IN HOSPITAL OUTCOME OF PATIENTS WITH ACUTE ST-ELEVATION MYOCARDIAL INFARCTION REQUIRING TEMPORARY TRANSVENOUS PACING

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ABSTRACT

Background: Acute myocardial infarction continues to be a major public health problem worldwide. Temporary pacing is needed in various situations of myocardial infarction. **Objective:** To determine in hospital outcome (electrical and mechanical complications) of acute myocardial infarction (MI) patients requiring temporary transvenous pacing. **Patients and Methods:** This descriptive case series was conducted at the Cardiology Department of the Punjab Institute of Cardiology, Lahore from October 2007 to April 2008.One hundred patients presenting with acute chest pain consistent with acute myocardial infarction, typical ECG changes and raised serum markers of myocardial infarction and requiring temporary pacing during their hospital stay were included. **Results:** A total of 100 patients were included in study. The mean age of the study population was 49.9±7.5 years. There were 85% males and 15% females. Majority of patients 66% were smokers. Diabetes mellitus and hypertension was observed in 45% patients. Mean duration of onset of symptoms till arrival at the hospital was 8.2±4.6 hours. Majority of patients 65% had inferior wall myocardial infarction (IWMI), 3% patients had IWMI with right ventricular MI. Extensive anterior wall myocardial infarction (AWMI) was observed in 25%. Anteroseptal wall MI occurred in 7% of patients. Streptokinase was used for thrombolysis in 76% patients. First degree heart block was noted in 2% patients at arrival. Second degree Mobitz type 1 occurred in 1% and Mobitz type 2 in 4%. Third degree or complete heart block was noted in 31% patients. Right bundle branch block with left anterior fascicular block occurred in 3% and trifascicular block in 4%. During hospital stay, complete heart block occurred on 1st post MI day in 55% patients, and on 2nd post MI day in 3% patients. Temporary pacemaker was implanted in 40% of patients at presentation, in 57% of patients on 1st post MI day and in 3% on 2nd post MI day. In-hospital mortality occurred in 8%, ventricular tachycardia in 29%, ventricular fibrillation in 2% and asystole in 2% patients. **Conclusion:** Complete heart block in patients with ST-Elevation myocardial infarction requiring temporary pacing is accompanied by a worse early prognosis. A more aggressive therapeutic approach aimed to reduce early mortality seems warranted in these patients.

Key words: Acute myocardial infarction, complete heart block, temporary transvenous pacing, in-hospital mortality, mechanical complications, electrical complications.

INTRODUCTION

Despite revolutionary achievements in diagnosis and management over the last three decades, acute myocardial infarction continues to be a major public health problem in the developing World.[1] It has been projected that by year 2020, cardiovascular disease will be the leading cause of death worldwide.[2] In the United States, nearly 1.5 million patients annually suffer from acute myocardial infarction.[3]

Temporary transvenous endocardial pacing was first described by Furman and Robinson in 1958.[4] Although there are several types of temporary cardiac pacing (transcutaneous, transesophageal), the most widely used is transvenous, i.e., peripheral venous puncture and placement of an electrode in the right sided chambers. This type of pacing has been employed since the 1960s, when it was first used in patients with permanent arrhythmias.[5] Temporary artificial pacing is indicated in various situations, particularly in patients with severe bradyarrhythmia (second- or third-degree atrioventricular block, or severe symptomatic bradycardia).[4,5] Bradyarrhythmias during the first few hours after an acute inferior myocardial infarction are responsive to atropine. If the patient has hemodynamic instability, worsening ischemia, or ventricular arrhythmias, a temporary pacemaker should be used. Conduction abnormalities associated with acute inferior myocardial infarction resolve within two weeks, and permanent pacing is not required.[6]

In the setting of inferior MI, the incidence of second or third degree heart block can be as high as 28%. The development of atrioventricular block (AVB), particularly in anterior MI, has been shown to confer higher in-hospital and long-term mortality. Atrioventricular block in the setting of inferior MI is also associated with higher in-hospital mortality.[7,8] The mortality associated with complete heart block (CHB) in anterior myocardial infarction, with or

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without preceding right bundle-branch block and left fascicular block, may be as high as 80 percent.[7] Patients with AMI who developed CHB had higher in-hospital death rates than those who did not develop CHB.[8-13] This mortality rate is largely related to progressive pump failure as a result of extensive myocardial necrosis. A temporary pacemaker should be placed in patients with anterior infarction and right bundle-branch block with left anterior or left posterior fascicular block if there is associated PR prolongation.[6]

Although the presence of atrioventricular block is thought to imply greater mortality in these patients, death is usually related to the infarct size rather than the conduction disorder.[14] The use of temporary pacing in acute myocardial infarction therefore deserves special attention.[14] Temporary pacing is used in situations of extreme emergency, and the devices are frequently implanted in older uncooperative patients. Implantation is typically accompanied by hemodynamic and/or electric instability that sometimes does not allow perfect placement, thus resulting in greater morbidity and mortality.[4] In Pakistan, mortality of acute myocardial infarction has been studied previously[15-17] but little data is available about outcome of patients with acute myocardial infarction requiring temporary transvenous pacemaker due to symptomatic 2nd or 3rd degree atrioventricular blocks. In this study, we evaluated the in hospital outcome of patients with acute ST elevation myocardial infarction requiring temporary pacemaker. This study would help the clinicians to incorporate the use of temporary pacemaker in their patients.

PATIENTS AND METHOD

This descriptive case series was conducted at the Cardiology Department of the Punjab Institute of Cardiology, Lahore from October 2007 to April 2008. One hundred patients presenting with acute chest pain consistent with acute myocardial infarction, typical ECG changes and raised serum markers of myocardial infarction and requiring temporary pacing during their stay hospital were included.

Patients presenting with acute myocardial infarction fulfilling the following criteria during their hospital stay were enrolled, for temporary pace maker.

1. Patients having 2nd (Mobitz II) or 3rd degree AV block.
2. Patients having systolic blood pressure of less than 90 mm Hg.
3. Patients having symptomatic bradycardia.
4. Age range: 20-60 years including both genders.
5. Patients having Non ST elevation myocardial infarction.

Acute myocardial infarction was defined as, patients presenting with chest pain with the presence of any of the following two criteria.[10]

1) Chest pain consistent with myocardial infarction.

2) Electrocardiographic changes i.e. ST-Segment elevation >2 millimeters in at least two contiguous chest leads or >1 millimeters in at least two contiguous limb leads.

3) New or presumably new left bundle branch block on electrocardiogram.

4) Raised levels of cardiac enzymes: creatine phosphokinase more than double and MB band above normal values.

Data collection procedure:

A detailed history was taken including age, sex, occupation, address, history of smoking, diabetes mellitus, hypertension, ischemic heart disease and family history of ischemic heart disease were recorded on a proforma. Time from onset of symptoms till arrival at the hospital was noted. Complete physical examination was done with emphasis on pulse, blood pressure, precordial examination and signs of congestive cardiac failure. ECG and X-ray chest was done in all patients. Site of myocardial infarction and medications given especially streptokinase was noted for all the patients. Laboratory tests like CK-MB levels, serum creatinine level, urea level, serum sodium and potassium levels and random blood sugar levels were done and noted for all patients. Keeping in view patients' clinical condition and ECG indications for temporary pacing a temporary pacemaker was implanted. Prior to pacemaker implantation all patients were given injection atropine up to 3 mg in divided doses intravenously for restoration of sinus rhythm.

During hospital stay detailed transthoracic echocardiography of all patients was done. Patients were followed up daily and pulse, blood pressure, ECG changes, temporary pacemaker status and complications were monitored till discharge or death

of the patient. Duration of pacemaker dependence was noted for each patient. Hospital stay on individual patient was also noted.

In hospital outcome was, in hospital mortality and mechanical complications like ventricular septal rupture, mitral regurgitation, left ventricular pump failure and ventricular aneurysm or pseudoaneurysm or electrical complications like ventricular tachycardia and ventricular fibrillation or asystole in patients of acute ST elevation myocardial infarction.

All the data was analyzed by using SPSS version 10.0. Categorical variables like gender, presence/absence of diabetes mellitus, hypertension, family history of ischemic heart disease, in-hospital mortality and mechanical complications (ventricular septal rupture, mitral regurgitation, left ventricular pump failure and ventricular aneurysm or pseudoaneurysm) and electrical complication (ventricular tachycardia and ventricular fibrillation or asystole) during hospital stay were expressed as frequency and percentages. Continuous variables like, age, time from onset of symptoms till arrival at the hospital and duration of hospital stay were expressed as mean±SD (Standard deviation).

RESULTS

The mean age of the study population was 49.9±7.5 years. There were 85% males and 15% females. Diabetes mellitus and hypertension was observed in 45% of patients. Majority of patients 66% were smokers. (Table I).

Mean duration of onset of symptoms till arrival at the hospital was 8.2±4.6 hours. Majority of the patients 65% had inferior wall myocardial infarction. 3% patients had IWMI with right ventricular infarct. Extensive AWMI was observed in 25%. Anteroseptal wall MI occurred in 7%. Streptokinase was used for thrombolysis in 76% patients. (Table II).

First degree heart block was noted in 2% of patients at arrival. Second degree Mobitz type 1, in 1% and Mobitz type 2 in 4%. Third degree complete heart block was noted in 31% patients. Right bundle branch block with left anterior fascicular block in 3% and trifascicular block in 4%. (Table II).

Mean creatine phosphokinase level noted at presentation was 1714 ± 1197.5. CK-MB band was 184.6 ± 118.8. Serum sodium 139.4 ± 3.9, serum potassium 4±0.5, serum urea 40±17.9, serum creatinine 1±0.3 and random blood sugar level was 194±106.2. (Table II).

Complete heart block developed on 1st post MI day in 55% patients, and in 3% on 2nd post MI day. Trifasicular block developed on first post MI day in 1% patient.(Table III). Temporary pacemaker was implanted in 40% patients at presentation, on 1st post MI day in 57% of patients and on 2nd post MI day in 3% patients. (Figure I).

Duration of temporary pacemaker dependency (TPM) was noted for one day in 2%, three days in 2%, 4 days in 15%, 5 days in 53% and 6 days in 26% patients. 2% patients proceeded for permanent pacemaker. The mean duration of TPM dependency was 5.03±0.95 days. (Table III).

Regarding outcome of study population, in-hospital mortality was noted in 8%, ventricular tachycardia in 29%, of these 10% patients had sustained VT requiring DC cardioversion while 19% had non sustained VTs. (Table IV). Ventricular fibrillation was noted in 2% and asystole in 2% patients. Pre discharge echo showed normal LV function in 2% patients, mild systolic LV dysfunction in 35%, moderate LV systolic dysfunction in 53% and severe LV systolic dysfunction in 10% patients. (Table IV) Ventricular septal defect, mitral regurgitation, aneurysm, pseudoaneurysm and ventricular free wall rupture were not noted in any patient.

Table I. Baseline demographics of the study population.

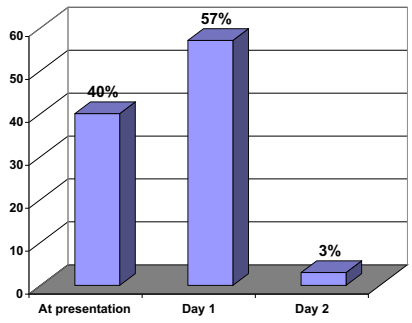
Characteristics	Number (%age) n=100
Mean age (years)	49.9 ± 7.5
Male Female	85(85%) 15(15%)
DM	45(45%)
Hypertension	45(45%)
Smoking	66(66%)
Hyperlipidemia	6(6%)
Family history of IHD	32(32%)
History of IHD	5(5%)

Table II. Presentation characteristics of the patients

Characteristics	Number (%age) n=100
Duration of onset of symptoms (mean hours)	8.2 ± 4.6
Site of Myocardial Infarction	
Extensive AWMI	25(25%)
ASMI	7(7%)
IWMI	65(65%)
IWMI+ Right Ventricle	3(3%)
Streptokinase	76(76%)
HEART BLOCK	
First Degree	2(2%)
Second Degree	
Mobitz I	1(1%)
Mobitz II	4(4%)
Third Degree (CHB)	31(31%)
RBBB+LAFB	3(3%)
Trifascicular Block	4(4%)
LABORATORY PARAMETERS	
Cardiac Enzymes	
Creatine phosphokinase	1714 ±1197.5
CK-MB	184.6 ±118.8
Serum Sodium	139.4 ± 3.9
Serum Potassium	4 ± 0.5
SerumUrea	40 ±17.9
Serum creatinine	1 ±0.3
Serum random blood sugar	194 ±106.2

AWMI=Anterior wall myocardial infarction; ASMI=Anteroseptal wall myocardial infarction; IWMI=Inferior wall myocardial infarction.
CHB=Complete heart block; RBBB=Right bundle branch block; LAFB=Left anterior fascicular block; CK-MB= Creatine phosphokinase myocardial band.

Figure I. Time of temporary pacemaker implantation.



Day 1= Day 1 post MI; Day 2= Day 2 post MI

Table III. Heart Blocks occurring during admission

Heart Blocks	Number (%age) n=100
CHB	
1st post MI day	55(55%)
2nd post MI day	3(3%)
Trifascicular block	1(1%)
Duration of TPM Dependency	
1 day	2(2%)
3 days	2(2%)
4 days	15(15%)
5 days	53(53%)
6 days	26(26%)
Proceeded to PPM	2(2%)

CHB=Complete heart block; TPM=Temporary pacemaker; PPM=Permanent pacemaker.

Table IV. Outcome of the study population

Outcome	Number (%age) n=100
In hospital mortality	8(8%)
VT	29(29%)
VF	2(2%)
Asystole	2(2%)
LV FUNCTION	
Normal EF (55-75%)	2(2%)
Mild Systolic dysfunction EF(40-55%)	35(35%)
Moderate systolic dysfunction EF(30-40%)	53(53%)
Severe systolic dysfunction EF(<30%)	10(10%)

VT=Ventricular tachycardia; VF=Ventricular fibrillation.
LV=Left ventricular; EF= Ejection fraction.

DISCUSSION

Despite revolutionary achievements in diagnosis and management over the last three decades, acute myocardial infarction continues to be a major public health problem in the developing world.[1] The development of atrioventricular block (AVB),

particularly in anterior MI, has been shown to confer higher in-hospital and long-term mortality. Atrioventricular block in the setting of inferior MI is also associated with higher in-hospital mortality.[7,8] The mortality associated with complete heart block in anterior myocardial infarction, with or without preceding right bundle-branch block and left fascicular block, may be as high as 80 percent.[7] Patients with AMI who developed CHB had higher in-hospital death rates than did those who did not develop CHB.[8-13] This mortality rate is largely related to progressive pump failure as a result of extensive myocardial necrosis. A temporary pacemaker should be placed in patients with anterior infarction and new right bundle-branch block with left anterior or left posterior fascicular block if there is associated PR prolongation.[6] Although the presence of atrioventricular block is thought to imply greater mortality in these patients, death is usually related to the infarct size rather than the conduction disorder.[14] The use of temporary pacing in acute myocardial infarction (AMI) deserves special attention, since the risk-benefit ratio is not well defined in these cases.

In the current study the majority of patients were male, diabetic, hypertensive and smoker. Inferior wall myocardial infarction was more frequent than anterior wall myocardial infarction. Streptokinase was used for thrombolysis in 76% patients. During hospital stay complete heart block developed on 1st post MI day in 55% patients followed by 3% on 2nd post MI day. Temporary pacemaker was implanted in 40% of patients at presentation, in 57% of patients on 1st post MI day and in 3% on 2nd post MI day. In-hospital mortality was 8%. Our results are consistent with previous studies.[7-13]

A large community-based study[8] consisting of 13,663 residents of the Worcester reported that the average age of the hospitalized study sample was 69 years, and 58% were men. The overall proportion of patients with AMI who developed CHB was 4.1%. The incidence rates of CHB complicating AMI declined appreciably over time, with the greatest decline in these incidence rates occurring during the most recent years under study. In 2005, 2% of patients hospitalized with AMI developed CHB compared to 5.1% in the initial study year of 1975. Patients with AMI who developed CHB had higher in hospital death rates (43.2%) than did those who did not develop CHB (13%).

An observational study[9] of 9082 reported overall, CHB developed in 5% of patients with AMI. The incidence rates of CHB declined in the periods studied. Declines in the occurrence of CHB were noted in patients with anterior or inferior/posterior MI. These trends remained after adjustment for other factors that might affect the risk of CHB. Patients in whom CHB developed experienced significantly higher hospital death rates than patients in whom CHB did not develop (46.8% vs 14.6%).

Archbold et al[12] have documented the frequency of conduction defects and their influence on prognosis in a large consecutive series of patients with acute myocardial infarction, over 70% of whom received thrombolytic therapy. Conduction defects at various sites within the conduction system were considered. Block at the atrioventricular node occurred almost exclusively in inferior infarction, while block involving the bundle branches was more common in anterior infarction and also in patients with diabetes, previous infarction, Q-wave infarction, anterior infarction and left ventricular failure, all of which are usually associated with severe myocardial injury. This relationship between infarct severity and conduction defects was supported by the enzymatic data, peak creatinine kinase providing a useful measure of cumulative enzyme release and the extent of myocardial necrosis.

The adverse effect of conduction defects on prognosis was presumably a result of their association with extensive myocardial injury. The mortality risk was increased for all types of conduction defects, being greatest for patients with severe involvement of the bundle branches. Thrombolytic therapy was given to over 70% of our patients and the data do suggest a small reduction in the frequency of conduction defects. Nevertheless, a recent analysis of 681 patients enrolled in the Global Utilization of Streptokinase and t-PA for Occluded Arteries (GUSTO) and Thrombolysis and Angioplasty in Myocardial Infarction (TAMI) trials reported a lower occurrence of persistent bundle branch block compared with previous studies, a finding attributed to the benefits of thrombolytic therapy.[18] Our data permit a similar conclusion, although because they are derived from large series of consecutive, non-selected patients with acute myocardial infarction they provide a more robust measure of the frequency of conduction defects than

can be obtained from clinical trial data. The probability is, therefore, that the consistent reductions in the frequency of the defects compared with earlier studies reflect parallel reductions in the severity of myocardial injury with the use of thrombolytic therapy.

Complete heart block complicating anterior AMI is usually within the His-Purkinje system and is related to interruption of septal perfusion accompanied by extensive myocardial damage and significant left ventricular dysfunction.[11] In inferior AMI, complete heart block usually involves the supra-Hissian atrioventricular junction due to hypoperfusion of the atrioventricular nodal artery. The reperfusion of the infarct related artery should conceivably reduce the incidence of complete heart block in both anterior and inferior infarctions. One possible mechanism may be vagally mediated complete heart block, which has been suggested as a sign of successful reperfusion.[11] This results from restoration of flow that facilitates leukocyte migration to the infarcted area, stimulating vagal innervation within the infarcted myocardium. Additionally, complete heart block may occur as a consequence of reocclusion following successful reperfusion (occurring in 14% of complete heart block patients in the TAMI trial).[18] Finally, reperfusion injury may further hamper the conduction system; reperfusion was a precipitating event in 10% of complete heart block patients in the TAMI trial.[18] Atrioventricular block is a common complication of acute MI. Despite the use of thrombolytic therapy and the increasing use of efficacious therapies, AVB in the setting of acute MI is associated with a high risk of short- and long-term mortality. Future studies designed to evaluate potential treatments for AVB in the setting of acute MI should be undertaken.

CONCLUSION

Complete heart block is accompanied by a worse early prognosis. Use of a temporary pacemaker for symptomatic patients of complete heart block reduces early mortality of acute myocardial infarction. A more aggressive therapeutic approach aimed to reduce early mortality seems warranted in these patients.

REFERENCES

1. Okrainec K, Benerjee D K, Eisenberg MJ. Coronary Artery Disease in the developing world. AHJ. 2004; 148: 7-15.
2. Popma JL. Coronary arteriography and Intravascular Imaging. Libby: Braunwald's Heart Disease: A textbook of Cardiovascular Medicine, 8th Edition. Libby P, Bonow RO, Mann DL, Zipes DP. Eds. Saunders Elsevier. Philadelphia. 2007: 465-501.
3. Rosamond W, Flegal K, Furie K, Go A, Greenlund K, Haase N, et al for the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart Disease and Stroke Statistics2008 Update A Report From the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Circulation. 2008; 117:e25-e146.
4. Ayerbe JL, Sabaté RV, García CG, Leor OR, Pérez MG, Abadal AC, et al. Temporary Pacemakers: Current Use and Complications. Rev Esp Cardiol. 2004; 57: 1045 - 1052
5. Gregoratos G, Abrams J, Epstein AE, Freedman RA, Hayes DL, Hlatky MA, et al. ACC/AHA/NASPE 2002 guidelines for implantation of cardiac pacemakers and antiarrhytmia devices: Circulation. 2002;106:2145-2161.
6. Zimetbaum PJ, Josephson ME. Use of the Electrocardiogram in Acute Myocardial Infarction. N Engl J Med . 2003;348:933-40.
7. Meine TJ, Al-Khatib SM,Alexander JH, Granger CB, White HD, Kilaru R, et al. Incidence, Predictors, and Outcomes of High-Degree Atrioventricular Block Complicating Acute Myocardial Infarction Treated With Thrombolytic Therapy. Am Heart J. 2005;149(4):670-674.
8. Nguyen HL, Lessard D, Spencer FA, Yarzebski J, Zevallos JC, Gore JM, et al. Thirty-year trends (1975-2005) in the magnitude and hospital death rates associated with complete heart block in patients with acute myocardial infarction: a population-based perspective. Am Heart J. 2008;156(2):227-33
9. García CG, Abadal AC, Flores JS, Marcos HT, Ruiz AC, Tudela VV. Duration of Complete Atrioventricular Block Complicating Inferior Wall Infarction Treated With Fibrinolysis. Rev Esp Cardiol. 2005; 58: 20 26
10. Spencer FA, Jabbour S, Lessard D, Yarzebski J, Ravid S, Zaleskas V, et al. Two-decade-long trends (1975-1997) in the incidence, hospitalization, and long-term death rates associated with complete heart block complicating acute myocardial infarction: a community-wide perspective. Am Heart J. 2003 Mar;145(3):500-7
11. Harpaz D, Behar S, Gottlieb S, Boyko V, Kishon V, Eldar K, for the SPRINT Study Group and the Israeli Thrombolytic Survey Group. Complete Atrioventricular Block Complicating Acute Myocardial Infarction in the Thrombolytic Era. J Am Coll Cardiol. 1999;34:17218.
12. Archbold RA, Sayer JW, Ray S, Wilkinson P, Ranjadayalan K, Timmis AD. Frequency and prognostic implications of conduction defects in acute myocardial infarction since the introduction of thrombolytic therapy. European Heart Journal. 1998;19:89398.
13. Ben Ameur Y, Mghaith F, Ouchallal K, Hmem M, Terras M, Longo S, et al. Prognostic significance of second and third degree atrioventricular block in acute inferior wall myocardial infarction. Ann Cardiol Angeiol

2003;52(1):152-55.
14. Burns RJ, Gibbons RJ, Yi Q, et al. The relationships of left ventricular ejection fraction, end-systolic volume index and infarct size to six-month mortality after hospital discharge following myocardial infarction treated by thrombolysis. J Am Coll Cardiol. 2002;39:30-6.
15. Abid AR, Khawaja SA, Abbas T, Shahbaz A, Mallick NH, Azhar A. In-hospital outcome of acute myocardial infarction in patients receiving streptokinase. Ann King Edward Med Coll. 2007; 13:73-7.
16. Abid AR, Ali L, Mohyuddin T, Naveed S, Tarin SMA, Azhar A. Acute myocardial infarction; evidence of sex- a g e interaction. Professional Med J. 2006; 16:143-8.
17. Memon NA, Kadir S, Memon AG. Outcome of ST segment elevated versus non-elevated acute myocardial infarction J Liaquat Uni Med Health Sci. Apr. 06;5:3-7.
18. An International Randomized Trial comparing four thrombolytic strategies for acute myocardial infarction. The GUSTO investigators. N Engl J Med. 1993; 329:673.