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Role of oxidative stress markers in acute myocardial infarction

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ABSTRACT: Cardiovascular diseases (CVD) commonly represent the disorder of heart and blood vessels that may include coronary heart disease, cerebrovascular disease, and other vascular conditions, and this may cause death and disability in the patients. Oxidative stress plays a vital role in the pathophysiology of major cardiovascular diseases such as myocardial infarction, atherosclerosis, and diabetic cardiovascular barriers. Acute myocardial infarction (AMI) is defined as the sudden blockade of coronary artery in the myocardium due to less oxygen supply or plague formation in the blood vessels**.** Increase of reactive oxygen species (ROS) is involved in the advancement and progress of cardiovascular diseases. Oxidative stress signifies a situation where there is an imbalance between the ROS and the availability and the movement of antioxidants. ROS are formed at a quicker rate in post ischemic myocardium. Cardiac myocytes, endothelial cells, and infiltrating neutrophils contribute to this ROS production. Exposure of these cellular components of the myocardium to exogenous ROS leads to cellular dysfunction and cell death. It is very vital to develop methods and find suitable biomarkers that may be used to evaluate oxidative stress. In this review we have discussed the importance and the role of oxidative stress and oxidative stress markers in the pathogenesis of acute myocardial infarction.

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INTRODUCTIONS:

Acute myocardial infarction (AMI), also known as heart attack, induced by a sudden blockade or occlusion in the coronary artery leading to ischemia. AMI is described as a cardiomyocyte decreases due to a long-term ischemia resulting from an acute imbalance between oxygen supply and demand [1, 2]. In recent years it has being noticed a considerable interest in the destructive action of oxygen free radicals to the heart [3,4]. There is increasing data that, inflammation and oxidative stress

are positively correlated with the variability of atherosclerotic plaque and the occurrence of acute coronary syndrome [5]. ROS-induced induction of inflammatory cascades and low-density lipoproteins (LDL) oxidation leads to formation of macrophage-derived foam cells, isolation and excess of vascular smooth muscle cells [6]. Oxidative stress is one of the leading causes of myocardial infarction. Oxidative stress occurs due to an inequity between antioxidant and ROS, and helps coronary artery disease (CAD), and increase in plaque exposure**.** Oxidative stress is the major mechanism involved in the process of atherosclerosis [7]. During myocardial infarction cellular defense against oxidative injury are decreased, with lower events of antioxidants such as glutathione peroxidase and superoxide dismutase. Although, the pathogenesis of myocardial injury is difficult, development of ROS plays a vital role. Oxidative stress during damage leads to lipid per-oxidation because, direct amount of progressive ROS is difficult due to their unpredictability, a stable lipid per-oxidation end-creation, is frequently used as a markers of ROS production [8]. There are few markers that evaluate the oxidant stress in the body, the markers such as 4-hydroxynonenal, lipid hydroperoxides, malondialdehyde (MDA), 8-hydroxyl-2-deoxyguanosine (8-OHdG), allantoin and advanced oxidation protein products (AOPP) and thiobarbituric acid reactive substances (TBARS).

OXIDATIVE STRESS IN MYOCARDIAL DISEASE:

The equilibrium between antioxidants and ROS is affected when extreme quantities of free radicals are designed, the amount of antioxidant is declined. The disruption is called as oxidative stress and a critical role in cardiac pathophysiology [9]. This involves the mechanism by which reactive ROS induces myocardial injury. The increase in level of oxygen species triggers protein and lipid peroxidation in the myocardium, thus resulting the contractile protein injury and myocardial sarcolemma damage. As a result of this damage, calcium desensitization and Ca^{2+} overload can appear in cardiac myocytes. This method further reduces myocardial contractility which leads to myocardia stunning (Fig 1).

The studies have described where excess production of oxidative stress effects like ROS can cause atherosclerosis, diabetes and myocardial infarction [10]. Oxidative stress is the inequalities in redox pair as reduced to oxidized NADPH/NADP+ ratios or the glutathione (GSH/GSSG) [11]. Free radical damage, signifies the changes in functionandstructure of biomolecules (lipids, DNA, and proteins.) Oxidative stress is related with the atherosclerotic plaque and the incidence of AMI [12,13]. Oxidative stress is more often linked with elevated RNS or ROS in cellular and sub-cellular levels [14]. ROS/RNS, the sub optimal stage can perform indicating particles retaining in cardiovascular role. The improved ROS/RNS levels can cause pathology by destructing DNA, protein and lipids [15]. The formation and release of ROS during myocardial damage is validated by blocking the free radicals by nitro DMPO [16] and alpha-phenyl N-tert-butyl nitrone spin trap probes [17]. Therefore, ROS dependent on their site of construction, their concentration, and the overall redox equilibrium of the cell will determine its biological action in the tissues.

MECHANISM OF OXIDATIVE STRESS CAUSING MYOCARDIAL INJURY:

The oxidative stress causing myocardial infraction. Under oxidative stress, ROS plays a critical part in the development of myocardial infarction. Whereas due to increased ROS, cellular redox rheostat causes different responses according to degree of stress and thereby causing glutathione depletion and thereby initiates apoptosis as well as inflammation and induction of cell death occurs in myocardial tissue**.** In addition, oxygen radicals can also start a series of procedures that eventually leads to necrosis and myocardial cell damage by means of amplification of the inflammatory cascade involving factor NF-kB, construction, infiltration of neutrophils and leukocyte–endothelial cell adhesion molecules (Fig 2).

OXIDATIVE STRESS MARKERS:

The processes that causing atherovascular disorder remains partly understood. There is a increasing evidence that irritation and oxidative stress are correlated with occurrence of acute coronary syndrome (ACS) and with the instability of atherosclerotic plaque. ROS-induced opening LDL and inflammatory cascades leads to macrophage formation resulting foam cells, proliferation and differentiation of vascular smooth muscle cells, beginning of vascular matrix metalloproteinases and damage of the extracellular matrix (ECM) of the affected site. This further conclude in ACS separation [18,19]. In some cases of ACS, there is an increase in the plasma levels of oxidized LDL. In difference, it is observed that, when there was no

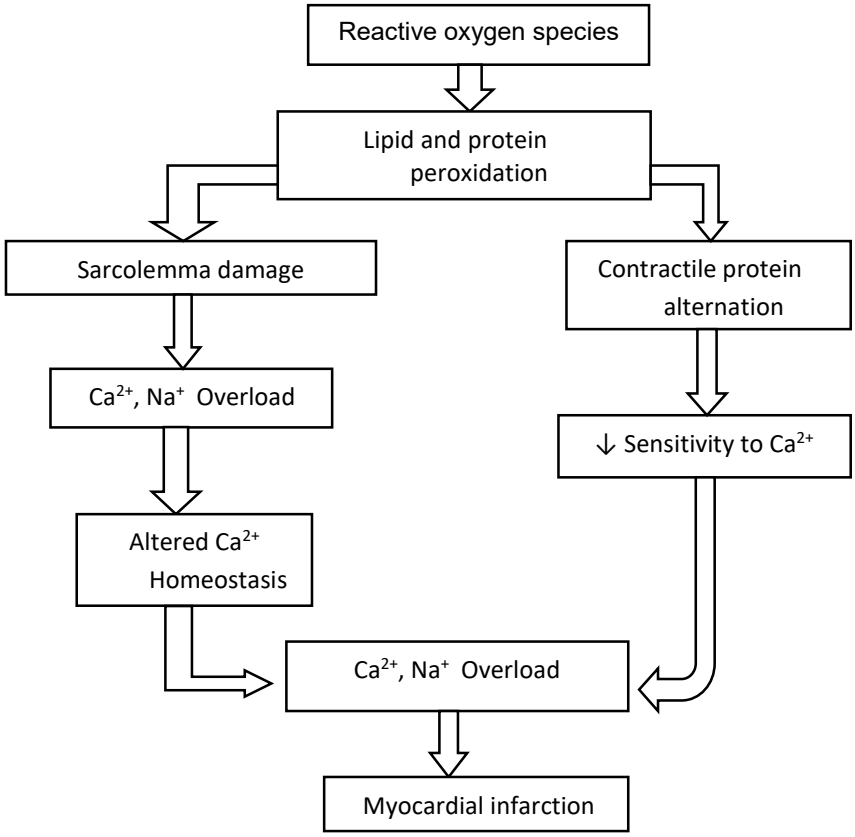

Fig 1. Oxidative stress in myocardial damage.

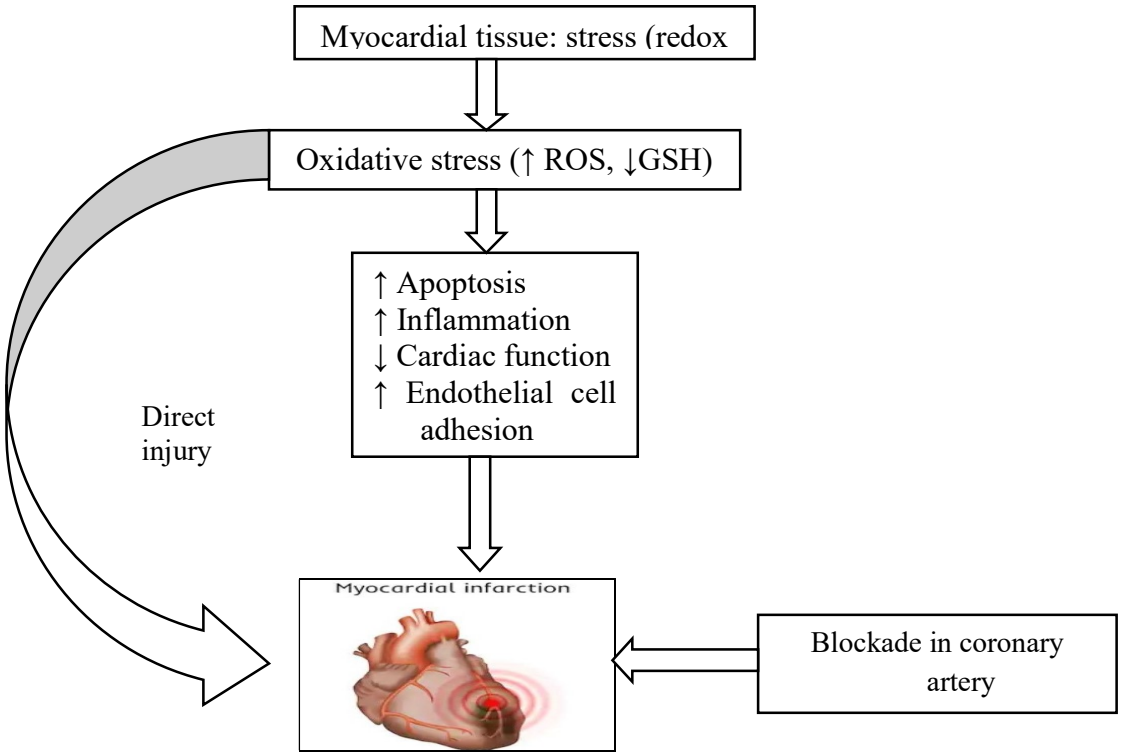

Fig 2. Mechanism of Oxidative stress causing Myocardial Injury.

Table 1. Markers of oxidative stress markers.

Process	Oxidative stress markers
Lipid peroxidation	Malondialdehyde (MDA), Oxidized low-density lipoproteins (LDL), Progressive lipid oxidation products
Protein oxidation	Thiobarbituric acid reactive substances (TABRS), Advanced oxidation protein products
Carbohydrate oxidation	3-nitrotyrosine
Nucleic acid oxidation	Reactive aldehydes

meaningful difference in angiographic stenosis, the creation of ROS is considerably advanced in unstable angina pectoris likened with stable angina pectoris [20]. Oxidative markers used to evaluate the oxidative stress have been interesting in recent years because the exact observation of such stress is needed to examine the diseases and to calculate the success of treatment.

Moreover, oxy radical products (e.g. lipid hydro-peroxides or hydrogen peroxide) are stable and having long half-life so, that can be watched constantly. Mostly, the oxidative markers in the body are anticipated, including 4-hydroxynonenal, lipid hydroperoxide sisoprostanes (IsoPs), malondialdehyde (MDA) 8-hydro-xy-2-deoxyguanosine (8-OHdG), allantoin or thiobarb-ituric acid reactive substances as given in the Table 1 [21]. Higher oxidation protein products (AOPP) were planned as one of the possible markers of oxidative damage, which initiates under oxidative and carbonyl stress and increase comprehensive inflammatory action [22]. MDA, a stable lipid peroxidation end-product, is frequently used as a marker of oxidative stress and reactive ROS production [23,24]. Thioredoxin, a stress-inducible protein containing a redox-active dithiol/ disulfide and thus offers a cytoprotection against oxidative stress [25]. These findings indicate that coronary artery disease may concluded by oxidative stress activity.

CONCLUSION:

Oxidant stress is an essential role in the pathophysiology of various diseases. The difference in the oxidative status and antioxidant interest in AMI replicates the significance of measuring the level of serum oxidative stress biomarkers and antioxidants as an analytical and predictive tool for medical therapy of AMI. This review reflects the capability of oxidative stress markers and antioxidants required for the effective management of AMI.

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