Correlation between body mass index and in-hospital mortality in patients with ST-segment elevation myocardial infarction in Erbil city- Iraq

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Abstract

Background: Although High body mass index is associated with many cardiovascular diseases including coronary artery disease. Its effect on in-hospital death in patients with acute ST-segment elevation myocardial infarction (STEMI) is still a subject of controversy.

Objective: To determine the correlation between body mass index (BMI) and in-hospital mortality in those patients.

Patients and Methods: In this cross-sectional study, 180 adult patients with acute STEMI were enrolled and their BMI was measured. The participants were classified according to BMI into three groups as normal, overweight, and obese. A correlation between in-hospital mortality due to STEMI and BMI was evaluated.

Results: Of the total participants, 62 (34.4%) were normally weighted, 61(33.8%) were over-weighted, and 57(31.6%) were obese. There was a significant difference (p= <0.001) between the groups concerning troponin I, hs-CRP, GRACE score, and the probability of in-hospital death. There were 16 (8.8%) in-hospital deaths during the study distributed as follows; 1(1.6%) in the normal-weight group, 5(8.1%) in the overweight group, and 10 (17.5%) in the obese group. In-hospital death showed a significant difference (p=0.04) between the study groups. In addition, a significant positive correlation(r=0.9) was found between BMI and in-hospital death.

Conclusion: A robust positive correlation was detected between BMI and in-hospital mortality due to acute STEMI. When BMI increases, the number of deaths also increases exponentially.

Keywords: Body mass index, ST-segment elevation myocardial infarction, mortality

Introduction

The body mass index (BMI) is a dependable marker used for many years to evaluate overweight and obesity. The BMI can be measured after using the following equation: the weight in kilograms is divided by height in meters squared (BMI = kg/m^2) [1]. On this basis, people can be divided into normal weight (when the BMI value was <25 kg/m^2), overweight (when their BMI falls between 25-29.9 kg / m^2), and obese (if their BMI was ≥ 30 kg/m^2) [2]. Accordingly, overweight and obesity are defined when there is an increment in BMI. Obesity is a disease that results in an increase in body fat that may represent a risk to health [3]. It is considered a chronic medical health problem that leads to many serious diseases [4]. In 2017, and according to the global burden of disease attributable to high body mass index, there were approximately four million deaths every year because of obesity or being overweight [5].

Globally, Obesity prevalence has increased and it was nearly tripled since 1975. In 2016, nearly two billion adults were overweight and obese. In addition, more than 340 million children and adolescents were overweight or obese [6].It became an epidemic proportion in some countries like the United States. It was mentioned that approximately 75% of male adults and nearly 60% of females are overweight or obese, and that out of every 3 people in America, one or more is obese or overweight [7]. In Iraq, as it is in the rest of the world, the prevalence of overweight and obesity is also increased. In 2006 and according to the World Health Organization (WHO) scanning, nearly 26% of adult males and 38% of adult females were obese [8]. In the Kurdistan region, the prevalence of overweight and obesity was also high. In Erbil city, for example, the prevalence of overweight was 33.4% and it was 40.9% for obesity [9].

An abnormal or excessive fat accumulation in overweight or obese patients produces many harmful proinflammatory cytokines [10].As a result, many heart-related diseases will occur, such as diabetes mellitus, hypertension, and dyslipidemia [11].Obesity is considered a distinct risk factor for many cardiovascular diseases [12].No current data about the prevalence of cardiovascular in Iraq are available, however; in 2014, cardiovascular disease mortality was estimated to account for 33% in Iraq [13]. The most common of cardiovascular diseases is coronary artery disease (CAD), which happened when the blood flow to the heart muscle is reduced due to the formation of plaque in the arteries of the heart [14].One of the most lethal presentations of CAD is acute ST-segment elevation myocardial infarction (STEMI). Acute myocardial infarction (AMI) is the most considerable cause of death in both developed as well as in developing countries. Worldwide, the prevalence of the disease increased with more than one million deaths in the United States annually[15]. Although an increased BMI is associated with a higher risk of getting AMI [16], many studies have reported a protective effect of BMI on outcomes. This phenomenon is called “the obesity paradox” or “BMI paradox” [17,18].As is evident, there is a lot of controversy about this issue and for this reason; the main aim of the current study is to determine the correlation between body mass

index and mortality during hospitalization in patients with ST-segment elevation myocardial infarction in Erbil city, Iraq.

Patients and Methods

This cross-sectional study was conducted in Rizgary Teaching Hospital, coronary care unit, in Erbil city- Iraq, from February 2019 to February 2020. A convenience sample of 180 adults, aged ≥ 18, presenting with acute STEMI, were involved in this study. The inclusion criteria were first-time acute STEMI with no previous attacks, and less than 24 hours of chest pain duration. The exclusion criteria were any previous history of myocardial infarction, any previous cardiac procedures like percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG), and patients with old Left bundle branch block (LBBB).

Acute STEMI diagnosis was considered when there is an elevation in cardiac biomarkers associated with one of the followings: Symptoms that are related to ischemia, ST-segment elevation on an electrocardiogram (ECG), a new onset of left bundle branch block, and when the motion of the heart wall was changed on imaging study [19]. In the current study, demographic variables (such as age and gender), cardiovascular risk factors (like hypertension, diabetes mellitus, dyslipidemia, and smoking), and physical examination (including Heart rate, blood pressure), and evaluating for the Killip class [20], were achieved. The Global Registry of Acute Coronary Events (GRACE) risk score [21] was evaluated as well as in-hospital death during admission.

Under aseptic conditions, a sample of blood was taken from each patient. Many laboratory tests including blood urea, serum creatinine, cardiac troponin I, and high-sensitivity C-reactive protein (hs-CRP) were done using an automated Cobas E601 clinical chemistry analyzer. The above-mentioned laboratory tests were evaluated according to their normal values. The value of the hs-CRP test has been approved according to the Centers for Disease Control (CDC) and American Heart Association (AHA)[22].

The patients' weight (in kilograms) and height (in centimeters, to be rounded later to squared meters) were measured using a dependable height and weight scale, and as a result, the calculation of BMI was done. Based on their BMI, the participants were classified into three groups according to the WHO standards [2].

Statistical analysis

The data were analyzed using statistical package for social sciences (SPSS, version 19), and the variables were expressed as the mean and standard deviation (SD). To compare these variables, a t-test was used. To compare proportions, a Chi-square test was used.When the P-value was ≤ 0.05, it was considered statistically significant.

Results

In the current study, 180 patients with acute STEMI were enrolled. Of the total participants, 62 (34.4%) were normally weighted, 61(33.8%) were over-weighted, and 57(31.6%) were obese, as seen in Table (1).

Table (1): Distribution of patients according to their body mass index

BMI groups	Number (%)
Total	180
Normal weight (BMI <25kg/m^2)	62(34.4%)
Overweight (BMI 25-29.99 kg/m^2)	61 (33.8%)
Obese (BMI ≥ 30 kg/m^2)	57 (31.6%)

*The results are expressed as number (%)

Table (2) shows the baseline characteristics of the participants according to BMI. There was a highly significant difference (p= <0.001) between the study groups concerning troponin I level, hs-CRP level, GRACE score, and the probability of in-hospital death. The other baseline characteristics were comparable.

Table (2): Baseline characteristics of the study groups

Variables	Group I (N=62)	Group II (N=61)	Group III (N=57)	P value
Age(years)	62.4±8.5	62.2±12.2	64±11.5	0.61
Male	30(48.3%)	43(70.4%)	35(61.4%)	0.34
Female	32(51.7%)	18(29.6%)	22(38.6%)	0.14
Hypertension	33(53.2%)	32(52.4%)	34(59.6%)	0.26
Diabetes	20(32.2%)	20(32.7%)	23(40.3%)	0.21
Smoking	25(40.3%)	27(44.2%)	26(45.6%)	0.26
Fqmily history of ischemic heart disesae	10(16.1%)	14(22.9)	19(33.3%)	0.13
Hyperlipidemia	36(58%)	44(72.1%)	38(66.6%)	0.21
BMI, kg/m^2	23.14±1.21	27.63±1	32±2.3	<0.001
Troponin I level (ng/ml)	4.01±7.55	8±10.7	11±13.43	<0.001
Hs-CRP(mg/L)	0.87±0.21	2.17±0.52	4.3±2.1	<0.001
GRACE score	124.5±23.9	167.91±42.4	180.4±32.3	<0.001
Probability of in-hospital Death(%)	2.69±3.2	11.34±14.9	13.8±12.3	<0.001

* The results are expressed as number (%) and mean ±SD

There were 16 (8.8%) in-hospital deaths during the study distributed as follows; 1(1.6%) in group I (normal weight patients) , 5(8.1%) in group II (overweight patients), and 10 (17.5%) in group III (obese patients), as shown in Table (3). In-hospital death showed a significant difference (p=0.04) between the study groups. In addition, there was a robust positive correlation between BMI and in-hospital death (r=0.9). When BMI increases, the number of deaths also increases exponentially.

Table (3): BMI and In-hospital death in the study population

Body mass index categories	Number of death (%)	P value	Correlation coefficient (r)
Group I (Normal)	1(1.61%)	0.04	0.9
Group II (Overweight)	5(8.1%)		
Group III (Obese)	10(17.5%)		
Total	16(8.8%)		

* The results are expressed as number (%)

Discussion

The current study showed that BMI was an important predictor of in-hospital mortality in patients with acute STEMI, and there was a robust positive correlation between BMI and death during hospitalization. When BMI increases, the number of deaths also increases exponentially. Our results are in agreement with other studies [23-25]. In 2004, Kaplan and co-workers published their study on 2677 survival patients with acute myocardial infarction between 1986 and 1996 (mean follow-up 3.4 years) identifying predictors of prognosis. They mentioned that high BMI was an independent risk factor for reinfarction and fatal coronary heart disease [23]. A published study of 1898 patients hospitalized with acute myocardial infarction by Rana et al in 2006, found a potent positive relationship between BMI and post-myocardial infarction death [24]. The effect of body weight on the in-hospital outcomes of more than 50,000 patients with STEMI was evaluated by Das et al in a study published in 2011. They found that severe obesity (BMI $\geq$40 kg/m^2) was distinctly associated with high rate of death during hospitalization [25]. In contrast, some studies didn't find such an association [26,27] and others even mentioned a "protective" effect of obesity [28,29].Haridasan *et al* in their study with acute myocardial infarction patients, found that BMI didn't predict cardiac events or death after MI [26]. Similar findings were found by Zeller et al when they evaluated 2229 patients with AMI from a French population-based cohort to analyze the effect of BMI on death rates [27].In 2019, Kim and co-authors mentioned some beneficial effects of high BMI on mortality due to AMI, and they suggested a better life-quality after AMI than normal weight patients [28].In concordant with these results, Camprubi and colloquies concluded a "paradoxical" relationship between BMI and death during hospitalization in patients with acute coronary syndrome (ACS). They mentioned that there was a decrease in the death rate when the BMI was increased [29].

In this study, the prevalence of obesity in patients with STEMI was 31.6%, and if we added the over weighted patients (33.8%), the prevalence of high BMI will increase to 65.4%. That means nearly 2/3 of our patients had high BMI. This high prevalence was seen in other studies. In 2016, Hartopo *et al*, in their cross-sectional study revealed that the prevalence of combined obesity and overweight was 63.2%. [30]. The prevalence of combined obesity and overweight in the Das et al study was 74.9% 25; however, a lesser prevalence (42.3%) was noted in the Spanish population [31].

The presence of high BMI in this group of patients who suffer from multiple risk factors will add an additional burden on the function of the heart and its coronary circulation.[33] The increment in BMI will change the nature of adipose tissue, which leads to insulin resistance that causes resistant type 2 diabetes, hypertension, dyslipidemia, and prothrombotic states which ultimately leads to ischemic cardiomyopathy [34].

There are many mechanisms explaining the increment of death rate in high BMI patients presenting with cardiovascular diseases. Obesity has a significant effect on increasing the amount of blood volume, making filling pressure to be higher, and also increasing the

sympathetic activation, which ultimately leads to raised stroke volume and augmenting heart beats and may contribute to adverse prognosis [35].When the adipose tissue accumulated in large amounts in the myocardium , a change will happened in the structure and function of the heart. One of cardiac structural changes in obesity include markedly increased left ventricular mass [36], which has a hazardous effect by increasing ventricular arrhythmias and enhancing sudden cardiac death.

What was also observed in the current study is that BMI was positively correlated with the "Global Registry of Acute Coronary Events" score (GRACE score). The GRACE score is the most frequently used risk assessment tool by the American Heart Association (AHA) and the European Society of Cardiology (ESC) in the management of ACS) [37]. It is also used to predict in-hospital mortality [38].

When the in-hospital GRACE score reaches 140 or more , the risk of death increases. As a result; more procedures and additional therapies are needed for these patients [39].In an interested study , 207 patients were evaluated by Gul *et al* in 2013 to define whether epicardial fat thickness (EFT) is correlated with high-risk acute coronary syndrome patients in relation to the GRACE score. They found that end-systolic and end-diastolic EFTs was positively correlated with the GRACE score. Patients with high GRACE score had more EFTS compared to those with lower GRACE score. Epicardial fat tissue was considered a type of visceral adipose tissue that expands over the coronary arteries, and some articles correlated between high EFT and diseases like hypertension, diabetes mellitus and metabolic syndrome [40].

Conclusions

Higher BMI was positively correlated with in-hospital mortality in patients with acute STEMI. BMI is an important predictor of death in AMI. Excess weight should be avoided as possible in those patients.

Recommendations

1- We recommend taking into consideration the issue of overweight and obesity in patients prone to heart attacks, and according to the results of our study. We found that myocardial infarction patients with high BMI are more likely to die than normal-weight patients. Therefore, we consider that being overweight or obese has added an additional risk to these patients.

2- We recommend conducting future studies to clarify the effect of weight loss on the death rate for patients with myocardial infarction.

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Ethical clearance: The consent to do this research was taken from all the patients who participated, and the required approval was obtained from the ethical committee of Hawler Medical University.

Conflict of interest: Nill

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