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Clinical Trials Study

Impact of Primary Percutaneous Coronary Intervention on ST-Segment Elevation Myocardial Infarction Patients: A Comprehensive Analysis

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Abstract

BACKGROUND

Myocardial infarction, particularly ST-segment elevation myocardial infarction (STEMI), is a key global mortality cause. Our study investigated predictors of mortality in 96 STEMI patients undergoing primary percutaneous coronary intervention at Erbil Cardiac Center. Multiple factors were identified influencing in-hospital mortality. Significantly, time from symptom onset to hospital arrival emerged as a decisive factor. Consequently, our study hypothesis is: "Reducing time from symptom onset to hospital arrival significantly improves STEMI prognosis."

AIM

The purpose of this study is to determine the key factors influencing mortality rates in ST-segment elevation myocardial infarction (STEMI) patients.

METHODS

We studied 96 consecutive STEMI patients undergoing primary percutaneous coronary intervention (PPCI) at the Erbil Cardiac Center. Their clinical histories were compiled, and coronary evaluations were performed *via* angiography on admission. Data included comorbid conditions, onset of cardiogenic shock, complications during PPCI, and more.

Post-discharge, one-month follow-up assessments were completed. Statistical significance was set at $P < 0.05$.

RESULTS

Our results unearthed several significant findings. The in-hospital and 30-day mortality rates among the 96 STEMI patients were 11.2% and 2.3% respectively. On the investigation of independent predictors of in-hospital mortality, we identified atypical presentation, onset of cardiogenic shock, presence of chronic kidney disease, Thrombolysis In Myocardial Infarction (TIMI) grades 0/1/2, triple vessel disease (3VD), ventricular tachycardia/ventricular fibrillation (VT/VF), coronary dissection, and the no-reflow phenomenon. Specifically, the recorded average time from symptom onset to hospital arrival amongst patients who did not survive was significantly longer (6.92 ± 3.86 h) compared to those who survived (3.61 ± 1.67 h), $P < 0.001$. These findings underscore the critical role of timely intervention in improving the survival outcomes of STEMI patients.

CONCLUSION

Our results affirm that early hospital arrival after symptom onset significantly improves survival rates in STEMI patients, highlighting the critical need for prompt intervention.

INTRODUCTION

Myocardial infarction (MI), a type of coronary heart disease, is a leading cause of morbidity and mortality. This disease causes more than 15% of deaths in the world, most of them have non-ST-segment elevation MI than ST-segment MI (STEMI), men are more prone to develop MI than women, several modifiable risk factors are responsible for more than 90% of MI, these factors include hyperlipidemia, diabetes mellitus (D.M.), smoking, heavy alcohol consumption, physical inactivity, hypertension, psychosocial stress and a diet low in fruits and vegetables (Jayaraj et al, 2019). Factors that may lead to ST-segment elevation include infarction of the cardiac muscles due to occlusion of one vessel with a

supply where there is obstruction, and this usually happens because of plaque rupture erosion, fissuring, or dissection, which leads to an obstructing thrombus (Hartikainen *et al*, 2020). ST-elevation MI can be defined as a clinical syndrome in which the characteristic symptoms of MI associated with ECG finding of ST-segment elevation in ECG associated later with elevation in biomarkers of myocardial necrosis, therefore a diagnostic ST-segment elevation is a new S.T. elevation at the J point in at least two contiguous leads > 2mm (0.2 mV) in men or > 1.5 mm (0.15 mV) in women in leads V2-V3 and of > 1mm (0.1mV) in other contiguous chest or limb lead (Hwang and Levis, 2014). It's found that timely primary percutaneous coronary intervention (PPCI) is the best treatment for ST-segment elevation MI (Keeley *et al*, 2003). The critical point is the time; most studies show that the preference of primary PCI over fibrinolytic therapy is just approximately 2 h, and this depends on the duration of ischemia and the number of myocardial muscles involved with ischemia in some countries, which was named as door to balloon time has been reduced to less than 1 h (Pinto *et al*, 2006). At the same, some studies show that if PCI is delayed after the onset of the symptoms, the outcome will be poor; others show that delay in performing PPCI may be only significant within the first 2 to 3 h after the onset of the symptoms since this is the time where myocardial salvage is most fabulous, or in those who are risky group such as in patients with cardiogenic shock. In general, studies that didn't confirm this relationship had already depended on a small sample size (Nallamothu *et al*, 2007). This work aims to comprehensively evaluate the outcomes of Primary Percutaneous Coronary Intervention (PPCI) in patients diagnosed with ST-segment elevation myocardial infarction (STEMI). To achieve this aim, we have set the following specific objectives. Firstly, assess the impact of PPCI on the improvement of cardiac function in patients diagnosed with STEMI, and determine and report the mortality rate among patients undergoing PPCI for STEMI. Investigate and establish associations between various risk factors and the overall outcomes of PPCI in patients diagnosed with STEMI, Analyze the association between the onset of STEMI symptoms and the timing of PPCI procedures, and their implications on patient prognosis and finally, explore correlations between the type of culprit vessel, the number of affected

vessels, the occurrence of complications, and the ultimate clinical outcomes in patients with STEMI undergoing PPCI.

MATERIALS AND METHODS

The type of study in this research is an interventional study; after selecting the samples to be included according to specific criteria, the intervention will be the PCI procedure. Ninety-six consecutive cases were selected according to inclusion criteria. This study will be conducted in the Cardiac Center in Erbil city in Kurdistan Regional Government. The time frame for this study was more than four months.

Sampling

A consecutive sampling technique was used for this study because of time restriction and availability of cases with the specified criteria; in addition to that, every facility regarding investigation, treatment, and intervention is available in this center. For these reasons, this sampling technique was used.

Inclusion criteria:

Cases present with myocardial infarction and apparent S.T. elevation on
electrocardiography records.

Case admitted to the hospital within the first 48 h of symptoms.

The age of patients should be between 30 and 90 years.

The patient agrees to participate in the study and sign the consent form.

Exclusion criteria:

Age that is out of the range described.

Cases received thrombolytic medications.

Patients refused to participate in the study.

Procedure technique:

Percutaneous coronary intervention is a surgical procedure used when there is a narrowing or stenosis in one of the coronary arteries that supply blood to the heart; this process includes coronary angioplasty and stenting, which is the process of inserting a permanent drug-eluting stent.

Tools used in the procedure:

Electrocardiogram (ECG).

Echocardiography (Echo).

Angiography and Angioplasty.

RESULTS

From the total number of patients enrolled in this study, 13 died, while eleven died during hospitalization before discharge and two died after discharge within one month of follow-up. Male to female ratio was 5: 1, and no significant correlation was established between death and gender (table 1) and age group (table 2).

More than one quarter (25%) of patients were hospitalized within the initial 2 hours of symptom onset, up until balloon inflation, and the rest were admitted in more than 2 h, as shown in table 3. There was a statistically significant association between total arrival time till balloon inflation and mortality. Therefore, the earlier the patient arrives, the better the outcome with a P value of < 0.0184. The time from symptom to hospital and door to balloon time alone was insignificant.

Most of the patients admitted with typical ischemic chest pain (89 cases), and 7 cases presented with an atypical presentation; there was a statistically significant association between syncope (8 cases), Cardiac arrest (1 case), and Ventricular arrhythmias (9 cases) with deaths inside the hospital as shown in table 4.

Although smoking is one of the essential factors that are usually associated with deaths, in this study, there was no statistically significant association with this factor; on the other hand, dyslipidemia showed a strong association with deaths inside hospitals with a P

value < 0.001. Chronic kidney disease was also significantly associated with in-hospital deaths, as shown in table 5. On the other hand, outside hospital deaths, only chronic kidney disease showed a significant association with deaths after PCI with a P value of < 0.002 (table 5).

Regarding the in-hospital deaths due to cardiogenic shock (SBP<90), there was a statistically significant association with this variable with a P value of 0.004 (table 6). Also, deaths within one month after discharge had a significant association with cardiogenic shock with a P value of 0.024 (table 6).

More than half of patients had high levels of HbA1c, and nearly 78% of cases had an average level of creatinine. However, only creatinine level had a statistically significant association with deaths with a P value of 0.014 (table 7).

Regarding angiographic results, most deaths inside the hospital happened due to 3 vessel disease (3VD) with a statistically significant association, a P value of < 0.001, and the minor disease association was a single vessel with a P value of < 0.05. Central stem disease was also associated with deaths inside the hospital with a P value of < 0.05 (table 8). However for deaths outside the hospital, only 3VD was associated with deaths with a P value < 0.05 (table 8).

The angiographic results regarding the culprit's vessels showed that the left circumflex, left anterior descending artery, and obtuse marginal were significantly associated with deaths inside the hospital (table 9). On the other hand, only the Left anterior descending artery was significantly associated with deaths outside the hospital within one month of discharge (table 9).

On looking at the complications associated with deaths inside the hospital, it was found that many complications were significantly associated with death except temporary pacemakers and contrast nephropathy. Most of these associations were highly significant, with a P value of < 0.001, as shown in table 10. While for deaths outside the hospital, the insignificant complications were coronary dissection and temporary pacemakers, other complications were statistically significant with a P value < 0.05, as shown in table 10.

DISCUSSION

In this study, the hospital mortality rate of STEMI patients who underwent PPCI was (11.4 %) and the mortality rate from discharge to one month was (2.35%). However, in comparison to another study done in 2021, the in-hospital mortality was slightly lower (9.2%), and 30-day mortality was (7.7%) (Takagi et al, 2021), which is slightly higher than our study since only one-quarter of our patients were admitted to the hospital within first 2 h from symptoms till needle insertion and the rest over 2 h as shown in table 3. The time to start treatment is the most important determinant of mortality, and it consists of the time from symptom to initiation of reperfusion therapy. This embraces the time from symptom to first medical contact and the time from hospital arrival to initiation of reperfusion (Kim et al, 2011). Notably, there was a statistically significant association between the time from starting symptoms to balloon inflation and mortality. This is due

to the lack of a standard emergency medical services system by telephone and public awareness. Nearly all patients were referred from other hospitals, especially emergency hospitals in Erbil, which are not PCI-capable hospitals, and no one received thrombolysis even those delayed more than six hours. This may be due to the delay in reaching the emergency hospital. The other explanation for higher in-hospital mortality is that primary PCI was done through a femoral rather than radial approach; the radial method, as compared to the femoral access approach, is associated with a lower mortality rate (2.7 % vs. 4.7 %) (Karrowni et al, 2013).

This study aims to identify both risk factors and variables influencing mortality among patients who have undergone primary percutaneous coronary intervention (PCI) for ST-elevation myocardial infarction (STEMI). Men have five-fold higher than females, and sex has shown no significant effect on mortality. However, death in STEMI patients occurs more in males, though some studies have found higher mortality rates in women than men (Keeley and Hillis, 2007). The lack of elevated risk among our female patients underscores the advantages of primary PCI for women.

Based on our results, in terms of STEMI and mortality, it was mostly related to middle-aged patients; with increased age, the risk for death becomes higher in patients who experienced a myocardial infarction (Jackson et al., 2011). This difference is justifiable Since very old patients with STEMI who did not undergo primary PCI may not reach PCI-capable hospitals and be prescribed pharmacological treatment instead.

In this study, we found that the presentation of patients to the hospital was critical; those patients who presented with typical ischemic chest pain were associated with a better survival rate, but patients who presented with syncope, ventricular arrhythmia, cardiogenic shock, and cardiac arrest were significantly associated with mortality (Puymirat et al, 2017).

In primary PCI patients, we observed diabetic state enhanced the probability of STEMI. In essence, diabetes did not augment mortality in hospitals and from hospital discharge to one month. Also, uncontrolled diabetes mellitus increases mortality in STEMI patients

who underwent primary PCI after putting the stent; however, trials attempting to decrease macrovascular events have been unsuccessful (Gerstein et al, 2008). However, better glycemic control has not led to reduction in the occurrence of cardiovascular events while ACCORD trial (Gerstein et al, 2008), It was linked to heightened risks of all-cause mortality and cardiovascular-related mortality. Notably, on admission, HbA1c levels had no association with in-hospital mortality and short-term all-cause mortality outcomes in diabetic patients with STEMI undergoing primary PCI. Still, they affected long-term outcomes and major cardiovascular events, as demonstrated in another study (Sabatine et al, 2005).

Another major risk factor for coronary artery disease is smoking. The contribution of smoking to the prevalence of mortality rates after primary PCI is also a cause for attention. The case in this study is that smoking had no detrimental effects on mortality. Nevertheless, other studies have shown superior reperfusion following PCI in smokers (Albertal et al., 2008). In contrast, high arterial blood pressure is associated with CAD and the incidence of complications after ACS (Ali et al, 2011, Li et al, 2020). However, we found that hypertension increases the risk of STEMI more than other risk factors but does not affect mortality. Furthermore, hyperlipidemia is a risk factor for coronary artery disease; it significantly affected the incidence of mortality in this study (Ismail et al, 2018). A strong association was demonstrated between mortality of STEMI in patients undergoing primary PCI and chronic kidney disease, and about half of them developed cardiogenic shock, were admitted to the intensive care unit (ICU) and associated with three-vessel disease, and had higher cardiovascular risk factors like hypertension, diabetes mellitus, and hyperlipidemia in contrast to those patients without chronic kidney diseases. The same results have appeared compared to a study of the outcome of STEMI patients with chronic kidney disease treated with primary PCI (Ismail et al, 2018). Low hemoglobin level before primary PCI was associated with a higher mortality rate, anemia was associated with cardiac arrest, congestive heart failure, cardiogenic shock and death, and anemia causing hypoxia during myocardial infarction. This hypoxia makes patients more vulnerable to spasms and arrhythmias (Mehta et al, 2009). However

in this study, there was no association between anemia and mortality because the hemoglobin of all our patients was above 11 g/dL, so it was mild anemia.

TIMI flow is one of the critical factors in determining the outcome of PCI in patients with STEMI. Good TIMI flows at the time of angiography, and PCI is a determinant of mortality in patients undergoing primary PCI. Patients with TIMI flow grade 3 are expected to have higher survival rates and fewer complications following primary PCI (Sadrnia et al, 2013, Brener et al, 2008). In the present study, TIMI flow grade less than three was associated with increased mortality in patients receiving primary PCI for STEMI. A significant relationship was shown between the number of involved vessels and outcome in patients who underwent primary PCI in STEMI (Jahic, 2017). However, the left circumflex and anterior descending arteries are affected in-hospital mortality following STEMI. This discovery validates the significance of the involvement of these arteries in myocardial infarction patients. Additionally, some studies have indicated that multi-vessel, especially 3VD and left central steam involvement in patients, increases the risk of primary PCI mortality. It is compatible with the results of this study (Jahic, 2017). Previous studies have proven that ventricular arrhythmia was significantly associated with in-hospital and thirty-day mortality rates (Entezarjou et al, 2018). Moreover, mortality from hospital discharge to one month was strongly affected by the three-vessel disease, chronic kidney disease, left anterior descending artery, cardiogenic shock, especially those are on positive inotropes and admitted to ICU on mechanical ventilation, intubated patients, patients who present to hospital with VT/VF or a ventricular arrhythmia that happened in Cath-lab and no-reflow less than class 2, respectively affect mortality.

CONCLUSION

This study thoroughly examines the effects of Primary Percutaneous Coronary Intervention (PPCI) on patients diagnosed with ST-segment elevation myocardial infarction (STEMI). Through our analysis, we have uncovered numerous parameters that exert a substantial impact on patient outcomes.

The results of our study highlight the significance of crucial factors linked to the prognosis of patients undergoing percutaneous coronary intervention. Several characteristics that can be considered include delayed presentation, syncope as the initial symptom, ventricular arrhythmias, cardiogenic shock, cardiac arrest, hyperlipidemia, and chronic kidney disease. In addition, the identification of the particular coronary arteries affected, such as the left anterior descending artery, left circumflex artery or left main stem, as well as the assessment of the amount of disease (three-vessel disease), were observed to have significant impacts on the determination of outcomes.

The incidence of several complications during the percutaneous coronary intervention (PPCI) operation, such as dissection, cardiogenic shock, the need for mechanical ventilation, ventricular arrhythmias, and the no-reflow phenomenon, have been found to have a significant impact on patient prognosis.

This study emphasizes the intricate nature of the parameters that influence the results of percutaneous coronary intervention (PPCI) in patients with ST-segment elevation myocardial infarction (STEMI), hence emphasizing the crucial importance of prompt intervention and customized care methods that are specifically designed to address the unique risk profile of each patient. Efforts to optimize these parameters can potentially enhance the overall success of primary percutaneous coronary intervention (PPCI) as a life-saving strategy for patients with ST-segment elevation myocardial infarction (STEMI).

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