Clinical Results of Acute ST Elevation Myocardial Infarction Patients with the Fast Tract Management System in Naresuan University Hospital

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Abstract

Background: Acute ST-elevation myocardial infarction (STEMI) is a life-threatening emergency cardiovascular condition. Mortality is still high in rural region.

Objective: to identify mortality rate and evaluate the clinical outcomes of acute STEMI patients using the fast tract management system at Naresuan University Hospital (NUH)

Material and Method: Descriptive review of clinical parameters from STEMI patients who participated in the fast tract management system

Results: Between Jan 2010 to Sep 2013, 191 STEMI patients were enrolled. The 147 patients (77%) were referrals and 44 patients (23%) were non-referrals. They were predominantly male patients with an average age of 65 years. The risk factors of coronary artery disease (CAD) were dyslipidemia (86.9%), hypertension (61.3%), smoking (51.3%) and diabetes mellitus (18.3%). Cardiac arrest was found in 16.2% and 14.1% presented with cardiogenic shock. 86.4% received reperfusion therapy with 37.2% got primary percutaneous coronary intervention (PCI). The median door to balloon time and door to needle time for non-referral patients were 89 and 58 minutes, respectively. The median time to treatment was 226 min in the thrombolytic group and 234 min in the primary PCI group. The overall mortality rate was 11.5% which was much lower than the previous data of NUH (33.3%). For the referred patients, the median first medical contact (FMC) to device time was 344 min. Mortality rate of primary PCI in referral group (17.9%) was higher than in non-referral group (6.3%).

Conclusion: The mortality rate at NUH is lower than before having established fast tract management system but still high as compare to standard of care. Fibrinolytic therapy is preferred for the treatment of choice at non-PCI capable hospital and PCI will be considered for failed fibrinolysis or presence of contraindication to fibrinolysis. Shortening of pain to treatment time by fast tract management system is the mainstay to improve survival in the patients who suffer from STEMI.

Keywords: ST elevation myocardial infarction, fast tract

Introduction

Coronary artery disease (CAD) is currently the most common non-communicable disease. One of the serious complications of CAD is ST-elevation myocardial infarction (STEMI). STEMI is caused by coronary plaque disruption with exposure of substances that promote platelet activation, adhesion and aggregation, thrombin generation, finally thrombus formation leading to an occluded epicardial artery. (Boersma, Mercado, Poldermans, Gardien, Vos, & Simoons, 2003)

Early reperfusion of the infarct-related coronary artery using fibrinolysis or percutaneous coronary intervention (PCI) is the mainstay for STEMI treatment, by reducing infarct size, minimizing myocardial damage, preserving left ventricular function, and decreasing morbidity and mortality. (Boersma et al., 2003; Ribichini, Ferrero, & Wijns, 2004; Kleinschmidt & Brady, 2001) Shortening the

time from symptom to reperfusion and choosing the optimal reperfusion strategy for STEMI patients are great challenges in clinical practice. (Zhang & Huo, 2001) Geographic STEMI regionalization programs to integrate care between non-PCI capable and PCI capable hospitals have resulted in improved treatment times. (Aguirre et al., 2008; Henry et al., 2007; Jollis et al., 2007; Patrick et al., 2013) Fast tract STEMI is the system management assisting local communities to improve STEMI care by employing components of the system and showing how they should work together. A fast tract STEMI system with multidisciplinary teams has also improved quality of care, decreased time to reperfusion, and decreased morbidity and mortality.

Naresuan University Hospital (NUH) is the tertiary care center in the lower North of Thailand. The mortality of STEMI patients was 33.3 percent in 2009. The fast tract managed care system was initiated in 2010 to reduce the mortality rate and provide better care for acute STEMI patients. This hospital is mainly received STEMI patients from Pichit and Kamphaeng Phet province. Therefore, the purpose of this study was to identify the mortality rate, review clinical outcomes and quality of care in STEMI patients after having established the fast tract management system at NUH.

Material and method

This is a descriptive review of clinical parameters from STEMI patients who participated in the fast tract management system. Inclusion criteria included the STEMI patients who presented at or were referred to NUH. Clinical parameters included demographic data, disease characteristics, risk factors, treatment information, complications and in-hospital mortality.

Inclusion and exclusion criteria

The STEMI patients admitted to NUH from Jan 2010 to Sep 2013 were included in this study. STEMI patients were defined as the patients who had an abnormal electrocardiogram (ECG) and one of the following criteria:

1. Symptomatic chest pain within 48 hours
2. Rising of cardiac enzyme

The abnormal ECG was defined as new ST elevation at the J point in at least 2 contiguous leads of $\geq$ 2 mm(0.2 mV) in men or $\geq$ 1.5 mm (0.15 mV) in women in lead V_2-V_3 and/or of $\geq$ 1 mm (0.1 mV) in other continuous chest leads or the limbs lead. (Patrick, et al., 2013, pp. e362-425) The raising of cardiac enzyme was defined as total creatine phosphokinase (CPK) or creatine kinase MB (CK-MB) fraction more than two times the upper limit of the local hospital's normal range and/or positive troponin I or T results. Exclusion criteria were STEMI patients who were re-admitted with acute STEMI and new left bundle branch block.

The fast tract management system was a system designed to focus on patients' chest pain, initiate investigation, start proper medication, promptly consult a cardiologist, transfer patients from emergency room to cardiac care unit (CCU), and record the timing of each step in the pathway protocol. The main objective was to provide reperfusion therapy by setting door to needle time and door to balloon time of less than 60 and 90 minutes, respectively. The type of reperfusion therapy was selected based on indication, contraindication, and availability of cardiac catheterization laboratory. The connection between nearby hospitals was established for referred STEMI patients and the timing of each step in the pathway protocol was also recorded. This study received approval from the ethic committee of NU.

Definition

Diabetes (DM) was diagnosed when the patient had a history of diabetes controlled by diet and/or anti-diabetic medications, or a fasting plasma glucose was 126 mg/dl or higher at least on two occasions. Hypertension was documented by history of hypertension previously diagnosed and treated with medication or life style modifications, or blood pressure greater than 140 mmHg systolic or 90 mmHg diastolic. Dyslipidemia was diagnosed if the patient was previously diagnosed and/or treated with lipid lowering drugs, total cholesterol >200 mg/dl or LDL cholesterol $\geq$130 mg/dl or HDL cholesterol<40 mg/dl. Chronic kidney disease was documented by history of chronic kidney disease at least stage III or on chronic renal replacement therapy. Congestive heart failure (CHF) was defined as killip classification: killip class I is no CHF, killip class II is bibasilar rales in $\leq$50% of the lung fields and/or presence of S3 gallop, killip class III is bibasilar rales in>50% of lung fields, and killip class IV was defined as CHF with cardiogenic shock (systolic blood pressure< 90 mmHg). Acute kidney injury (AKI) was documented by increase in serum creatinine to $\geq$ 1.5 times baseline, which is known or presumed to have occurred within the prior 7 days or require renal replacement therapy.

Death was recorded and classified as cardiac death or non-cardiac death. Heart block was diagnosed when ECG showed at least 2nd degree atrioventricular block. Ventricular arrhythmia was defined as ventricular tachycardia or ventricular fibrillation. Reperfusion treatment included fibrinolysis or primary percutaneous intervention (PCI). Primary PCI was indicated for the patient who presented within 12 hours from onset of chest pain or more than 12 hours but within 24 hours with persistent chest pain. Rescued PCI was indicated for the patient who failed fibrinolytic therapy which defined by the reduction of ST-segment less than 50% in the lead showing greatest ST-segment elevation obtained at 90 minutes with or without chest pain. Referral time was defined by the duration from the time at acceptance to the arrival time at NUH.

Statistical analysis

Categorical data were summarized as frequencies and percentages. Continuous variables were reported as mean ± standard deviation (SD) or median.

Results

One hundred ninety-one patients who had STEMI were included between Jan. 2010 and Sept. 2013. They were predominantly male patients with an average age of 65 years.

The risk factors of CAD (Table 1) were mainly dyslipidemia (86.9%), hypertension (61.3%), and smoking (51.3%). Only a small group had DM (18.3%). Thirty-one patients (16.2%) had cardiac arrest at presentation. Overall 165 patients (86.4%) received reperfusion therapy. Ninety-four patients (49.2%) received thrombolytic therapy, which mainly was streptokinase. Seventy-one patients (37.2%) received primary PCI. Fifty patients (53.2%) received rescue PCI in thrombolytic group. Forty-seven patients (24.6%) received delayed PCI and six patients (3.1%) received emergency coronary artery bypass graft (CABG). The median door to balloon time and door to needle time for non-referral (no refer) patients were 89 and 58 minutes, respectively. Time at reperfusion was mainly at before midnight (4.00 pm-0.00 am) (52.4%) followed by during office hours (8.00 am-4.00 pm) (32.5%) and after midnight (0.00 am-8.00 am) (15.2%). (Table 1) The common complications were CHF (41.9%), heart block (24.1%), ventricular arrhythmia (33.5%), upper gastrointestinal hemorrhage

(UGIH) (20.4%), hospital acquired pneumonia (HAP) (19.9%), and acute kidney injury (AKI) (22%). (Table 3) The patients who were referred from other hospitals had a referral time of about one hour and forty-five min (mean 105.3 ± 65.4 min, median 105 min). The overall mortality rate was 11.5%. Mortality rate of primary PCI was 17.9% in referral group and 6.3% in non-referral group (Table 4).

Table 1 Baseline characteristics, medication, angiographic characteristics and procedure of the patients

Total case		191 (%)			191 (%)
Age(y)		65.0±11.7	Medication		
Male		140(73.3)	Beta-blocker		58(30.4)
Risk factors and clinical characteristics			Angiotensin converting enzyme inhibitor		59(30.9)
Diabetes		35(18.3)	Statin		170(89)
Hypertension		117(61.3)	Angiotensin receptor blocker		4(2.1)
Smoking		98(51.3)	Amiodarone		46(24.1)
Dyslipidemia		166(86.9)	office hour		62(32.5)
Chronic kidney disease		5(2.6)	before midnight		100(52.4)
Left ventricular systolic function (%)		40.2±19.4	after midnight		29(15.2)
Killip class at presentation	Killip I	117(61.3)	Angiogram characteristics and procedure		
	Killip II	43(22.5)	Coronary angiography		186(97.4)
	Killip III	4(2.1)	Percutaneous coronary intervention		169(88.5)
	Killip IV	27(14.1)	Angiographic success		164(85.9)
Previous myocardial infarction		5(2.6)	Number of disease vessel	SVD	65(34.0)
CPR prior PCI		31(16.2)		Multivessel	117(61.3)
Duration of admission(day)		5.9±6.9	Pre-PCI TIMI	TIMI 0-1	92(53.5)
Medication				TIMI 2-3	80(46.5)
Aspirin		190(99.5)	Post-PCI TIMI	TIMI 0-1	18(10.5)
Adenosine di-phosphate(ADP) inhibitor		189(99)		TIMI 2-3	154(89.5)
Glycoprotein IIB/IIIA		109(57.1)	Myocardial perfusion grade	MPG 0-1	41(23.8)
Dopamine		90(47.1)	(MPG)	MPG 2-3	131(76.2)
Dobutamine		50(22.6)	Central venous catheter insertion		6(3.1)
Epinephrine/Norepinephrine		48(25.1)	Temporary pacemaker insertion		29(15.2)
Heparin/LMWH		174(91.1)	Intra-aortic balloon pump insertion		41(21.5)

CPR=cardiopulmonary resuscitation; PCI; percutaneous coronary intervention; TIMI=Thrombolysis in Myocardial Infarction; SVD=single vessel disease

Table 2 Reperfusion treatments in STEMI

STEMI			
Non refer		Refer	
Number of patient	44		147
Thrombolytic (%)	5(11.4)	Thrombolytic (%)	89(60.5)
Streptokinase (%)	4(9.1)	Streptokinase (%)	87(59.2)
Tissue plasminogen activator (%)	1(2.3)	Tissue plasminogen activator (%)	1(0.7)
Door to needle time	(N=5)	Tenecteplase (%)	1(0.7)
:median (min)	58		
Time to treatment	(N=5)		
:median (min)	226		
Door to needle time within 30 min (%)	20		
Primary PCI (%)	32(72.7)	Primary PCI (%)	39(26.5)
Door to balloon time	(N=29)	FMC to balloon time	(N=39)
:median (min)	89	:median (min)	344
Time to treatment	(N=29)	Time to treatment	(N=39)
:median (min)	234	:median (min)	553
Rescue PCI (%)	0 (0)	Rescue PCI (%)	50(34.0)
Delayed PCI (%)	7(15.9)	Delayed PCI (%)	40(27.2)
Emergency CABG (%)	4(9.1)	Emergency CABG (%)	2(1.4)
CAG (%)	40(90.9)	CAG (%)	146(99.3)

PCI=percutaneous coronary intervention; FMC=first medical contact;
CABG=coronary artery bypass graft; CAG=coronary angiography

Table 3 Hospital outcomes and complication in patient with STEMI

Total case	191(%)	Total case	191(%)
CHF	80(41.9)	Septic shock	13(6.8)
Heart block	46(24.1)	DKA/HHNK	2(1)
Ventricular arrhythmia	64(33.5)	Length of stay (days)	
Atrial fibrillation	32(16.8)	:mean(min)±SD	5.9±6.9
Ischemic stroke	6(3.1)	:median (min)	4.0
Hemorrhagic stroke	1(0.5)	Death	
UGIH	39(20.4)	In hospital (%)	11.5
Hematoma at puncture site	12(6.3)	Cardiac (%)	8.4
Acute kidney injury	44(22)	Non-cardiac (%)	3.1
Hospital acquired pneumonia	38(19.9)		

CHF=congestive heart failure; UGIH; upper gastrointestinal hemorrhage;

DKA=diabetic ketoacidosis; HHNK=hyperglycemic hyperosmolar nonketotic coma

Table 4 Mortality rate of primary PCI and rescue PCI between refer and non-refer group

	Mortality rate	
	Non-refer	Refer
Primary PCI	2/32(6.3%)	7/39(17.9%)
Rescue PCI	0/0(0%)	8/50(16%)

PCI=percutaneous coronary intervention

Discussion

This is the first formally reported STEMI registry initiated by the cardiology team at NUH. The mortality from the present study was higher than the GRACE registry (Steg et al., 2002) and 2nd TACS registry (Srimahachota et al., 2012) (11.5% NUH, 7% GRACE and 5.3% 2nd TACS) but less than the 1st TACS registry (17%). (Srimahachota et al., 2007) The reasons may be the difference of demographic characteristics, regional health policy, and disease severity in each registry. (Srimahachota et al., 2007; Srimahachota et al., 2012) First, the major population in this study was referred from other hospitals according to unsuccessful medical reperfusion and/or complicated STEMI, e.g., heart block, cardiogenic shock, etc. Secondly, the difference of disease severity in each registry, represented by the presence of cardiogenic shock (killip 4), was 14.1% in the NUH registry, 17.3% in the 1st TACS registry, and 7.9% in the 2nd TACS registry. However, cardiac arrest requiring CPR prior to PCI in the NUH registry was more than in the1st and 2nd TACS registries (16.1% vs. 7.3% and 3.8%). Thirdly, the angiogram data showed multivessel disease for about two thirds of the population in the NUH registry. However, the mortality rate after using fast tract management system at NUH was much lower than previous data in 2009.

The median door to needle time in non-referral patients was 58 min, which was more than the door to needle time in the standard of care (30 min). (Antman et al., 2004) Only one out of five patients (20%) received thrombolytic therapy within 30 minutes. This was from waiting time for cardiologist to confirmed the diagnosis. The median door to balloon time was 89 min, which was within the standard of care (90 min). (Antman et al., 2004; Antman et al., 2004) For the referred patients, the median first medical contact (FMC) to device time was 344 min in primary PCI group, which was longer than the standard of care (120 min). (Van de Werf, 2009; Van de Werf et al., 2008) Only one out of thirty nine patients (2.6%) had FMC to device time less than 120 min. The important reasons for the time delay were the far distance between non-PCI-capable and PCI-capable NUH and the local health care operating system, e.g., extra time to call the referral team and EMS availability for referring the patient. Presently at NUH, it is 37.2% for primary PCI and 49.2 % for thrombolytic therapy. Reperfusion therapy either primary PCI or thrombolytic was used more than previous study. From the 1st and 2nd TACS registry, primary PCI was performed in 22.2% and 24.7%, respectively, and thrombolytic therapy was given in 30.4% and 42.6%, respectively. Mortality rate of primary PCI in referral group (17.9%) was higher than in non-referral group (6.3%). Even though, primary PCI has excellent outcomes than fibrinolysis but mortality benefit of primary PCI is diminished by delays to reperfusion. (Greg, 2008, pp. 552-566) It may be

primary PCI is not suitable reperfusion method for referral patient in this area.

Beta-blocker and ACE inhibitor/ angiotensin receptor blocker (ARB) were used less than the guideline recommendations, possibly due to the higher proportion of complications, such as congestive heart failure, cardiogenic shock, and AKI which are the contraindications of both drugs.

What have the authors learned from this study? The high mortality rate of the presented patients has to be considered. The overall time to treatment in this study was lower than the 1st and 2nd TACS registry but still high to seek treatment. Although door to balloon time of the non-referrals was within the standard of care, the door to needle time was quite disappointing. We still need to further develop clinical skills and communication of the patient care team. For non-PCI capable hospital, primary PCI is not the treatment of choice in the situation that no absolute contraindication for thrombolytic drug.

This study had some limitations. It was a retrospective study with incomplete data collection in some patients.

Conclusion

The mortality rate at NUH is lower than before having established fast tract management system but still high as compare to standard of care. Fibrinolytic therapy is preferred for the treatment of choice at non-PCI capable hospital in this area and PCI will be considered for failed fibrinolysis or presence of contraindication to fibrinolysis. The fast tract management system is one of the effective tools to control door to balloon and door to needle time and may reduce mortality rate. Continuous improvement in the fast tract management system could be decrease mortality.

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Potential conflicts of interest

None

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