic dysfunction	
	p	**OR(95% CI)**	**p**	**OR(95% CI)**
Age	0.465	1.387(0.576-1.798)	0.387	1.298(0.928-1.987)
Sex	0.578	1.498(0.568-1.898)	0.692	1.761(0.465-2.937)
GLS	0.036	1.287(1.029-1.495)	0.004	1.289(1.059-1.928)
Troponin 1	0.003	1.928(1.376-2.387)	0.013	1.498(1.102-1.828)
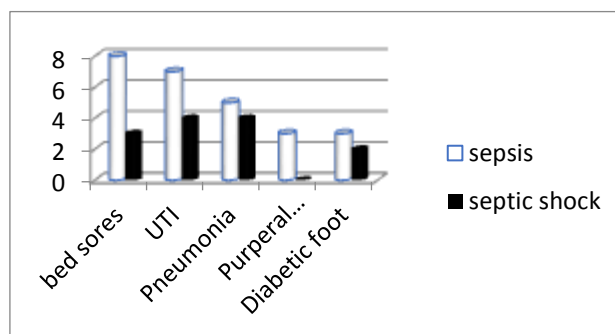
Fig. (1) Main sources of sepsis among studied groups.

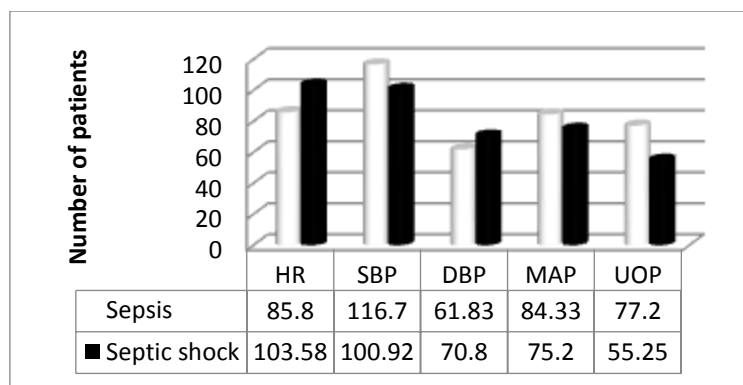|	HR	SBP	DBP	MAP	UOP
Sepsis	85.8	116.7	61.83	84.33	77.2
■ Septic shock	103.58	100.92	70.8	75.2	55.25

Fig. (2) clinical parameters in the two groups.

Regarding sepsis group, the mean LVEDD was 4.600±0.41, the mean LVESD was 2.867±0.329, the mean ESV was 35.67±7.586, the mean EDV was 83.43±15.576and the mean LVEF was 56.67±5.175. Regarding septic shock group, the mean LVEDD was 4.712±0.367, the mean LVESD was 2.96±0.296, the mean ESV was 38.98±7.389, the mean EDV was 92.78±18.143 and the mean LVEF was 57.05±3.993.

GLS showed a correlation with highly sensitive troponin I.

4. Discussion

This kind of myocardial dysfunction is caused by sepsis, and it is reversible [5]. Severe sepsis and septic shock patients had a strong link with their mean arterial pressure, according to our research. The findings echo those of a prior research [6]. While vasopressor dosage and GLS have a strong link in our research, no discernible differences in vasopressor and inotrope usage between SIC and non-SIC patients have been seen in other studies [7]. Patients with septic shock had greater levels of serum procalcitonin than those with sepsis, and those with cardiomyopathy had a higher amount. Procalcitonin, a systemic inflammatory mediator linked to the severity of infectious processes and bacterial infection, was shown to be elevated in our study of biochemical indicators of tissue inflammation and damage [8]. Diastolic dysfunction may be caused by causes other than tachycardia and AF (up to 42 percent in septic shock). Because of this, the diagnostic value of diastolic function is limited.

4.1. Limitations,

An ICU patient with septic shock requires high-quality STE imaging, which may be challenging, particularly when mechanically ventilated.

References

[1] M.Singer, CS.Deutschman, CW.Seymour, M.Shankar-Hari, D.Annane, M.Bauer , et al.The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3).*JAMA.vol. 315,pp.801–10,2016.*

[2] C.Fleischmann-Struzek, L.Mellhammar, N.Rose, et al Incidence and mortality of hospital- and ICU-treated sepsis: results from an updated and expanded systematic review and meta-analysis. *Intensive Care Med* .vol. *46(8),pp.1552–15623,2020.*

[3] N. F.Lu, L.Jiang, B.Zhu, D. G.Yang, R. Q.Zheng, J.Shao, & X. M.Xi, Elevated Plasma Histone H4 Levels Are Important. RiskFactor in the Developmentof Septic Cardiomyopathy.*Balkan Medical Journal*.vol. *37(2),pp.72,2020.*

[4] P. A.Ward, and F.Fattahi, New strategies for treatment of infectious sepsis. *J. Leukoc. Biol*.vol. *106,pp.187-192,2019.*

[5] HS.Jeong, TH.Lee, CH.Bang, JH.Kim, SJ. Hong, Risk factors and outcomes of sepsis-induced myocardial dysfunction and stress-induced cardiomyopathy in sepsis or septic shock: A comparative retrospective study.*Medicine (Baltimore). Mar*.vol. *97(13),pp.e0263,2018.*

[6] Pham Dang Hai , Le Lan Phuong , Nguyen Manh Dung , Le Thi Viet Hoa , Do Van Quyen et.al . Subclinical Left Ventricular Systolic Dysfunction in Patients with Septic Shock based on Sepsis 3 Definition : A Speckle Tracking Echocardiography Study . *Critical Care Research and Practice,2020.*

[7] Myung Jin Song , Sang Hoon Lee , Ah YougLeem , Song Yee Kim , Kyung Soo Chung et.al . Predictors and Outcomes of Sepsis induced Cardiomyopathy in Critically ill Patients . *Acute and Critical Care May* .vol. *35(2),pp.67-76,2020.*

[8] SH.Hoeboer, PJ.van der Geest, D.Nieboer, B.GroeneveldA, The diagnostic accuracy of procalcitonin for bacteraemia: a systematic review and meta-analysis. *ClinMicrobiol Infect*.vol. *21,pp.474-81,2015.*