Recent advances in Cardiac biomarkers as Diagnostic and prognostic tool in critically ill patients

Essay

Submitted for partial fulfillment of Master Degree of Intensive Care

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سورة البقرة الآية: ٣٢

Acknowledgement

*First of all I thank **Allah**, the most gracious for helping me to accomplish this research and for providing me with such very encouraging and supportive supervisors.*

*I would like to express my deepest gratitude to **Prof. Dr. Samia Ibrahim Sharaf,** Professor of Anesthesia and Intensive care, Faculty of Medicine, Ain Shams University. I appreciate her unforgettable support as well as her generous efforts in the evaluation of this work. It is honorable to be supervised by her.*

*Very special thanks are offered to **Dr. Halah Salah El Din El-Ozairy,** Lecturer of Anesthesia and Intensive care,Faculty of Medicine, Ain Shams University for her valuable effort throughout this work.*

*Very special thanks are offered to **Dr. Hany Magdy Fahim,** Lecturer of Anesthesia and Intensive care, Faculty of Medicine, Ain Shams University, for his great help in this work.*

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List of Abbreviations

ACC	American College of Cardiology
ACS	Acute Coronary Syndrome
ACTH	Adrenocorticotropic Hormone
ADP	Adenosine 5'-Dinophosphate
AHA	American Heart Association
AMI	Acute Myocardial Infarction
ANP	Atrial Natriuretic Peptide
AST	Aspartate Aminotransferase
ATP	Adenosine Triphosphate
ATPase	Adenosine Triphosphatase
AVP	Arginine Vasopressin
BMI	Body Mass Index
BNP	B-type Natriuretic Peptide
BP	Blood Pressure
Ca	Calcium
CABG	Coronary Artery Bypass Grafting
CAD	Coronary Artery Disease
cGMP	cyclic Guanosine Monophosphate
CI	Cardiac Index
CK	Creatine Kinase
CKD	Chronic Kidney Disease

CNP	C-type Natriuretic Peptide
CO	Cardiac Output
COPD	Chronic Obstructive Pulmonary Disease
CREED	Cardiovascular Risk Extended Evaluation
CRH	Corticotropin-Releasing Hormone
CRP	C--Reactive Protein
CT	Computed Tomography
cTn	cardiac Troponin
CVD	Cardiovascular Disease
DNP	Dendroapsis Natriuretic Peptide
ECG	*Electrocardiography*
ESC	European Society of Cardiology
ESKD	End-Stage Kidney Disease
FA	Fatty Acid
FDA	Food and Drug Administration
Fig.	Figure
FN	False Negative
FP	False Positive
g	gram
GC	Guanylylcyclase
GP	Glycoprotein
HD	Hemodialysis

HF	Heart Failure
H-FABP	Heart type-Fatty Acid Binding Protein
hsCRP	high sensitivity C-Reactive Protein
i.v.	inravenous
ICU	Intensive Care Unit
IHD	Ischemic Heart Disease
IL-8	*Interleuken-8*
kDa	kilodalton
L	Litre
LDH	Lactate Dehydrogenase
LDL	*Low-Density Lipoprotein*
LV	Left Ventricle
LVH	Left Ventricular Hypertrophy
µg	microgram
mg	miligram
MI	Myocardial Infarction
ml	mililiter
MPO	Myeloperoxidase
MW	Molecular Weight
NAD	Nicotinamide Adenine Dinucleotide
ng	nanogram
NIH	National Institutes of Health

NIHSS	National Institutes of Health Stroke Scale
NOS	Nitric Oxide Synthase
NP	Natriuretic Peptide
NPV	Negative Predictive Value
NSTE-ACS	*Non-ST-Elevation* Acute coronary syndrome
NSTEMI	Non-ST-Elevation Myocardial Infarction
NT-proBNP	N-Terminal fragment of pro-BNP
PAI-1	Plasminogen Activator Inhibitor-1
PCI	Percutaneous Coronary Intervention
PD	Peritoneal Dialysis
PE	Pulmonary Embolism
pg	pictogram
PMN	Polymorph nuclear Neutrophils
pmol	picomole
PPV	Positive Predictive Value
pre-proAVP	Pre-provasopressin
Pts	Patients
RV	Right Ventricle
STEMI	ST-Elevation Myocardial Infarction
Tab.	Table
TF	Tissue Factor
TN	True Negative

Tn	Troponin
TNF-α	Tumor Necrosis Factor-alpha
TP	True Positive
t-PA	tissue Plasminogen Activator
TV	Tricuspid Valve
U	Unit
UA	Unstable Angina
VNP	V-type Natriuretic Peptide
VTE	Venous Thrombo-Embolism
WBC	White Blood Cell

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Introduction

The need for rapid diagnosis, more precise prognostic assessment and treatment choices in different illnesses has led to the investigations of biomarkers ***(Dobša and Edozien, 2013).***

The word biomarker, abbreviated from "Biological marker", refers to a broad subcategory of quantifiable and reproducible biological signs or any substance, structure or process that can be measured in the body or its products and influence or anticipate the occurrence of an illness or its outcome ***(Cahill et al., 2015).***

For as far back as 40 years, the utilization of biomarkers has been greatly valuable in the early detection of acute myocardial infarctions (AMI). Sensitivity, specificity and the clinical utility have kept on expanding and the current researches suggest that these advances will continue to grow ***(Rosenblat et al., 2012).***

In 1954 Karmen et al. were the first to report that aspartate aminotransferase (AST) is released from necrotic cardiac myocytes. In 1955 lactate dehydrogenase (LDH) was first published as a marker of acute myocardial infarction (AMI). In the 1960s Rosalki established that creatine kinase (CK) is the standard marker for detection of muscle damage, CK remained the pillar for AMI diagnosis for about 20 years. In the 1970s when radio-immunoassay were developed, it made creatine kinase-myocardial band

CKMB level estimations as the basic standard for AMI diagnosis ***(Mair et al., 2015).***

Troponin I first depicted as a biomarker specific for AMI in 1987; Troponin T in 1989. Presently troponins are the biochemical "gold standard" for the diagnosis of acute myocardial infarction according to current guidelines of European Society of Cardiology and American College of Cardiology (ESC/ACC) ***(Pant et al., 2012).***

While current markers have significantly enhanced the diagnosis and specified the management of AMI patients, there is still room for improvement, particularly in the area of early diagnosis. The following markers are some of the potential MI future markers that may enhance the sensitivity, specificity and prognosis: Myeloperoxidase (MPO), Copeptin, Heart type-fatty acid binding protein (H-FABP) and B-type natriuretic peptide (BNP) and N-Terminal fragment of pro-BNP (NT-proBNP) ***(Rosenblat et al., 2012).***

The role of cardiovascular biomarkers in clinical practice is developing rapidly. In the intensive care unit (ICU), interpretation of biomarkers may be bewildered by multiple conditions, including severity of the illness, coinciding organ dysfunction, multi-organ derangement or changed synthesis/clearance ***(Noveanu et al., 2009).***

During the previous couple of years emerging data have been published demonstrating that elevated troponin are not just saw among patients experiencing acute coronary syndromes, yet can likewise be available in myocarditis, congestive heart failure, cardiac trauma, percutaneous cardiac interventions, tachycardia, infiltrative diseases of the myocardium (for example, amyloidosis and sarcoidosis), and perioperative cardiac complications. Non-cardiovascular illnesses with reported high cardiac troponin levels include sepsis or septic shock, renal failure, hypertension, hypothyroidism, drug toxicity, pulmonary embolism, transient ischemic attack, subarachnoid hemorrhage and stroke ***(Gunnewiek et al., 2004).***

In a comparable way, the rise in BNP and NT-proBNP levels are not conclusive for heart failure only, conditions other than heart failure can lead to an increase in BNP and NT-proBNP, for example: Systemic arterial hypertension with left ventricular hypertrophy, Pulmonary hypertension and Acute or chronic renal failure ***(Wu et al., 2007).***

Additionally copeptin has been considered as a diagnostic and prognostic biomarker in different illnesses in addition to acute myocardial infarction as heart failure, respiratory disorders (as acute exacerbation of chronic obstructive pulmonary disease, lower respiratory tract infections, acute dyspnea), different types of shock (as hemorrhagic, vasodilatory shock and septic shock), metabolic disorders (as diabetes mellitus, metabolic

syndrome, hyponatremia and diabetes insipidus), autosomal dominant polycystic kidney disease (ADPKD), intracerebral hemorrhage, ischemic stroke and traumatic brain injury (***Dobša and Edozien, 2013)***.