Myocardial Dysfunction in Systemic Sepsis

Diagnostic and Prognostic Role of Brain Natriuretic Peptide and Cardiac Troponins

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MYOCARDIAL DYSFUNCTION IN SYSTEMIC SEPSIS

DIAGNOSTIC AND PROGNOSTIC ROLE OF BRAIN NATRIURETIC PEPTIDE AND CARDIAC TROPONINS

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abstract

Objective: To analyze the elevations of BNP and cTn-I in patients with sepsis, and septic shock and evaluate their relationships with echo data and outcome.
Methods: 43 patients diagnosed to have sepsis (group I) or severe sepsis and shock (group II) admitted to Critical Care Department (Cairo University) from October 2007 to April 2009, in addition to ten healthy volunteers (group III). All patients were subjected to APACHE II, MODS,SOFA, O/A and day 2,echo O/A, as well as BNP and cTn-I O/A, and day 2.

Results: BNP level O/A was significantly higher in groups I,II than group III; BNP level day 2 was higher in group II than group I. cTn-I in day 2 was higher in group II than group III.BNP level O/A and day 2 correlated inversely in both groups with Abe; as well as with pH.BNP levels O/A and day 2 had negative correlation in both groups with PC.BNP levels day 2 had a positive correlation in both groups with PT. BNP and cTn-I correlated positively with APACHE- II, MODS, SOFA (O/A and day2). cTnI O/A was inversely proportional to LVEF and LVFS, whereas Neither BNP O/A nor at day 2 correlated to LV diameters, volumes, LVEF, FS,CO or CI. BNP at day 2 was directly proportional to cTn-I at day 2.BNP and cTn-I were higher in non-survivors than survivors but this has not statistical significance.

Conclusion: BNP cannot be used as a marker of heart failure in septic shock, although BNP and cTn-I were higher in non-survivors yet without statistical significance.

Key Words: BNP, cTn-I; septic shock and myocardial dysfunction.

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LIST OF ABBREVIATIONS

2D	Two-dimensional.
ACCP	American college of chest physician
ANP	Atrial natriuretic peptide.
APACHE II	Acute physiology and chronic health evaluation score II
BNP	Brain natriuretic peptide
BUN	Blood urea nitrogen
CAD	Coronary artery disease
CD4	Cluster determinant 4
CI	Cardiac index
cNOS	Constitutive nitric oxide synthase
CO	Cardiac output.
CTn-I	Cardiac troponin-I
DM	Diabetes mellitus.
ECHO	Echocardiography.
E-Coli	Escherichia coli
EDD	End diastolic diameter
EDV	End diastolic volume
EF	Ejection fraction

ESD	End systolic diameter
ESV	End systolic volume
FS	Fraction shortening
HR	Heart rate
HTN	Hypertension
IFN-8	Interferon gamma
IL-1B	Interleukin-1B
IL-4	Interleukin 4
IL-6	Interleukin-6
IL-8	Interleukin-8
IL-10	Interleukin-10
i NOS	Inducible nitric oxide synthase
LBP	Lipopolysaccaride-binding protein.
LPs	Lipopolysaccarides
LOS	Length of stay
LV	Left ventricle
MAP	Mean arterial pressure
MDS	Myocardial(myocyte) depressant substance
MOF	Multiple organ failure

MODS score	Multiple organ dysfunction score
NOS	Nitric oxide synthase
NT-pro BNP	N-terminal pro brain natriuretic peptide.
PAC	Pulmonary artery catheter
PMNLs	Polymorph nuclear leucocytes
RBCs	Red blood cells
RCT	Randomized controlled trial
ROS	Reactive oxygen species
RV	Right ventricle
SBP	Systolic blood pressure
SCCM	Society of critical care medicine
SIRS	Systemic inflammatory syndrome
SOFA score	Sepsis-related organ failure assessment score
Staph	Staphylococcus
SV	Stroke volume
SVR	Systemic vascular resistance
TLRs	Toll-like receptors
TNF-*a*	Tumor-necrosis factor alpha
TNF-*B*	Tumor-necrosis factor beta
WBCs	White blood cells.

CONTENTS

INTRODUCTION

Shock may be defined as an impairment of the normal relationship between oxygen demand and oxygen supply. As a consequence, there are detrimental alterations in tissue perfusion resulting in a reduction in the delivery of oxygen and other nutrients to tissue beds and causing cellular and then organ dysfunction. In hypovolemic, cardiogenic, and obstructive forms of shock, the primary defect is a fall in cardiac output, leading to hypoperfusion, hypotension and anaerobic metabolism ***(Beole R et al., 2004).***

In septic shock, however, there is a complex interaction between pathologic vasodilatation, relative and absolute hypovolemia, direct myocardial depression, and altered blood flow distribution, which occur as a consequence, of the inflammatory response to infection. Even after volume restoration, maldistribution of a normal or increased cardiac output typically persists as a consequence of micro-vascular abnormalities. In addition, cellular and organ injury also occur as direct consequences of the inflammatory response in sepsis and as a, consequence of hypoperfusion ***(Beole R et al., 2004).***

Sepsis is the hosts' reaction to invading microbes and involves a rapidly amplifying polyphony of signals and responses that may spread beyond the invaded tissue. Fever or hypothennia, tachypnea and tachycardia often herald the onset of sepsis and systemic response to microbial invasion.

Myocardial dysfunction, which is characterized by transient biventricular

impairment of intrinsic myocardial contractility, is a common complication in patients with sepsis.

Early recognition of myocardial dysfunction is crucial for the administration of the most appropriate therapy. Regarding the fact that the insertion of a PAC (pulmonary artery catheter) is an invasive procedure without proven survival benefit ***(Richard C et al., 2004***), and a comprehensive echocardiography studies requires a high degree of training and sometimes is not available within 24 hours, a biomarker accurately detecting myocardial dysfunction and providing prognostic information in patients with sepsis would be of paramount interest.

Cardiac troponins and natriuretic peptides are biomarkers that were previously introduced for diagnosis and risk stratification in patients with acute coronary syndrome and congestive heart failure, respectively. However their prognostic and diagnostic impact in critically ill patients warrants definition. The elevation of cardiac toponins in patients with sepsis, severe sepsis and septic shock has been shown to indicate poor prognosis. Troponin release in this population occurs in the absence of flow-limiting coronary artery disease, suggesting the presence of mechanisms other than thrombotic coronary artery occlusion, probably a transient loss in membrane integrity with subsequent troponin release or micro-vascular thrombotic injury ***(Metha NJ et al., 2004).***

The impact of raised B-type natriuretic peptide (BNP) levels in patients with sepsis, still unclear. The relationship between BNP and LVEF is weak ***(Maeder M et al., 2005)***, and data on prognostic impact of high BNP levels in patients with sepsis are conflicting. Mechanisms other than left ventricular wall

stress may contribute to BNP release, including right ventricular overload, cathecholamine therapy, renal failure, diseases of the CNS, and cytokine up-regulation.