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ORIGINAL ARTICLE

Atrial ejection force and brain natriuretic peptide as markers for mortality in sepsis

Mohammed Badr Salim [a,*], Hesham Elaasr [b], Mervat El Damarawy [a], Ashraf Wadee [b], Alaa Ashour [b], Fatma Mohammad Nasr [a]

[a] *Theodor Bilharz Research Institute, Egypt*
[b] *Cairo University, Egypt*

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KEYWORDS

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Abstract *Background:* In early stages of septic shock, impaired myocardial function plays an important prognostic role. AEF and Plasma BNP level may be a valuable prognostic factor for patients with sepsis.

Objective: We aimed also to evaluate the value of atrial ejection force (AEF) B-type natriuretic peptide (BNP) in predicting the outcome of sepsis, severe sepsis and septic shock patients.

Methods: 40 patients presenting with sepsis, severe sepsis or septic were included in the study. The patients had undergone transthoracic Echocardiographic examinations and BNP measurements on the 1st and 3rd day of admission. The patients were retrospectively divided into survivors and non survivors.

Results: There was a significant statistical difference in BNP level ($P = 0.0001$) between the two groups. BNP showed a statistically significant rise in the non survival group from day 1 to day 3 ($p = 0.002$) and a statistically significant decrease from day 1 to day 3 in the survived group ($p = 0.001$). As regards the echo findings there was a statistically significant difference AEF 3rd day between survivors and non survivors ($P = 0.0001$). The ROC curve showed that BNP 1st day, 3rd day are good tests for prediction of mortality in patients with sepsis.

Conclusion: Atrial ejection force on the first day of admission, unlike BNP level, might not be used as an independent predictor of mortality in patients with sepsis. BNP level correlates with the severity of sepsis. According to our study, AEF in the third day may be a good predictor for survival of patients presenting with sepsis.

* Corresponding author at: 8th Elmobtadian St, Elsayeda Zinab, Cairo 11461, Egypt. Tel.: +20 1224474665, +20 223684144.
E-mail address: drmbadr@hotmail.com (M.B. Salim).

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1. Introduction

Sepsis is defined as "the systemic inflammatory response syndrome (SIRS) that occurs during infection."Sepsis is not a homogenous disease; rather, it is a complex clinical syndrome with distinct immunological features [1,2]. The ambiguities of clinical findings and unclear risk stratification

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in sepsis have been major problems in sepsis intervention trials [3].

In early stages of septic shock, impaired myocardial function plays an important prognostic role. In this context, B-type natriuretic peptide (BNP) has been shown to be a neurohumoral marker for left ventricular dysfunction, because myocardial strain and ischemia both increase BNP concentration [4] Ventricular dysfunction with reduced ejection fraction and biventricular dilatation is present in most patients with severe sepsis and septic shock. In survivors, this depression in cardiac function is reversible over the course of seven to ten days. Even though some prognostic factors have been identified in patients with sepsis-induced myocardial dysfunction, their measurement often includes costly and cumbersome techniques. Thus, there is a need for an inexpensive, simple, rapid, and readily available marker to predict mortality in septic shock. There is a growing evidence supporting the hypothesis that BNP could be an early predictor of mortality in septic shock. If proven, the hypothesis would have important clinical and public health implications [5]. Plasma BNP level may be a valuable prognostic factor for severe sepsis and septic shock patients [6].

There have been many studies in animals and a few in humans which have confirmed the presence of diastolic dysfunction - particularly in those patients that go on to die from sepsis. In the presence of adequate fluid resuscitation there is an increase in end diastolic volume and this is probably a normal response to a decrease in contractility. However, in the non-survivors of sepsis there is a normal or low-end diastolic volume that is the result of a decrease in ventricular diastolic compliance. Thus, there is a decreased end diastolic volume at the same filling pressure [7].

Assessment of diastolic function through measurement of the components of ventricular filling has largely neglected the vigor of atrial systole, in part because this has been difficult to quantify. However, atrial ejection force defined as the force exerted by the left atrium to accelerate blood into the left ventricle during atrial systole can be assessed non-invasively by combined two-dimensional imaging and Doppler echocardiography. This index of atrial function, based on classic Newtonian mechanics, provides a physiologic assessment of atrial systolic function [8].

2. The aim of this work

Is to assess the utility of atrial function (diagnosed by atrial ejection force) in predicting mortality in the ICU population with sepsis. Our hypothesis was that as the atrium shares the same pathophysiological effects as the ventricles, assessment of the atrial function may be used as an alternative easy method of assessing the severity of myocardial dysfunction in sepsis and may therefore help to predict mortality. We aimed also to evaluate the value of B-type natriuretic peptide (BNP) in predicting the outcome of sepsis, severe sepsis, and septic shock patients.

3. Patients and methods

This was a prospective study involving forty patients with sepsis admitted to the intensive care unit in the Theodor Bilharz research institute (TBRI) from March 2012 to September 2013. This study was approved by the local ethics committee and an informed consent was obtained from every patient or his next of kin if the patient was unable to give consent before being included in the study.

3.1. Inclusion criteria

Patients with

1-Sepsis: Documented or suspected infection 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 <4000/dL or immature forms $>10\%$.

2-Severe sepsis: Sepsis associated with organ dysfunction.

3-Septic shock: Sepsis associated with circulatory failure characterized by persistent arterial hypotension (decreased systolic blood pressure below 90 mmHg or $\geqslant 40$ mmHg from baseline, or mean arterial pressure <60 mmHg despite adequate fluid resuscitation) unexplained by other causes [9].

3.2. 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).
- History.
- Full clinical assessment.
- Laboratory tests on admission and follow up including cultures as appropriate.
- Acute physiology and chronic health evaluation II (APACHE II) scores and the length of stay (LOS) in ICU were collected.
- Plasma BNP level (by Enzyme Immunoassay (EIA)) was measured upon admission and on the third day after admission to the intensive care unit. Transthoracic echocardiography (TTE): All echocardiographic measurements were performed by one operator and according to the recommendations of the American Society of Echocardiography [10]. 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.
- With M-mode, measurements of interventricular septum (IVS) and left ventricle posterior wall thicknesses (PWT) separately at diastole and systole were done and left ventricle end-diastolic (LVEDD) and end systolic (LVESD) diameters were determined. Left ventricular ejection fraction (EF%) was measured from M-mode dimensions using Teichholz formula [11].