Evaluation of Left Atrial Diameter and Volume as Prognostic Factor In Sepsis

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Abstract: Cardiovascular changes are important in septic shock; peripheral vascular dysfunction, which can result in heterogeneous microcirculatory flow, can frequently induce myocardial depression. In this population, cardiovascular collapse can increase the risk of death in sepsis as much as two times and myocardial depression occurs in almost 40% of septic patients. Myocardial depression is characterized by a cardiac output that fails to meet metabolic demands. **Objective:** The aim of this study is to detect the need for anticoagulation therapy during the transseptal left sided Accessory Pathway (AP) ablation, and to determine at which stage of RF procedure antithrombotic drugs should be administered. The biochemical markers used in this study is direct measures of fibrinolysis (d-dimer, DD). **Patients and Methods:** It was a prospective study involving forty patients (18 females and 22 males) with sepsis admitted to the intensive care unit in Theodor Bilharz Research Institute (TBRI), this study was approved from the local ethical committee. The mean patients age is 53±15. An informed consent was obtained from every patient or his next to kin if he is unable to give the consent before being included in the study. **Inclusion criteria:** ***Patients with: 1-Sepsis*** Documented or suspected infection (considered as pathologic process caused by invasion of normally sterile tissue, fluid or cavity by pathogenic or potentially pathogenic microorganisms) associated with Systemic inflammatory response syndrome (SIRS) when two or more of the following criteria are met: A. Body temperature > 38°C or < 36°C. B. Tachycardia >90/minute. C. Hyperventilation: respiratory rate >20/minute or arterial hypocapnia < 32 mmHg. D. White blood cell count > 12,000/dL or <4,000/dL o immature forms > 10% ***2-Severe Sepsis***b Sepsis associated with organ dysfunction. ***3-Septic shock*** Sepsis associated with circulatory failure characterized by persistent arterial hypotension (decrease of systolic blood pressure below 90 mmHg or ≥ 40 mmHg from baseline, or mean arterial pressure < 60 mmHg despite adequate fluid resuscitation) unexplained by other causes. ***All patients included in the study were subjected to:*** Full history taking, Full clinical assessment. Laboratory tests on admission and follow up including urea, creatinine, sodium, potassium, random blood sugar, complete blood count, coagulation profile, liver function tests. Transthoracic echocardiography (TTE): All echocardiographic measurements of left atrium were performed according to the recommendations of the American Society of Echocardiography (5). M-mode, Two dimensional echocardiography and Doppler ultrasound studies were made using a high resolution. **Exclusion criteria:** Exclusion criteria: **1**- Patients with history of ischemic heart disease. 2- Patients with history of congestive cardiac failure. 3- Patients with history of rheumatic heart disease. 4- Terminally ill patients due to causes other than current sepsis. 5-patients with AF. **Results:** We studied 40 patients: 17 had sepsis, 14 had severe sepsis and 9 had septic shock during the study. We used the criteria of the 2016 SCCM international sepsis definitions conference to define and classify the patients. In our study 17 patients didn't survive while 23 patients survived. There was no statistically significant difference between the two groups concerning the age and the gender. The two compared groups were homogenous. There was no statistically significant difference between survivors and non survivors regarding LAD and LAV neither on the first nor the third day. Conclusion: Left atrial diameter and volume seem of limited value as indicators of mortality in sepsis. It was apparent there is no statistically significant difference between survivors and non-survivors regarding LAD and LAV neither on the first nor the third day.

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1. Introduction:

Sepsis is defined as life-threatening organ dysfunction due to dysregulated host response to infection, and organ dysfunction is defined as an acute change in total Sequential Organ Failure Assessment (SOFA) score greater than 2 points secondary to the infection cause (1).

Cardiovascular changes are important in septic shock; peripheral vascular dysfunction, which can result in heterogeneous microcirculatory flow, can frequently induce myocardial depression. In this population, cardiovascular collapse can increase the risk of death in sepsis as much as two times and myocardial depression occurs in almost 40% of septic patients. Myocardial depression is characterized by a

cardiac output that fails to meet metabolic demands (2,3).

In general, approximately 15% of the deaths related to septic shock are secondary to myocardial depression (3). Myocardial dysfunction can determine whether a patient survives or not. In survivors, ventricular compliance is increased with a higher end-diastolic volume that helps maintain adequate stroke volume. Non survivors, in contrast, are progressively unable to maintain the same stroke volume because of reduced diastolic compliance (4).

The aim of this work is to assess the left atrial diameter in predicting mortality in the ICU population with sepsis. Our hypothesis was as the atrium share the same pathophysiological effects of sepsis. Atrial diameter may be used as an alternative easy method of assessing the severity of myocardial dysfunction in sepsis and may therefore help to predict mortality.

Patients and methods:

It was a prospective study involving forty patients (18 females and 22 males) with sepsis admitted to the intensive care unit in Theodor Bilharz Research Institute (TBRI), this study was approved from the local ethical committee. The mean patients age is 53±15. An informed consent was obtained from every patient or his next to kin if he is unable to give the consent before being included in the study.

Inclusion criteria:

Patients with:

Sepsis is life-threatening organ dysfunction due to dysregulated host response to infection, and organ dysfunction is defined as an acute change in total Sequential Organ Failure Assessment (SOFA) score greater than 2 points secondary to the infection cause (1).

Organ dysfunction criteria (including lactate level greater than 2 mmol/L). Organ dysfunction may also be identified in the future using the quick Sepsis-Related Organ Failure Assessment (qSOFA) evidence of two out of three qSOFA elements (altered mental status, respiratory rate greater than or equal to 22 breaths/min and systolic blood pressure less than or equal to 100 mm Hg) in patients who have screened positive for infection may be used as a secondary screen to identify patients at risk for clinical deterioration.

Table (1): SOFA score

SOFA score	1	2	3	4
PaO_2/FIO_2 (mmHg) or	<400	<300	<220	<100
SaO_2/FIO_2	221-301	142-220	67-141	<67
Platelets x $10^3/mm^3$	<150	<100	<50	<20
Bilirubin (micromol/L)	20-32	33-101	102-204	>204
Hypotension	MAP <70*	dopamine ≤5 or any dobutamine†	dopamine >5 or noradrenaline ≤0.1	dopamine >15 or noradrenaline >0.1
Glasgow Coma Score	13-14	10-12	6-9	<6
Creatine (micromol/L) or	110-170	171-299	300-440	>440
Urine output (mL/day)			<500	<200

**MAP = mean arterial pressure (mmHg)*

†Vasoactive agents administered for at least 1 hour (doses given are in micrograms/kg/minute)

Exclusion criteria:

1- Patients with history of ischemic heart disease.

2- Patients with history of congestive cardiac failure.

3- Patients with history of rheumatic heart disease.

4- Terminally ill patients due to causes other than current sepsis.

5-patients with AF.

Included patients were subjected to the following:

Written consent (by the patient or his relatives).

- Detailed History.
- Full clinical assessment.
- Laboratory tests on admission and follow up including urea, creatinine, sodium, potassium, random blood sugar, complete blood count, coagulation profile, liver function tests.
- Cultures as appropriate.

- sequential organ failure assessment (SOFA) scores.
- Transthoracic echocardiography (TTE):

All echocardiographic measurements were performed according to the recommendations of the American Society of Echocardiography (5).

M-mode, Two dimensional echocardiography and Doppler ultrasound studies were made using a high resolution (ALT 5000 HDI) Toshiba Nemo 30 scanner equipped with a 2.5 mHz transducer.

1- Left atrium diameter was determined from the parasternal long axis view at end systole. Left atrium volume was measured from the Simpson method used apical 4-chamber and apical 2-chamber views at ventricular end systole (maximum LA size). Estimation of LA volume by Simpson's method of disc is well validated and recommended by the American Society of Echocardiography (ASE) guidelines (6).

- All echordiographic measurements were done on the first day of admission and on the third day.

Statistical analysis:

All collected questionnaires were revised for completeness and consistency. Pre-coded data was entered on the computer using "Microsoft Office Excel Software" program (2010) for windows. Data was then transferred to the Statistical Package of Social Science Software program, version 16 (SPSS) to be statistically analyzed.

Data was summarized using mean, standard deviation, median and percentiles for quantitative variables and frequency and percentage for qualitative ones.

Comparison between groups was done using independent sample t-test and one way ANOVA (if parametric) and Mann Whitney test or Kruskal Wallis test (if non-parametric) for quantitative variables and Chi square test or Fischer exact test for qualitative ones.

Pearson correlation coefficient was calculated to get the association between different quantitative variables.. P values equal to or less than 0.05 were considered statistically significant. Graphs were used to illustrate some information.

3. Results:

- We studied 40 patients: 17 had sepsis, 14 had severe sepsis and 9 had septic shock during the study. We used the criteria of the 2016 Society of critical care medicine (SCCM) international sepsis definitions to define and classify the patients.
- In our study 17 patients didn't survive while 23 patients survived. There was no statistically significant difference between the two groups concerning the age and the gender. The two compared groups were homogenous.

Table (2): Echo findings and mortality

	Non survivors (Mean ± SD)	Survivors (Mean ± SD)	P value
LAD1stD (mm)	35 ± 6	33 ± 7	0.291
LAD3rdD (mm)	36 ± 8.8	35 ± 5	0.213
LAV1stD (ml)	44.4 ± 8.6	42.4 ± 9.5	0.506
LAV3rdD (ml)	46.1 ± 8.9	47.4 ± 10.3	0.677

There was no statistically significant difference between survivors and non survivors regarding LAD and LAV neither on the first nor the third day.

Table (3): Echo findings and mortality

	Non survivors (Mean ± SD)	Survivors (Mean ± SD)
LAD1stD (mm)	35 ±6	33 ± 7
LAD3rdD (mm)	36 ± 8.8	35 ± 5
P value	0.294	0.005

Table (3): Relation between LAD in 1st and 3rd day in non survivors and survivors.

As shown in table (3) LAD 1st day and LAD 3rd day show insignificant statistical increase in non survived group (p=0.294) and significant statistical increase in survived group (p=0.005).

Table (4): Relation between LAV in 1st and 3rd day in non survivors and survivors

	Non survivors (Mean ± SD)	Survivors (Mean ± SD)
LAV1stD (ml)	44.4 ± 8.6	42.4 ± 9.5
LAV3rdD (ml)	46.1 ± 8.9	47.4 ± 10.3
P value	0.099	0.03

As shown in table (4) LAV 1st day and LAV 3rd day show insignificant statistical increase in non survived group (p=0.099) and significant statistical increase in survived group (p=0.03).

4. Discussion

The aim of the study was to evaluate left atrial diameter in predicting mortality in the ICU population with sepsis.

Left atrial diameter in sepsis:

Regarding the left atrial diameter on the 1st day in the parasternal view, there was no statistically significant difference between survivors and non survivors regarding this item. Our results meet the study done by **Sturgess et al** (7). that measured the left atrial diameters and found no statistically significant difference between survivors and non-survivors. Our results also meet the results of **Abu-Khabar et al** (8). where there was no statistically significant difference between the survivors and non survivors regarding LA diameter.

Regarding left atrial volume there was no statistically significant difference between survivors and non survivors. Our results meet the study done by **Samuel M Brown et al.** (9) who stated that left atrial size is often used as a criterion for diagnosing LV diastolic dysfunction (10) However, left atrial enlargement is most likely a slowly developing adaptation to chronically elevated LV filling pressures (11). In the case of sepsis, diastolic abnormalities are frequently acute, and LA enlargement is not expected to occur rapidly. Therefore, LA size is not likely to be a reliable marker of diastolic filling abnormalities in this specific condition.

Conclusion

Left atrial diameter and volume seem of limited value as indicators of mortality in sepsis. It was apparent there is no statistically significant difference between survivors and non-survivors regarding LAD and LAV neither on the first nor the third day.

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