Time Equals Myocardium: Are We in Time?

S Mohan, S Lynch, TA Cummings

ABSTRACT

Objective: *To determine the door to thrombolysis time of patients who presented to the Adult Priority Care Facility of the Eric Williams Medical Sciences Complex from February 1 – May 31, 2008.*
Method: *The patients who presented to the Adult Priority Care Facility of the Eric Williams Medical Sciences Complex with cardiac type chest pain and ST segment elevation that met the international criteria and had positive troponin test were interviewed and their notes reviewed to obtain the relevant information.*
Results: *Fifty-one patients were treated with ST segment elevation myocardial infarctions; 78.4% were thrombolysed. Patients were: 59.75 years old, 68.6% male and 66.7% were of East Indian extraction. The average time to thrombolysis was 5 hours and 31 minutes from the onset of chest pain. The average door to thrombolysis time was 2 hours and 7 minutes with 20% of patients having a door to thrombolysis time of 30 minutes.*
The time to thrombolysis from the onset of chest pain and the door to thrombolysis times were adversely affected by the health facility to which the patient first presented.
Conclusion: *The majority of patients presented within the thrombolysis window. Early recognition of symptoms of myocardial infarction and arrival at a healthcare facility is not being achieved by the majority of patients. The systems that are responsible for the transport, triage and treatment of patients who present with chest pain are inadequate and require urgent review and overhaul to achieve the goals outlined by the American Heart Association and the American College of Cardiologist.*

Keywords: Myocardium, myocardial infarction, ST segment elevation, thrombolysis

Tiempo Igual a Miocardio: ¿Estamos a Tiempo?

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RESUMEN

Objetivo: *Determinar el tiempo de la puerta a la trombólisis en pacientes que acudieron al Centro de Cuidados de Prioridad del Adulto del Complejo de Ciencias Médicas Eric Williams, el 1ero de febrero a mayo 31 de mayo del 2008.*
Método. *Los pacientes que acudieron al Centro de Cuidados de Prioridad del Adulto del Complejo de Ciencias Médicas Eric Williams, con dolor cardíaco en el pecho, elevación del segmento ST de conformidad con criterios internacionales, y resultados positivos en la prueba de troponina, fueron entrevistados y sus notas examinadas para obtener información relevante.*
Resultados: *Se trataron cincuenta y un pacientes con infartos del miocardio con elevación del segmento ST; 78.4% estaban trombolizados. Las características de los pacientes fueron las siguientes: 59.75 años de edad; 68.6% varones y 66.7% de extracción indo-oriental. El tiempo promedio de la trombólisis fue 5 horas y 31 minutos a partir del comienzo del dolor en el pecho. El tiempo promedio de la puerta a la trombólisis fue 2 horas y 7 minutos, con 20% de los pacientes con un tiempo puerta-trombólisis de 30 minutos. El tiempo de trombólisis desde el comienzo del dolor en el pecho y los tiempos de la puerta a la trombólisis fueron afectados de modo adverso por el centro de salud al que acudieron los pacientes en primer lugar*
Conclusión: *La mayoría de los pacientes se presentaron dentro de la ventana de la trombólisis. El reconocimiento temprano de los síntomas del infarto del miocardio y la llegada a un centro asistencial*

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de salud, es algo que la mayor parte de los pacientes no alcanzan a lograr. Los sistemas que son responsables del transporte, la clasificación y tratamiento de los pacientes que se presentan con dolor de pecho, son inadecuados y requieren revisión urgente y reparación para lograr las metas definidas por la Asociación Americana de Cardiología y el Colegio Americano de Cardiología.

Palabras claves: Trombólisis, miocardio, elevación del segmento ST, infarto del miocardio

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INTRODUCTION

The leading causes of mortality and morbidity in the United States of America are chronic diseases (1). In Trinidad and Tobago, a developing nation, ischaemic heart disease has been shown to be the leading cause of death among adults (2). An acute myocardial infarction is one of the most dramatic and life threatening manifestations of ischaemic heart disease. Reperfusion strategies that focus on the early, effective and persistent re-canalization of the thrombosed vessel in the area of infarcted myocardium are the treatments of choice for patients who present within twelve hours of the onset of symptoms and who have ST segment elevation on their electrocardiograms [ECG] (3–5).

It has been demonstrated that faster times to reperfusion, whether by fibrinolytic therapy (6–8) or percutaneous coronary intervention [PCI] (9–11), and better systems of care are associated with important reductions in the morbidity and mortality rates for patients who have ST segment elevation myocardial infarctions [STEMI] (6–11). The guidelines, published by the American Heart Association (AHA) and the American College of Cardiologist (ACC), recommend a goal of 30 minutes from the time of presentation to the hospital to the administration of fibrinolytic therapy (door-to-needle time) and 90 minutes from the time of presentation to the hospital to the inflation of an angioplasty balloon [door-to-balloon time] (12–13).

This study at the Eric Williams Medical Sciences Complex (EWMSC) will be the first in Trinidad and Tobago to assess the performance of a hospital in achieving the recommended times to reperfusion for patients who present with STEMIs.

SUBJECT AND METHODS

This exploratory study was designed to determine the time it takes a patient who has suffered an ST segment elevation myocardial infarction (STEMI) who presented to the Adult Priority Care Facility (APCF) of the EWMSC from February 1 to May 31, 2008 to obtain thrombolysis. Permission to conduct this study and access patients' notes was sought and obtained from the Ethics Committee and the Medical Chief of Staff of the EWMSC.

A STEMI was defined as ST segment elevation greater than 2 mm in two or more contiguous chest leads or 1 mm in two limb leads in a patient who presented with acute onset of chest pain/shortness of breath with progressively rising creatine kinase MB or a positive troponin result (14–15). Patients were excluded if they had repolarization abnormalities on ECG that mimicked ST elevation, new onset left bundle branch block and those that had chest pain but had negative 12-hour troponin, *ie* angina pectoris.

The population of patients that met the above criteria was invited to participate in the study. Each consecutive patient was interviewed when out of distress and their notes reviewed to determine the times at which: their symptoms first occurred, their arrival to the first point of care (the first medical institution the patient presented to) and thrombolysis was performed. Preceding the interview, informed consent was obtained from each patient. The limitations of this study included patients being unsure of the exact time of onset of their symptoms, the accuracy of the recorded time of arrival and thrombolysis.

Data were analysed using the Statistical Programme for Social Sciences (SPSS) (Chicago, Illinois, version 9.0). Descriptive statistics was used to describe the demographic characteristics of the study population, times to arrival at the EWMSC and door to thrombolysis time. Differences in the mean times to thrombolysis were investigated using chi-squared test, t-test and Kruskal-Wallis test with a significance level of 0.05.

RESULTS

There were a total of fifty-one patients who presented to the APCF of the EWMSC with STEMIs. There were 24 anterior, 25 inferior and 2 lateral wall myocardial infarcts. The demographics of the study population were: average age of 59.75 years (56.9%, < 60 years old; range 38–90 years), 68.6% male, 31.4% female, 66.7% East Indian, 29.4% African and 3.9% were of mixed ancestry. The risk factor profile of these patients was: 51% diabetic, 64.7% hypertensive, 35.3% hyperlipidaemic, 49% were smokers and 19.6% had a strong family history of myocardial infarctions.

Of the patients, 41.2% came directly to the APCF at EWMSC; 23.5% were referred from the Chaguanas Medical Facility, 23.5% from the Arima Medical Facility and the remaining 7.8% from other institutions. The patients arrived at their first point of care either by private vehicle (72.5%) or ambulance (27.5%). For the patients who presented directly to the APCF nine (42.9%) came via ambulance and 12 (57.1%) *via* private vehicle (Fig. 1).

Patients were not thrombolysed as a result of: seven (63.6%) presenting outside of the thrombolysis window, three (27.3%) due to diagnostic uncertainty and one (9.1%)

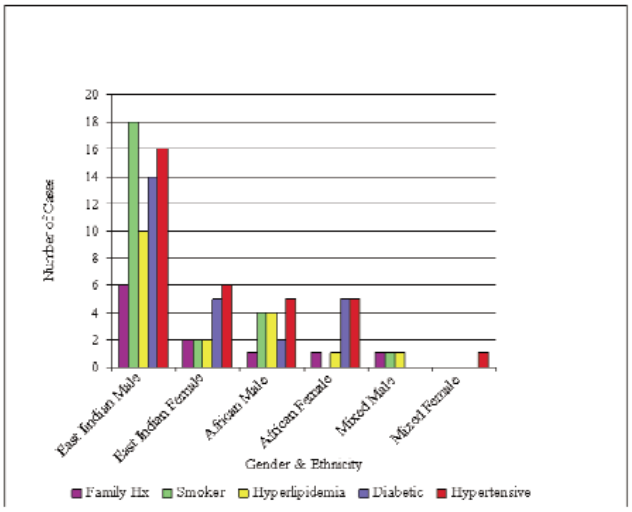

Fig. 1: Graph showing the risk factor profile of patients presenting to EWMSC with STEMI according to gender and ethnicity.

refused. The average time to thrombolysis, regardless of the institution of first presentation, gender, ethnicity and risk factor profile, was 5 hours 31 minutes (± 1 STD 3 hrs 12 minutes) from the onset of chest pain. The average door to thrombolysis time was 2 hours 7 minutes. There were no statistical differences in both the average time to thrombolysis and the door to thrombolysis times for patients of different gender, ethnicity and risk factor profile (Table 1).

Table 1: Showing the demographic profile of the patients who presented to the EWMSC with STEMI

	Number (total = 51)	Age (years)
Gender		
Male	35	57.8
Female	16	64
Ethnicity		
East Indian	34	57.5
Male	6	57.2
Female	8	58.5
African	15	64.9
Male	8	61.3
Female	7	69.3
Mixed	2	59.5
Male	1	48
Female	1	71

The data suggest that patients got to some institutions quicker than others from the onset of symptoms. There is no difference in the time taken to arrive at the thrombolysis centre from the local health institutions, the door to thrombolysis time is affected by the institution the patient first presented to and the length of time it takes a patient to receive thrombolysis, from both the onset of symptoms and from their arrival at a local health centre.

Patients who first presented to an institution other than EWMSC had a significantly longer ($p = 0.02$) average time to thrombolysis from the onset of chest pain (6 hours 41 minutes) than patients who did. The time taken for a patient to obtain thrombolysis, if that patient first presented to a medical facility other than the APCF of EWMSC, from the time of their arrival to that facility to thrombolysis at EWMSC, was significantly longer (4 hours and 1 minute *versus* 1 hour and 30 min, t-test: $p = 0.02$), than for patients who presented directly to the APCF of EWMSC. The average transit time between the first point of care and the thrombolysis centre was 1 hour 56 minutes for patients who did not present to the APCF and were thrombolysed. The average door to thrombolysis time for these patients while longer than that for patients who presented directly to APCF was not statistically significant (2 hours 56 minutes *versus* 1 hour 30 minutes, t-test: $p = 0.173$).

Only 20% of patients had a door to thrombolysis time of the recommended 30 minutes. Whether a patient first presented to EWMSC or to another institution appears to play a role in determining if that patient receives early thrombolysis (6 patients *versus* 2 patients, chi-squared test $p = 0.014$). The number of patients who had a door to thrombolysis time of 90 minutes was 22 (55%).

The analysis of the data also suggest that the institution of first presentation also plays a role in determining if a patient receives early thrombolysis [$p = 0.05$] (Table 2).

Table 2: Showing the location of the STEMI, risk factor profile and mode of arrival to and Institution of first presentation

	Number
Location of MI	
Anterior	24
Posterior	25
Lateral	2
Risk Factor	
Diabetic	26
Hypertension	33
Hyperlipidemia	18
Smoker	25
Family History	19
Institution of First Presentation	
EWMSC	21
Arima	12
Chaguanas	14
Other	4
Mode of arrival	
Ambulance	14
Private Vehicle	37

Other: Couva Health Facility, Caura Chest Hospital and Private Hospitals

Table 3: Showing the average times to arrival at the various institutions form onset of symptoms, time to arrive to EWMSC and time to intervention

First Point Of Care	Average Time (hrs and minutes)				
	Onset of symptoms to arrival at first point of care	To Arrive at EWMSC from first point of care	Door to thrombolysis	Arrival at first point of care to thrombolysis	Symptoms to thrombolysis
EWMSC	1:56†,Ψ	____Ψ	1:30	1:30Ψ	3:34
Chaguanas*	1:49	1:48	3:08	4:10	6:46
Arima*	3:25	2:13	1:40	3:53	7:19
Other*	0:40	1:39	2:05	3:45	4:25
p= (Kruskal-Wallis)	0.036	0.873◊	0.032	0.001	0.006
Overall time	1:45	1:56	2:07	2:19	5:31

Key: † – from the patient's home; Ψ – first point of care EWMSC;
* – patient had to be transported to EWMSC for thrombolysis;
◊ – not inclusive of persons who presented directly to APCF;
Other: Couva Health Facility, Caura Chest Hospital and Private Hospitals.

Table 4: Showing the percentage of patients who were thrombolysed in the recommend time frame.

First Point Of Care	Percentage of patients whose door to thrombolysis time was	
	30 minutes**	90 minutes
EWMSC (n = 15)	**40**	80
Chaguanas (n = 13)	**0**	23.1
Arima (n = 9)	**11.1**	55.6
Other (n = 3)	**33.3**	66.6
p = (Chi-squared)	**0.05**	0.025

**: recommended door to thrombolysis time for fibrinolysis
Other: Couva Health Facility, Caura Chest Hospital and Private Hospitals.

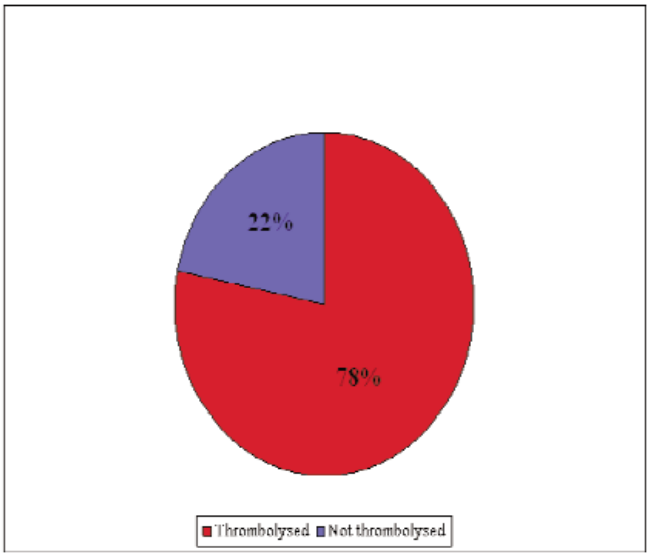

Fig. 2: Pie chart showing the percentage of patients thrombolysed at EWMSC.

DISCUSSION

There is a preponderance of evidence that demonstrates that the time to reperfusion from the onset of symptoms of a STEMI is an important predictor of the infarct size and a key determinant of the morbidity and mortality rate regardless of whether reperfusion was accomplished by fibrinolysis or PCI (12,18–21). Given that the efficacy of fibrinolytic agents in lysing thrombus diminishes with time (12, 22) and fibrinolysis within the first 2 hours (especially the first hour; the so-called "golden hour") can occasionally abort an MI and dramatically reduce mortality (12, 16, 23), every effort should be made to shorten the time from the recognition of symp-toms to contact with the medical system, triage and the receipt of reperfusion therapy (12).

The establishment of and adherence to protocols for the early and prompt recognition, transportation and treatment of acute ST elevation myocardial infarctions is therefore key to reducing the morbidity and mortality (12). The ACC and AHA have proposed guidelines for the transportation of a patient with STEMI and reperfusion treatment (12). These guidelines emphasize: patient education on the signs and symptoms of a myocardial infarction, the rapid transport of patients to reperfusion centres via ambulance**,** the shunting of patients with suspected myocardial infarctions to the last level of triage and immediate implementation of that institution's chest pain protocol. The ACC and AHA have

suggested a total ischaemic time of 120 minutes with a maximum door to reperfusion time of 30 minutes for thrombolysis and 90 minutes for PCI.

At the EWMSC, 40% of patients who present directly to the emergency room are thrombolysed within the recommended time frame, a figure that is comparable to the 46% found in the USA (6). While some of the AHA/ACC recommendations are in place at EWMSC, the fact that overall only 20% of patients are being reperfused in the recommended time period and the long ischaemic times mean that the morbidity and mortality benefits gained from early thrombolysis of a STEMI are not being received by the vast majority of patients. These findings also demonstrate the severe shortcomings of: patient education, the current system of transportation to healthcare facilities, communication, triage and implementation of the chest pain protocol, as well as, need for their urgent review and improvement.

The negative impact of the failure to provide rapid reperfusion on the quality of life, the life expectancy of the relatively young patients (56.9% less than 60 years) and on the economy has yet to be calculated.

If patients who suffer a STEMI are to be effectively and efficiently treated, it is clear that the healthcare system need to be re-engineered to achieve the goals of the ACC/AHA guidelines. Steps that can be adopted include:

- The education of the public to the signs and symptoms of myocardial infarctions and the need to get to an emergency room promptly.
- Adequate numbers of fully equipped ambulances and trained paramedics to facilitate the safe assessment and rapid transport of patients.
- The establishment of a chest pain protocol.
- Advance notification of the staff at the reperfusion centre that a patient with a possible STEMI will be arriving must always be done.
- Adequate staffing of the emergency department.
- A system of continuous, objective and critical examination of the performance of the medical institution needs to be developed. The prompt correction of any deficiency identified by this system needs to be undertaken.

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