Troponin T and Creatine Kinase As risk predictors of Myocardial Infarction

Research project

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By

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SUPERVISOR CERTIFICATE

This research project has been written under my supervision and has been submitted for the award of the degree of Bachelor of Science in **Biology** with my approval as supervisor.

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Dedication

This project is dedicated to our wonderful parents who have raised us to be the person that we are today, to our supervisor, our friends whom we consider as family and the endless river of inspiration and support and all those who stood by our side through this journey.

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SUMMARY

Myocardial infarction (**MI**), commonly known as a heart attack, occurs when blood flow decreases or stops to a part of the heart, causing damage to the heart muscle and it is an event of myocardial necrosis caused by an unstable ischemic syndrome. In practice, the disorder is diagnosed and assessed on the basis of clinical evaluation, the electrocardiogram (ECG), biochemical testing, invasive and noninvasive imaging, and pathological evaluation. The aim of current study is to use CK-MB, and cardiac troponin T (cTnT) in prediction of MI, and to determine the effect ofMI on some of biochemical test and CBC. Fifty MI patients were recruited including 30 male and 20 female subjects age ranging from (45-70). According to our results there are an increase in CK-MB and cTnT level in cases when compared with the healthy group, and urea level showed a notable elevation in patients 39 (27.25-50.25) in comparing to control group 27.67 ± 0.9958 , while there is a slight increase in creatinine levels in all patients. In hematological parameters we notes a significant differences in each of WBC, MCV, RDW, PDW and MPV while other parameters showed no significant changes in treatment group when compared with the healthy one. In conclusion there are a strong correlation between CK-MB and cTnT level and the risk of MI.

Keyword:Creatine kinase troponin T and Myocardial infarction

LIST OF CONTENT

Introduction

A heart attack (myocardial infarction) happens when one or more areas of the heart muscle don't get enough oxygen. This happens when bloodflow to the heart muscle is blocked. Most MIs occur due to coronary artery disease. Acute myocardial infarction is the most severe manifestation of coronary artery disease (Nichols et al., 2014).

Risk factors include high blood pressure, smoking, diabetes, lack of exercise, obesity, high blood cholesterol, poor diet, and excessive alcohol intake, among others. The complete blockage of a coronary artery caused bya rupture of an atherosclerotic plaque is usually the underlying mechanism of an MI (Falk et al., 1995)

MIs are less commonly caused by coronary artery spasms, which may be due to cocaine, significant emotional stress, and extreme cold, among others.The disorder is diagnosed and assessed on the basis of clinical evaluation, the(Nichols et al., 2014) electrocardiogram (ECG), biochemical testing, invasiveand noninvasive imaging, and pathological evaluation (Thygesen et al., 2012). A number of tests are useful to help with diagnosis, including electrocardiograms (ECGs), blood tests, and coronary angiography. An ECG, which is a recording of the heart's electrical activity, may confirm an ST elevation MI (STEMI) if ST elevation is present.

Cardiac markers are used in the diagnosis and risk stratification of patients with chest pain and suspected acute coronary syndrome (ACS). The cardiac troponins, in particular, have become the cardiac markers of choice for patients with ACS. Cardiac troponin (cTn) isoforms I and T have emerged asthe preferred diagnostic biomarkers, because they are highly sensitive and specific for myocardial injury, detectable within 2−3 h, and peak within
24−28 h. (Morrow et al., 2007)

Troponin refers to a group of proteins that help regulate the contractions of the heart and skeletal muscles. High troponin levels can indicate a problem with the heart.

The heart releases troponin into the blood following an injury, such as a heart attack. Very high troponin levels usually mean that a person has recently had a heart attack. The medical term for this attack is myocardial infarction normal normal range: below 0.04 ng/ml and Probable heart attack: above 0.40 ng/ml.

Having a result between 0.04 and 0.39 ng/ml often indicates a problem with the heart. Creatine kinase myocardial band (CK-MB) follows similar kinetics as cTn; although a CK-MB to total CK ratio of 2·5% or more is specific for myocardial injury, it is relatively insensitive for detecting small myocardial infarctions (Roffi et al., 2016). Although elevations in these biomarkers reflect myocardial necrosis, they do not indicate its mechanism. (Jaffe et al., 2000) and (Jaffe et al., 2006) Thus, an elevated value of cardiac troponin in the absence of clinical evidence of ischaemia should prompt a search for other aetiologies of myocardial necrosis, such as myocarditis, aortic dissection, pulmonary embolism, congestive heart failure, renal failure.

Clinical classification of different types of myocardial infarction:-

- Type 1: Spontaneous myocardial infarction related to ischaemia due to a primary coronary event such as plaque fissuring, erosion or rupture, or dissection

- Type 2: Myocardial infarction secondary to ischaemia due to either increased oxygen demand or decreased supplies eg, coronary artery spasm, coronary embolism (thrombus, vegetations, or atrial myxoma), (Jaffe et al., 2006) anaemia, arrhythmias, hypertension, or hypotension (Jaffe et al., 2000)

- Type 3: Sudden unexpected cardiac death with symptoms suggestive of myocardial ischaemia, accompanied by new ST elevation, or new left bundle branch block, but dying before blood samples could be obtained, or in the lag phase of cardiac biomarkers in the blood

- Type 4 A: Myocardial infarction associated with PCI

- Type 5: Myocardial infarction associated with coronary artery bypass grafting

Symptoms of a Heart Attack

The following are the most common symptoms of a heart attack. But each person may have slightly different symptoms.

- Severe pressure, fullness, squeezing, pain, or discomfort in the centerof the chest that lasts for more than a few minutes
- Pain or discomfort that spreads to the shoulders, neck, arms, or jaw
- Chest pain that gets worse
- Chest pain that doesn't get better with rest or by taking nitroglycerin
- Chest pain that happens along with any of these symptoms:
    - Sweating, cool, clammy skin, or paleness
    - Shortness of breath
    - Nausea or vomiting
    - Dizziness or fainting
    - Unexplained weakness or fatigue
    - Rapid or irregular pulse

  Although chest pain is the key warning sign of a heart attack, it maybe confused with other conditions. These include indigestion, pleurisy, pneumonia, tenderness of the cartilage that attaches the front of the ribs to the breastbone, and heartburn. Always see your healthcare provider for a diagnosis.

  The aim of this study is to know if elevated troponin T and CK.MB levels is risk factor of MI, and to knows relation between hematological test (CBC test)and biochemical tests (urea and creatinine test) with MI.

Material and methods

The study has been carried out in October 2021- Jan 2022 on fifty acute Myocardial infarction patients (20 females and 30 males) age 45 to 70years different stages of the disease was collected at random as they were admitted to Howler Cardiac Center twenty healthy individuals has been collected as a control group during the study period to study the effect of Biochemical parameters on the heart disease.

Methods:

2.1-Collection of Blood Samples:

Five (5) ml venous blood was obtained from each patient by vein puncture,using a ten (10) ml disposable syringe. Then the blood has been collected in a sterile, plain tubes to obtain the serum by centrifugation at 3000 rpm for 15 min. (at 4C^{o}, using cooling centrifuge) to separate serum for estimation of serum biochemical test (Cheng, 2002).

2.2-Complete Blood Measurements:

Complete blood counts (CBC) of all blood samples were carried out at cardiac center Laboratory. The blood parameters were measured by coulter counter (Sysmex K-1000), TOA medical electronics CO., LTD. KOBE. JAPAN (Haen, 1995 and Rodak, 1995).

2.3-Differential Leukocyte Percentage and Count (DLC):

The leukocyte types were determined by preparation of blood films. A drop of (EDTA blood) was placed about 2 to 3 mm at one end of a clean

slide. Place the pusher slide at 30^{o} to 45^{o} angle to the slide, and then move it back to make contact with the drop. The drop should spread along the edge of the pusher slide, and a film is made by a forward movement of the pusher slide. Blood films should be air – dried as soon as they were made. The blood films were fixed with undiluted stock Lei-shaman stain for 2 to 3 minutes, then the stain on film was diluted with distilled water, and left for 5-7 minutes, and then washed by a stream of tap water, the stained film was dried and examined under light microscope (Oil - immersion objective)employing a battlement counting technique, and at least (200) consecutive leukocytes should be identified (Evatt *et al*., 1992).

2.4-Biochemical analysis:

Serum biochemical analyses were determined using (Cobas E 311) full automatic chemical analyzer. These tests included Troponin T , CKMB and urea.

One ml of the serum was added to flexor tube and the tests are analyzed by using automatic chemical analyzer (Cobas CE 311 biochemical analyzer) use only 20 µL of serum for each test.

2.5-Statistical Analysis:

All data are expressed as means ± standard error (M ± SEM); statistical analysis of the obtained data was done according to independent simple's t- test and correlation was used to compare the means. The statistical analysis was carried out using statistically available software (Graph Pad version 9).

Results & Discussion

The hematological and biochemical results obtained from this study are summarized in Tables (1 & 2).

3.1-Impact of MI on some Biochemical parameters:

Biochemical parameters including CK -MB, Troponin T, urea and creatinine has been measured selected male and female MI patients and compared with healthy individuals.

Troponin T and CK.MB levels has been raised significantly 0.17(0.0525- 31.15) and 9.94 (3.015- 31.15) respectively when compared with the control group. This is in agreement with findings of (Brackenbury et al., 1996). CK-MB and Troponin T over a period of 24 h post procedure in a group of patients undergoing percutaneous coronary revascularization, with a view to determining the most sensitive marker of myocardial damage. Troponin T and CK.MB are found in cardiac muscles but released into the blood stream when damage to heart muscle occurs.

Urea and Creatinine levels showed a significant increase in patients 39 (27.25-50.25), 0.98 (0.847- 1.543) respectively. These results are consistent with previous studies (Smith et al., 2005), (Wright et al., 2002) Increased in levels of urea and creatinine an indication to renal dysfunction is associated with increased mortality in patients with myocardial infarction (MI).

Table 1: shows some biochemical parameters in MI patients.

Parameters	**Control**	**Treatment**	**P<0.05**
CK-MB	1.8 (0.6 - 2.3)	9.94 (3.015 – 31.15)	0.0001
Troponin	0.0045 (0.0023- 0.00575)	0.17 (0.0525 – 0.3975)	0.0001
Urea	27.67 ± 0.9958	39 (27.25-50.25)	0.01
Creatinine	0.666 ± 0.0494	0.98 (0.847-1.543)	0.0001

3.2-Impact of MI on some Hematological parameters:

Table 2 shows some hematological parameters including Hb, RBCs, Hct, MCH, RDW, MCV, platelets and MPV in MI patients comparing with healthy population. According to our results there was a significant decrease in RDW level 12.9(12.38-14.08) in MI patients in comparing to healthy individuals. These results are comparable with earlier studies (Abrahan et al., 2018) lower RDW is associated with lower risk for major adverse cardiovascular events in patients with acute coronary syndromes. Hct, Hb, RBCs, MCH, showed no singnificant changes in MI patients comparing with the control group. Elevated WBC level (11.7±0. 7398) in MI patient has been recorded, this is in agreement with(Horne et al., 2005) elevated total WBC count was associated with reduction of blood flow and higher incidence of death due to new congestive heart failure, increased total WBC count is associated with decreased blood flow in cardiac tissue. The results showed Patient to be with significant increased MPV 10.35(9.975-19.93) due to tissue ischemia, and platelets showed no significant changes in treatment comparing with the healthy once, these results are not comparable with earlier studies (Klovaite et al., 2011),(al.,2013)cardiac infection is caused by platelets rich thrombi that form at sites of rupture or tissue(Yaghoubi et al., 2013) of atherosclerotic plaque.

While each or MCV, PDW showed as significant decreased in patients comparing with the control group, in dissagrement with (Braekkan et al., 2010; Demirkol et al., 2012) were stated Various studies have highlighted the correlation between the increase in MCV with CVDs and the prognostic role of this biomarker in these diseases; for example, it has been shown that increasing MCV is associated with MI and accepted manuscript unstable angina, and rising platelets volume is related with an increased risk of mortality due to CVDs .

Table 2: shows some hematological parameters in MI patients

Parameters	Control	Treatment	P<0.05
WBC	6.605 ± 0.307	11.79 ± 0.7398	0.0001
RBC	5.15 (4.45-5.425)	4.97 (4.25-5.22)	NS
Hb	14.13 ± 0.2618	14.2 (12.98-15.05)	NS
HCt	42.58 ± 0.7191	41.85 (37.35-45.5)	NS
MCV	87.05 ± 0.4384	84.7 (81.6-87.85)	0.05
MCH	29.16 ± 0.3031	29.25 (27.2-30.98)	NS
RDW	14.31 ± 0.2406	12.9 (12.38-14.08)	0.01
PLt	265.5 (251-299.3)	249 (222.5-290.8)	NS
PDW	37.24 ± 0.1599	41.9 (38.25-46.03)	0.0001
MPV	8.487 ± 0.0821	10.35 (9.975-19.93)	0.0001

Conclusion

In summary in this study we concluded were a number of changes is both hematological and biochemical parameters in MI patients, like WBCs, MPV and MCV levels that has been significantly changed and this is an indicators to cardiac problem. Also an elevated Troponin T and CK.MB levels might be a strong indicator to myocardial infarction and can be used as MI predictor.

Recommendation

Depending on our study we recommended for the further studies to

1- To study more biomarkers like my globulins because it is most sensitive early marker for cardiac problems.

2-To make a comparisons before and after getting treatments for MI.

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