ASSOCIATION BETWEEN LEFT VENTRICULAR DIASTOLIC DYSFUNCTION AND ACUTE KIDNEY INJURY IN SEPTIC SHOCK PATIENTS

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Introduction

Septic shock is life-threatening and time-dependent condition that requires timely management to reduce mortality. Cardiac dysfunction is common in patients with sepsis in an entity called sepsis-induced cardiomyopathy with an incidence ranging from 40% to 60%. Left ventricular (LV) dysfunction can be a serious obstacle in restoring organ perfusion when treating patients with sepsis. Indeed, diastolic dysfunction is associated with increased mortality in patients with sepsis. Sepsis-associated AKI patients may experience any of several disease trajectories, including renal recovery, survival with diminished kidney function, or death. The outcome depends greatly on the severity of the kidney injury.

Left ventricular diastolic dysfunction (LVDD), which is reflected by early diastolic velocity of mitral inflow to early diastolic mitral annular velocity (E/e′) and left ventricular ejection fraction (LVEF), are related to the risk of AKI and mortality, and E/e′ is a significant predictor of adverse kidney events under different clinical conditions.

Aim of the Work

The aim of the present study was to investigate the association of left ventricular diastolic dysfunction with septic acute kidney injury among septic shock patients.

Patients and Methods

This was a single center, prospective observational cohort study was carried out in Alexandria main university hospitals on 70 critically ill patients of both sexes admitted to intensive care units according to the sample size study the following demographic, clinical, laboratory and radiological data were obtained from all patients on admission:

1. Demographic data including age (years) and sex.
2. Complete medical history including comorbidities.
3. Vital signs (Blood pressure, heart rate, respiratory rate, axillary temperature) over 7 days of study period.
4. Echocardiogram on admission to the ICU.
5. Lab investigations: Complete blood count, Kidney function test, Serum electrolytes (Na and K), C- reactive protein, Liver function test, Arterial blood gases and Serum lactate.
6. Sepsis work up (Urine culture, sputum culture if possible, blood culture, CRP).
7. Baseline disease severity was assessed on admission by Sequential Organ Failure Assessment (SOFA) score and The Acute physiology And Chronic Health Evaluation (APACHE ||) score.
8. Data on baseline and inpatient serum Creatinine levels and urine output were obtained to define the presence of AKI. The corresponding glomerular filtration rate (eGFR) was calculated using the Modification of Diet in Renal Disease equation and assessment of AKI criteria according to KDIGO guidelines.
9. Assessment of LV dysfunction by Echocardiography through measurement of Left Ventricular Ejection Fraction (LVEF), E/e', lateral e' Velocity, Septal e' Velocity and Left Atrial Volume Index (LAVI).
10. This study was held for 7 days including: Primary end point: This included mortality during ICU stay. Secondary end point: This included (days of hospital stay, days of ICU stay, days of mechanical ventilation and days of Vasopressor or inotropes needed).

Results

Table 1: Comparing both studied groups according to echocardiography parameters

	GroupA(n = 35)	GroupB(n = 35)	t	p
E/e′				
Min – Max.	8.00 – 17.00	11.0 – 17.0	5.838*	<0.001*
Mean ± SD.	12.45 ± 2.41	15.12 ± 1.23		
Median (IQR)	12.60 (10.50 – 14.50)	15.0 (14.80 – 16.0)		
Tricuspid regurge velocity (m/s)				
Min – Max.	2.80 – 3.30	2.70 – 3.32	1.450	0.152
Mean ± SD.	2.96 ± 0.13	3.01 ± 0.15		
Median (IQR)	2.90 (2.86 – 3.04)	3.0 (2.90 – 3.11)		
Left atrial volume index (ml/m²)				
Min – Max.	34.50 – 47.00	35.80 – 46.0	0.941	0.350
Mean ± SD.	39.82 ± 3.13	40.45 ± 2.46		
Median (IQR)	40.0 (37.35 – 42.0)	40.40 (38.80 – 42.0)		
Septal e' (cm/s)				
Min – Max.	6.00 – 7.00	6.0 – 6.93	1.712	0.091
Mean ± SD.	6.61 ± 0.31	6.49 ± 0.27		
Median (IQR)	6.70 (6.42 – 6.87)	6.50 (6.24 – 6.73)		
Lateral e' (cm/s)				
Min – Max.	8.30 – 9.90	7.30 – 8.60	11.843*	<0.001*
Mean ± SD.	9.08 ± 0.36	8.14 ± 0.30		
Median (IQR)	9.12 (8.85 – 9.31)	8.10 (7.90 – 8.40)		
LVEF (%)				
Min – Max.	56.00 – 74.00	55.00 – 72.00	1.900	0.062
Mean ± SD.	64.37 ± 5.55	62.03 ± 4.73		
Median (IQR)	64.00 (59.00 – 69.50)	62.0 (58.50 – 64.50)		

Table (1) exposed that there had been a statistically significant increase in E/e′ & a statistically significant reduction in Lateral e' among studied cases in group B compared with group A.

Table (2) showed that there was a statistically significant increase days of ICU stay, days of mechanical ventilation, days of Vasopressor or inotropes needed and days of hospital stay among studied cases in group B compared with group A.

Table 2: Comparing both studied groups according to Secondary end point

	GroupA(n = 35)	GroupB(n = 35)	Test of Sig	p
Days of ICU stay				
Min – Max.	5.00 – 12.00	7.00 – 15.00	t= 3.610*	0.001*
Mean ± SD.	7.91 ± 1.69	9.49 ± 1.95		
Median (IQR)	8.00 (7.00 – 9.00)	9.00 (8.00 – 10.00)		
Days of Mechanical ventilation				
Min – Max.	0.00 – 11.00	0.00 – 12.00	U= 400.50*	0.011*
Mean ± SD.	3.89 ± 3.93	6.51 ± 3.74		
Median (IQR)	3.00 (0.00 – 8.00)	8.0 (4.50 – 9.0)		
Days of Vasopressor or inotropes needed				
Min – Max.	3.00 – 12.00	5.0 – 14.0	t= 3.398*	0.001*
Mean ± SD.	7.03 ± 2.20	8.83 ± 2.23		
Median (IQR)	7.0 (5.0 – 8.50)	9.0 (7.50 – 10.0)		
Days of hospital stay				
Min – Max.	7.00 – 18.00	7.0 – 33.0	U= 442.50*	0.044*
Mean ± SD.	10.34 ± 2.70	13.74 ± 6.75		
Median (IQR)	10.0 (8.0 – 12.0)	12.0 (9.0 – 16.0)		

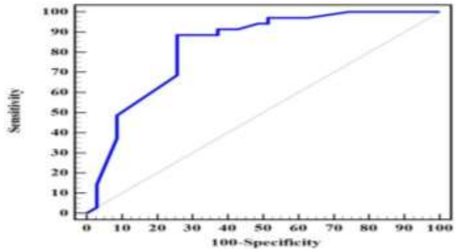

Figure 1:
Showed that AUC for E/e′ to discriminate group B from group A was 0.830 with cut off value >14 with 88.57% sensitivity and 74.29% specificity. The PPV & NPV were 77.5 & 86.7, respectively.

Conclusion

Left ventricular diastolic dysfunction is commonly seen in ICU patients undergoing echocardiographic hemodynamic assessment for septic shock. Left ventricular diastolic dysfunction is a risk factor for septic acute kidney injury, and E/e′ and e′ can be useful to predict the development of septic AKI in severe sepsis and septic shock patients as AUC for E/e′ was 0.830 with cut off value >14 with 88.57% sensitivity and 74.29% specificity. The PPV and NPV were 77.5 and 86.7, respectively. Left ventricular diastolic dysfunction could be linked to ICU mortality in patients experiencing septic shock.