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ORIGINAL ARTICLE

Short- and Long-Term Cause of Death in Patients Treated with Primary PCI for STEMI

TARIQUE AHMED[1], TAHIR SAGHIR[1], NASIR ALI[1], SHAHZAD[1], FARAZ FAROOQ MEMON[1], ABDUL HAKEEM SHAIKH[1]
[1]*National Institute of Cardiovascular Diseases, Karachi*
Corresponding author: Tarique Ahmed, Email: tariqueship@gmail.com

ABSTRACT

Background: While the long-term cause of death in patients with STEMI is still undetermined, short-term mortality in patients experiencing PCI has been well-researched.

Aims and Objectives: This study set out to investigate the connection among the time and cause of mortality rates in patients with STEMI who were receiving Primary Percutaneous Coronary Intervention.

Materials and Methods: In 934 continuous patients with STEMI (age 60 ± 12 years, 72 per cent males) cured with primary PCI, the time and fatality were tracked using a centralized civil registration process, client files, and death cause and public disease registries with proper record linkage.

Results: An average of 8 months was followed up with patients. 101 people passed away out of a total of 934 patients. Anoxic brain injury and cardiogenic shock following cardiac arrest were the two primary causes of death in the 1st1 30 days. The death rate was independently predicted by culprit vessel size, age, and flow, the prevalence of heart problems and Mellitus, and age. The yearly cardiac death rate is a little less than 1.5 per cent after thirty days. In 65 per cent of instances, non-cardiac mortality causes occurred after 30 days (mainly pulmonary diseases and malignancies). The death rates for all causes (including cardiac) at 30 days, 6 months, and over were 7.8 per cent (7.2 per cent), 11.2 (8.1 per cent), and 23.2 (13.7 per cent), accordingly.

Conclusions: Patients with a good prognosis who survive the first month following a STEMI cured with PPCI have a less than 1.5 per cent monthly risk of subsequent cardiac mortality. Most of these individuals' later deaths occur from reasons other than cardiac ones.

Keywords: Percutaneous Coronary Intervention, Cause of Mortality, Acute MI, Follow-up Study

INTRODUCTION

Patients who report STEMI within 12 hours after the beginning of symptoms are usually treated with PCI, assuming that prompt treatment can be started by a skilled team (Patel et al., 2012). In order to adopt novel tactics, and create clinical studies, cardiac rehab centers, and secondary preventive programs to further reduce death rates in patients cured with primary PCI, it is critical to have information on the reasons for death in these patients (Piepoli et al., 2010). However, extensive research into the relationships between time and other causes of death following PPCI has not been done in sizable all comer cohorts. The purpose of the current study was to investigate the relationships between the time as well as the causes of cardiovascular and noncardiovascular death in a group of STEMI patients who received primary PCI at the same time.

MATERIALS AND METHODS

Patients with primary PCI at the National Institute of Cardiovascular Diseases in Karachi between January 2021 and August 2021 were participants in this study. Patients experiencing chest discomfort that started during the previous 12 hours with ST-segment elevation in at minimum 2 adjacent echocardiographic leads were diagnosed with STEMI. All patients receiving primary PCI, with hypotension as well as receiving resuscitation after cardiogenic shock were included in this study. Each patient was treated with unfractionated heparin, 300 or 600 mg of clopidogrel, and 300 mg of aspirin were administrated to the patients in emergency care. Following primary PCI, participants undergo medical care in accordance with contemporary guidelines.

According to The Joint Commission's guidelines for the hospital's certification, conscious patients were notified. Individuals who were drowsy or unable to move were managed by the Council of Ethics guidelines.

Patient's Record: Every patient's vital occurrences are documented for every record using a unique, 10 digits civil personal registrations (CPR) code that is given at birth or during registration inside the CCRS. The operational doctors and associates in the cardiology lab recorded the CPR code, clinical factors, background, and PCI operational data in connection to the PPCI procedure into the medical database.

Medial Trials: Several clinical PPCI trials were carried out in our division throughout the period of study (Steg et al., 2012). The analysis includes participants and methods from these studies. 367 STEMI patients out of 934 were enrolled in controlled clinical studies.

Endpoints Data Completion: The study's end-points were time and reasons of death as recorded in health records, the National Patient Registry, the Centralized Civil Registration System for Denmark, and the Cause of Mortality Registry. Every individual was categorized as either dead or alive. Within two weeks of receiving notice of a death, the Centralized Civil Registration System records the incident. It is exceedingly improbable that any deaths would be missed from our study because the minimum follow-up period was 3 months. Patients who migrated (n = 8) were monitored up till the day of their departure.

Mortality Rate Classification: All deceased patients' records were examined by two doctors, who independently determined the causes of death. When there was any uncertainty or disagreement, a third doctor evaluated the records and debated them until the reason behind death was found.

The reason behind death was divided into one of the two categories—cardiovascular or noncardiovascular - that are mutually exclusive. Anoxic brain injury following cardiac arrest, sudden death, new AMI, life threatening arrhythmias (Heart rhythm problem, Abnormal heart rhythm (arrhythmia), or AV, or heart failure were all subclassified as cardiac causes. Cardiac death was known as cardiac sudden death (Arena et al., 2007). A sudden loss of consciousness after several cardiac causes within one hour after the onset of potential cardiac symptoms was referred to as sudden cardiac death. Any death, even those that happened while a person was asleep, that couldn't be firmly linked to a noncardiac cause was labeled as cardiac. The fatality in a person with reinfarction was categorized as death as a result of reinfarction. Unknown death causes were categorized based on the files that were accessible. For instance, the reason for death would be listed as pneumonia if a patient was receiving antibiotics for bronchitis, and stroke would be recorded as the cause of mortality if a patient had recently suffered a stroke. Depending upon whether they were linked to the initial infarction, or reinfarction, or were unrelated to infarcts, malignancy rhythms, cardiac arrhythmias, and ventricular rupture were separated into subgroups.

The information in the available files was insufficient to determine the precise cause of death for 19 patients. The death

certificates for 7 of these individuals were absent. These victims fell under the category of sudden cardiac arrest.

Patients Excluded: The only STEMI patients (n = 28) not included in the research were those who had no CPR code.

Statistical Evaluation: Statistical analysis was performed using IBM SPSS. The mean, standard deviation (SD), average, and interquartile are used to define statistical parameters, and probabilities are calculated as a percentage, when necessary. Using all accessible follow-up information from the STEMI, all outcomes were examined either until mortality, migration, or the study's conclusion date in August 2021. For individuals, Kaplan Meier curves were created to depict death rates over time. Factors related to the time to all cause death in the multivariate regression Cox linear regression (p less than 0.1) were added to the univariate Cox regression model, resulting in the participation of 1286 patients in this model, except for high blood pressure and BMI (proportion of omitted values greater than 6 per cent). A 2-tailed p-value of 0.05 or lower was deemed to be significant.

RESULTS

28 out of 1430 consecutive STEMI patients at the National Institute of Cardiovascular Diseases in Karachi who received initial PCI were disqualified (without a CPR code). As a result, 934 sufferers were enrolled in the study, with an average age of 60.5 ± 11.2 years. The median amount of time between the beginning of the symptoms as well as the onset of the PPCI operation was 230 minutes (interquartile range: 160 to 340 minutes). The table below lists potential risks, emergency system latencies, TIMI flow in the vessels that caused the MI, the number of vessels fixed, concurrent medical therapy, as well as other operational data.

Table 1: Procedural Characteristics of Patients (N = 934)

Variables	N (%)	Total Cases, N (%)
Age, years	60.5 ± 11.2	934 (100)
Women	266 (28.6)	934 (100)
High Blood Pressure Levels	266 (33.7)	793 (84.9)
High Blood Cholesterol	158 (32.6)	489 (52.6)
Current or ex-smoker	590 (78.4)	750 (80.5)
Diabetic Person (Type 1 and 2)	141 (15.1)	934 (100)
History of Cardiovascular Disease	36 (3.6)	934 (100)
Killip class 1/2/3/4, (Percentage)	29/2/0.6/1.6	883 (94.6)
BMI, kg/m^2	25.1 ± 5.1	384 ± 14
Average time delay, minutes (24th to 70th percentile)		
1st Medical Contact of Patient	42 (65–240)	511 (54.5)
Paramedic Services	20 (32–90)	524 (56.2)
Onset of Percutaneous coronary intervention (PCI)	77 (159–345)	511 (54.7)
Targeted Coronary Artery		934 (100)
Anterior interventricular branch	524 (44.6)	—
LCX	156 (13.4)	—
Right Coronary Artery	481 (40.7)	—
LM	13 (1.3)	—
Keyhole Surgery	4 (0.1)	—
CABG	1 (0.1)	—
Number of Problems Focused		934 (100)
Focus on 1 problem	732 (78.5)	—
Focus on 2 problems	165 (17.5)	—
Focus on 3 problems	30 (3.1)	—
Greater than 3 problems	7 (0.2)	—
Culprit artery		934 (100)
Anterior interventricular branch	432 (46.1)	—
LCX	113 (12.0)	—
Right coronary	377 (40.1)	—
LM	11 (0.8)	—
Keyhole Surgery	8 (0.9)	—
CABG	1 (0.1)	—
Flow of the Culprit Vessel		
TIMI Flow (Before 0/I/II/III, (Percentage)	22/3/5/4	932 (99.7)
TIMI Flow (After 0/I/II/III, (Percentage)	1/1/2/30	933 (99.8)
Treatments		934 (100)
PTCA	98 (10.6)	—
Stent	835 (89.6)	—
Peripheral or Coronary Stent	418 (44.7)	—
Bare Metal Stent	417 (44.7)	—
No use of balloon/stent	2 (0.1)	—
Large Balloon, mm	1.1 ± 0.2	907 ± 47.7
Maximum Pressure of Balloon, atm	5.3 ± 1.1	908 ± 47.2
Procedural Medicine		918 (98.3)
Plavix	838(91.6)	—
Acetylsalicylic Acid	857 (93.5)	—
GP IIIa/IIb inhibitor	554 (60.5)	—
Angiomax	28 (3.1)	—

Values are expressed as mean and standard deviation or n (percentage).

101 individuals passed away over the follow up of about 8 months. The equivalent cardiac death rates were 7.1 per cent, 8.1 per cent, and 13.1 per cent, correspondingly, whereas the 30 day, 1-month, and 6-month all-cause fatality rates were 7.8 per cent and 23.5 per cent 11.5 percent, respectively. The ten day and twenty-day all-cause fatality rates were 6.4 per cent and 5.6 per cent, respectively, while the average hospital stay time was 5 days.

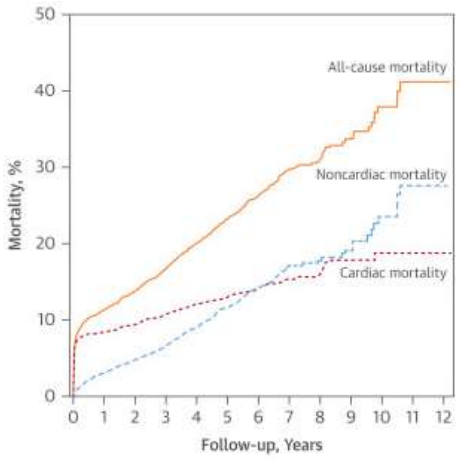
Table 2: Major Reasons Behind Death

Main Subgroups & Groups	Main Groups	Sub-groups	Average Time to Death
Cardiovascular			
Hypotension and Multiorgan Failure	46 (19.6)		1 (0 to 2)
Cardiac shock		41 (17.2)	1 (0 to 2)
Cardiac shock: Ventricular septal rupture (VSR)		3 (1.3)	3 (0 to 2)
Pericardial Tamponade		2 (1.1)	0 (0 to 3)
Cardiac Accident	37 (15.6)	37 (15.6)	355 (155 to 602)
Heart Attack	15 (6.4)		75 (2 to 365)
Heart Attack		8 (3.3)	100 (28 to 448)
Cardiac shock		6 (2.7)	2 (1 to 263)
Cardiac shock: Ventricular septal rupture (VSR)		1 (0.3)	366
Bradycardia (Infarction)		1 (0.3)	3
Tachycardia		1 (0.1)	468
Heart Failure	9 (4.1)		239 (16 to 413)
Cardiogenic shock		2 (0.9)	171 (14 to 451)
Pulmonary Congestion		5 (2.3)	253 (to 485)
Chronic heart failure		3 (1.3)	279 (46 to 406)
Hypoxic-anoxic injury	7 (3.3)	7 (3.3)	2 (2 to 5)
Other Heart Problems	6 (2.9)		310 (183 to 406)
Unspecified Heart Problems		2 (0.8)	219 (144 to 341)
IHD		3 (1.6)	310 (33 to 427)
Tachycardia		1 (0.3)	572
Arrhythmias	4 (1.6)		1 (0 to 3)
Ventricular tachycardia		1 (0.6)	1 (0 to 3)
Bradycardia		2 (0.9)	1 (1 to 11)
Electromechanical Dissociation		2 (0.9)	1 (0 to 2)
Vascular			
Hemorrhagic Stroke	14 (5.6)	14 (5.7)	255 (47 to 484)
Dissecting abdominal aortic aneurysm	3 (1.5)	3 (1.5)	438 (195 to 709)
Peripheral Artery Disease	3 (1.2)		199 (2 to 465)
Mesenteric ischemia		2 (0.6)	3 (1 to 225)
Peripheral arterial disease		1 (0.5)	504
Pulmonary Embolism	2 (0.6)	2 (0.9)	594 (469 to 868)
Non-cardiovascular			
Cancer and tumors	41 (17.5)	41 (17.5)	395 (240 to 563)
Other Reasons	27 (11.5)		207 (55 to 705)
Peritonitis		4 (1.9)	180 (20 to 481)
Septicemia		6 (2.7)	408 (252 to 460)
MOF		2 (1.2)	24 (9 to 471)
Others		14 (5.8)	208 (55 to 458)
Respiratory Tract Infection	22 (9.2)		366 (179 to 657)
Pneumonia		17 (7.2)	330 (266 to 990)
ARDS		3 (2.1)	326 (180 to 583)
Upped GI Bleed	2 (0.8)	1 (0.8)	125 (19 to 434)
All	239 (100)	239 (100)	186 (3 to 467)

Cardiovascular disease was the cause of mortality in 61.4 per cent of cases (n = 221) and noncardiovascular disease in 38.5 per cent of cases (n = 137). Cardiac hypertrophy accounted for 19.5% of all deaths within the first 30 days, anoxic brain injury

accounted for 3.2 per cent of all fatalities, and pathological arrhythmias accounted for 1.6 per cent. After 30 days, non-cardiac conditions were held responsible for 64.6 per cent of mortalities; after 30 days, reinfarction (6.4 per cent) and vascular diseases (5.4 per cent) were the leading causes of death; after 30 days, CHF (4 per cent), acute respiratory infections (9.0%), unexpected cardiac death (15.4 per cent), and carcinoma and malignancies (17.2 per cent) were the leading causes of death.

The median or n (Percentage) for values (interquartile range): After one-month, cumulative survival curves revealed yearly cardiac fatality rates of less than 1.5 per cent. Anoxic brain injury following cardiogenic shock and cardiac mortality from cardiogenic shock (median 1 day) was found to be related in both the time of death analysis (median 6 days).



Source: (Andersen et al., 2003)

DISCUSSION

Larger randomized clinical trials contrasting invasive method and fibrinolysis and analyzing various medicinal regimes and accessible site techniques in chosen individuals provide a clear description of the pattern of both early and long-term death after STEMI in the age of PPCI (Ripa et al., 200). In the current investigation, we concentrated on providing a thorough account of the immediate and long-term causes of death in a sizable cohort of recurrent STEMI patients who underwent primary PPCI (Sejersten et al., 2009).

In our all-comers cohort, cardiovascular mortality was higher above 7 per cent during the 1st month, as should be predicted. The main causes of death in the index incident were cortical anoxia following cardiogenic shock, cardiac arrhythmias, and malignancy rhythms. Cardiac death rate did, however, significantly decline after the first month (to less than 1.5 percent per year), suggesting that patients who lived in the acute stage of STEMI treated with PPCI have a late cardiac diagnosis and that the late cardiovascular death rate in unchecked all-comers is comparable to that of selected respondents of prior trials (Lnborg et al., 2013). Our findings support focusing resources, especially in the initial stages of a STEMI, on the treatment and prevention of cardiac problems.

Our results also highlight the significance of carefully interpreting experimental studies that concentrate on how various treatment approaches affect long-term medical outcomes. It might be necessary to employ large patient sample sizes to demonstrate any differences in therapeutic effects because late cardiac mortality may be quite low (Montalescot et al., 2009). However, investigations of death causes are constrained by the challenges of determining the precise cause of the death, especially in those with MOF and in patients who reported dead. Noncardiovascular death is also likely to be influenced by cardiovascular illness (Thiele et al., 2012). Therefore, it would appear justified to continue to concentrate on all-cause death rates in STEMI patients undergoing modern invasive and medicinal treatment. It's interesting to note that, as the Study of Platelet Inhibition and Patients Outcomes researchers have shown (Valgimigli, et al., 2012). By changing treatment protocols, it appears that mortality can still be affected even one month afterwards. In contrast to our cohort, less than 75 per cent of STEMI patients in that trial had PCI within 12 hours of the beginning of symptoms.

Our data also revealed that noncardiac causes of mortality were uncommon early after STEMI treated with PPCI but much more frequent later, and that these latter noncardiac causes of death were mostly attributed to malignancy and lung diseases, including bronchitis. Studies have shown that those who habitually smoke had a better prognosis for recovering from an AMI, and the majority of our patients had a history of smoking. Smokers are known to be at an increased likelihood of developing lung cancer as well as other ailments in the coming years. The low early cardiac mortality and late non-cardiac death in our study may make this question significant but our data do not allow us to determine the percentage of regular smokers, and current research does not suggest that there is a "smoker's dilemma" (Patel et al., 2012).

Patients in randomized clinical trials examining potential advancements in the standard PCI method, trials with various criteria for inclusion, and trials with various 30-day and 6 months fatality rates (Wallenti et al., 2009). PPCI has since been made available to all STEMI sufferers, regardless of their age, socioeconomic situation, or place of residence. To facilitate field triage, every ambulance and helicopter is capable of performing electroencephalography and telehealth transmission of electrocardiography of all patients suffering from acute heart problems to the local PCI center. These services may assist in explaining why the mean time delays to primary PCI in our investigation were minimal, given the study's small geographic scope and well-developed infrastructures.

In this study, cardiac hypertrophy and its aftereffects, such as various organ dysfunction syndromes, were the primary cause of cardiac death (Mehran et al., 2009). Despite effective revascularization and using an intra-aortic balloon pump, hypotension affects 5 per cent to 10 per cent of patients suffering from acute myocardial infarction and is still highly related to mortality (Nielsen et al., 2010). The unknown is whether a left ventricular assist device that revives heart function in patients with hypotension will increase cardiac recovery and decrease early cardiac death when employed as a bridge to efficient reperfusion in the acute stage of myocardial infarction. It is recognized that percutaneous left ventricular assist devices rarely recover heart function (Keeley et al., 2003). Modern thrombolytic treatments may tend to raise the likelihood of bleeding problems at the expense of reducing all-cause mortality in the early stages of a STEMI. Future surveys will clarify whether these early improvements will lead to an increase in long-term outlooks or whether they will be offset by other issues.

Limitations of the Study: The reliability of procedural data was generally high, although lag time and other potential risk data were less comprehensive, which could affect the survival analysis's findings (Bjarnason-Wehrens, 2010). Therefore, the multivariate survival analysis didn't include all the high blood pressure or BMI in order to minimize the possibility of bias from incomplete data.

Conclusions: After PPCI, the first month is the most common time for cardiac fatalities. Hypotension, anoxic brain injury brought on by cardiac arrest, and malignant arrhythmias are the leading causes of premature mortality. Cardiovascular mortality drops to less than 1.5 per cent after one month. The late fatalities in these individuals are caused by non-cardiac reasons.

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