Predictors of In-Hospital Mortality in Thai STEMI Patients: Results from TACSR†

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Background: *Clinical predictors of high-risk STEMI patients may guide physicians to the type of treatment, as high-risk patients need more aggressive treatment than low-risk patients. There was no previous registry of STEMI patients in Thailand.*
Objective: *To determine the clinical predictors of in-hospital mortality in STEMI patients from the Thai ACS Registry.*
Material and Method: *A multi-center prospective nationwide Thai Acute Coronary Syndrome Registry (TACSR) was done between August 1, 2002 and October 31, 2005. The STEMI patients were registered to Thai ACS web site. Clinical and demographic characteristics, coronary risk factors, presenting symptoms, in-hospital treatments, reperfusion procedures and the patients' outcomes were recorded and analyzed.*
Results: *3,836 STEMI patients were studied. The mean age was 62.2 $\pm$ 12.8 years and 68% of the patients were male. The mortality rate of Thai STEMI patients was 17% (86.8% from cardiac causes) and the main cause of death was pumping failure (61.3%). The patients with older age $\geq$ 75 years, patients with diabetes, shock, and cardiac arrhythmias had a higher mortality (29.4, 21.2, 43.4 and 37.24% respectively), while patients who underwent primary percutaneous coronary intervention (primary PCI) had a lower mortality rate (12.66%). Patients who received treatment with ASA, beta-blocker, ACE inhibitor/ ARB and statin had lower in-hospital mortality.*
Conclusion: *The clinical predictors of high in-hospital mortality in STEMI patients from the TACSR were older age $\geq$ 75 years, diabetes, shock, and cardiac arrhythmias. The treatments that can decrease the mortality were primary PCI, ASA, beta-blocker, ACE inhibitor/ARB and statin.*

Keywords: *Predictors of in-hospital mortality, STEMI patients, TACSR*

J Med Assoc Thai 2007; 90 (Suppl 1): 91-7
Full text. e-Journal: *http://www.medassocthai.org/journal*

Acute ST segment elevation myocardial infarction (STEMI) is a major health problem in Thailand. The mortality rate of STEMI patients declined to 4-7% in the GUSTO report[1]. However, the acute coronary syndrome (ACS) registries from some countries still revealed a very high mortality and morbidity compared with the published clinical trials[2].

Clinical predictor models may help to identify high risk patients, who need aggressive surveillance and earlier treatment, while patients who had low risk may be managed less aggressively[3,4]. The Global Registry of Acute Coronary Events (GRACE) reported 9 variable predictors; older age, previous myocardial infarction, history of heart failure, increased pulse rate

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and lower systolic blood pressure at presentation, elevated initial serum creatinine and cardiac biomarker levels, ST segment depression on presenting electrocardiogram, and not having a percutaneous coronary intervention (PCI) performed in hospital, were the independent predictors of the six-month mortality post acute coronary syndrome[4-7]. The previous report of Thrombolysis In Myocardial Infarction (TIMI) Risk Score was also a bedside clinical score to predict short-term mortality of the STEMI patients[8].

There were many registries of ACS from various parts of the World, the in-hospital mortality rates were higher in the ACS registries compared with the treatment trials. Jose et al reported that the mortality rate in Acute STEMI patients from a tertiary hospital in India was 16.9% and most of the patients (82.8%) received thrombolytic therapy with Streptokinase[2], while the Chinese ACS registry reported 48.9% of STEMI patients who underwent primary PCI and only 12% of patients received the fibrinolytic therapy[9].

The Thai Acute Coronary Syndrome Registry (TACSR) is the first largest registry in Thailand, the Thai STEMI patients may have some differences in the aspects of clinical severity, coronary risk factors, clinical presentations and patients' outcomes compared with the patients from other parts of the world. The clinical predictors of mortality in Thai STEMI patients were not well established.

Objective

To determine the predictors of in-hospital mortality in Acute STEMI patients from the Thai ACS Registry.

Material and Method

Thai Acute Coronary Syndrome Registry (TACSR) recruited 17 hospitals, 13 hospitals in the metropolitan area and 4 hospitals in the provinces. Consecutive patients who presented with chest pain or other presentations of ACS and had ECG changes were accepted into the registry, patients with STEMI were classified according to the TACS Registry report[10].

Data collection

Data collection was performed by well trained critical care nurses and cardiologists from the sixteen hospitals and registered to the web site of Thai ACS Registry. Data includes; patients' characteristics, medical history, coronary risk factors, clinical presentations, in-hospital treatments, complications, revascularization procedures and in-hospital outcomes of the STEMI patients.

Data analysis

Data were entered to the Data-Management Center at the Heart Association of Thailand under the Royal Patronage and was analyzed by STATA version 9, patients' baseline characteristics were expressed in number and percentage, continuous variables are expressed as mean, standard deviation (SD), median, and inter-quartile range. The Chi-square was used to compare between the groups, p value < 0.05 was considered to be statistically significant. Baseline characteristics, coronary risk factors, clinical presentations, in-hospital treatments, complications, revascularization procedures and in-hospital outcomes were analyzed by univariate and multivariate logistic regression model to identify the predictors of in-hospital mortality.

Results

Between August 1, 2002 and October 31, 2005, 9,373 ACS patients were registered to the Thai ACS website. There were 3,836 STEMI patients (40.9%), 3,548 NSTEMI patients (37.9%) and 1,989 unstable angina (UA) patients (21.2%). Among the 3,836 STEMI patients, the mean age was 62.2 ± 12.8 years, 2,613 patients (68%) were male and 1,223 patients (32%) were female. The clinical and demographic data of STEMI patients are summarized in Table 1. Coronary risk factors of the STEMI patients were diabetes (37.15%), hypertension (51.43%), family history of cardiovascular diseases (12.14%), smoking (42.7%) and dyslipidemia (72.5%). The presenting symptoms of the STEMI patients were chest pain (91.61%), cardiogenic dyspnea (24.83%), shock (16.27%) and post cardiac arrest (7.3%).

The all causes mortality rate of the Thai STEMI patients was 17%, compared with those who survived; they were of an older age (69.83 ± 0.35 vs. 64.47 ± 0.14, $p < 0.001$). The odd ratios of increase mortality in the older age ≥ 75 years, female patients, diabetes, hypertension, cardiogenic dyspnea, shock, and post cardiac arrest were 4.67, 1.90, 1.79, 1.23, 2.53, 5.70 and 5.66 respectively.

In-hospital treatment of STEMI patients included; ASA, ADP inhibitors, calcium channel blocker, beta-blocker, angiotensin converting enzyme inhibitor (ACEI)/angiotensin receptor blocker (ARB), statin and thrombolytic therapy (Table 2). Forty-five percent of STEMI patients underwent percutaneous coronary intervention (PCI) while 30.4% of patients received

Table1. Clinical and demographic data of the Thai STEMI patients

Patients data	Total n = 3,836	Dead n = 652 (17%)	Survive n = 3,184 (83%)	OR (95%CI)	p-value
Age (years, M ± SD)	62.2 ± 12.8	69.83 ± 0.35	64.47 ± 0.14	-	<0.001
Age ≥ 75 years (%)	16.03	27.76	13.63	4.67 (3.06-7.30)	<0.001
Female (%)	31.88	44.17	29.37	1.90 (1.60-2.26)	<0.001
Refer (%)	54.24	52.13	54.67	0.90 (0.76-1.07)	0.24
CAD risk factors (%)					
DM (%)	37.15	49.00	34.89	1.79 (1.50-2.14)	<0.001
HT (%)	51.43	55.66	50.59	1.23 (1.03-1.46)	0.02
Family history of CVD (%)	12.14	9.40	12.66	0.72 (0.52-0.99)	0.04
Smoking (%)	42.70	31.32	44.88	0.56 (0.46-0.68)	<0.001
Dyslipidemia (%)	72.5	60.52	74.51	0.52 (0.43-0.64)	<0.001
Presenting symptoms (%)					
Chest pain (%)	91.61	78.22	94.35	0.22 (0.17-0.27)	<0.001
Cardiogenic dyspnea (%)	24.83	41.20	21.52	2.53 (2.05-3.18)	<0.001
Shock (%)	16.27	41.56	11.09	5.70 (4.71-6.91)	<0.001
Post cardiac arrest (%)	7.3	21.01	4.49	5.66 (4.40-7.28)	<0.001

Table 2. In-hospital treatments of the Thai STEMI patients

Treatment	Total n = 3,836 (%)	Dead n = 652 (%)	Survive n = 3,184 (%)	OR (95%CI)	p-value
ASA	95.18	82.36	97.80	0.10 (0.07-0.14)	<0.001
ADP inhibitors	60.40	41.26	64.32	0.38 (0.32-0.46)	<0.001
CCB	10.22	6.44	10.99	0.56 (0.40-0.78)	0.001
Beta-blocker	58.32	22.39	65.67	0.15 (0.12-0.18)	<0.001
Anti-AII	64.72	25.00	72.86	0.28 (0.22-0.36)	<0.001
Statin	77.48	43.71	84.39	0.14 (0.12-0.17)	<0.001
Thrombolysis	30.37	22.09	32.07	0.60 (0.49-0.73)	<0.001
CAG	62.72	44.02	66.55	0.39 (0.33-0.47)	<0.001
PCI	45.41	27.76	49.09	0.39 (0.33-0.48)	<0.001
Primary PCI	22.24	16.56	23.40	0.49 (0.39-0.62)	<0.001
Rescue PCI	3.34	3.53	3.30	1.51 (0.87-2.51)	0.09
Elective PCI	19.84	7.67	22.33	0.48 (0.33-0.69)	<0.001
CABG	6.00	6.44	5.90	1.09 (0.77-1.55)	0.59

ASA; Aspirin, ADP inhibitor; clopidogrel/ticlopidine, LMWH; low molecular weight heparin, CCB; calcium channel blocker, Anti-A II ; angiotensin converting enzyme inhibitor/angiotensin receptor blocker, PCI; percutaneous coronary intervention, Rescue PCI; PCI after thrombolysis failure, Elective PCI; PCI post MI within 1 week, CABG; coronary artery bypass graft surgery

thrombolysis with Streptokinase (SK) or tissue plasminogen activator (tPA) and only 6% of patients underwent coronary artery bypass graft surgery (CABG). The median door to needle time in the thrombolytic group and door to balloon time in the primary PCI group was 85 and 122 minutes respectively.

Among the PCI group, primary PCI was performed in 22.24% of the STEMI patients, the odd ratios of decreased mortality were demonstrated in primary and elective PCI groups but not in the rescue PCI group (OR 95% CI of 0.49, 0.48 and 1.51 respectively).

The all causes mortality rate was 17% in the Thai STEMI patients; 14.8% was from cardiac causes (61.3% from pump failure, 9.5% from mechanical complications) and only 2.2% from non cardiac causes. The length of hospital stay in STEMI patients was

Table 3. In-hospital complications of the Thai STEMI patients

Complications	Total n = 3,836 (%)	Dead n = 652 (%)	Survive n = 3,184 (%)	OR (95%CI)	p-value
Heart failure	44.06	77.30	37.25	5.73 (4.69-7.03)	<0.001
Cardiac arrhythmias	29.12	63.80	22.02	6.24 (5.19-7.50)	<0.001
Stroke (CVA)	2.50	5.06	1.98	2.64 (1.66-4.12)	<0.001
Major bleeding	7.90	15.95	6.25	2.84 (2.18-3.69)	<0.001

9.4 $\pm$ 12.3 days (median 6 days). The occurrence of heart failure, cardiac arrhythmias (VT/VF and/or heart block), stroke, and major bleeding was 44.06, 29.12, 2.5 and 7.9% respectively. The odd ratios of increased mortality in heart failure, cardiac arrhythmias, stroke and major bleeding groups were 5.73, 6.24, 2.64 and 2.84 respectively (Table 3).

The mortality rate of STEMI patients in this registry was higher compared with the non-ST elevation MI (NSTEMI), and unstable angina (UA) patients (17, 13.1 and 3% respectively). The mortality rate of the STEMI patients was correlated with Killip's classification; the mortality rate was 8.0, 13.1, 18.8, and 50.5% in the patients with Killip's class I, II, III, and IV respectively.

The multivariate analysis by logistic regression model to determine the predictors which increased in-hospital mortality revealed the older age $\geq$ 75 years, diabetes, shock and cardiac arrhythmias (OR 95% CI of 1.93, 1.38, 1.97, and 3.73 respectively), while the primary PCI, ASA, beta-blocker, ACE inhibitor/ARB and statin therapy were the predictors which decreased in-hospital mortality (OR 95% CI of 0.65, 0.35, 0.37, 0.45, and 0.33 respectively, Table 4).

Table 4. The multivariate analysis of the predictors of in-hospital mortality in Thai STEMI patients

Predictors	Adjusted OR (95% CI)	p-value
Age $\geq$ 75	1.93 (1.43-2.60)	<0.001
Diabetes	1.38 (1.11-1.72)	0.003
Chest pain	0.55 (0.39-0.78)	0.001
Shock	1.97 (1.50-2.60)	<0.001
Cardiac arrhythmias	3.73 (2.87-4.84)	<0.001
Primary PCI	0.65 (0.46-0.92)	0.016
ASA	0.35 (0.22-0.55)	<0.001
Beta-blocker	0.37 (0.28-0.49)	<0.001
Anti-A II	0.45 (0.22-0.92)	0.03
Statin	0.33 (0.25-0.43)	<0.001

Discussion

This is the first largest acute STEMI Registry in Thailand; 3,836 STEMI patients were enrolled, the mean age was 62.2 $\pm$ 12.8 years and two third of these were male. The all causes mortality rate in the presented registry was higher compared with the GRACE report (17% vs. 7%). The authors found some coronary risk factors of the Thai STEMI patients that differ from the INTERHEART study's report, such as high percentage of diabetes in Thai STEMI patients (37.2 vs. 18.45%)[11] and the diabetic patients in the presented registry had a higher mortality compared with the non-diabetic STEMI patients (21.2 vs. 13%, $p < 0.001$).

The clinical presentation of STEMI patients in the presented registry were chest pain, cardiogenic dyspnea, shock and post cardiac arrest (91.61, 24.83, 16.27 and 7.3% respectively). The in-hospital complications of STEMI patients were heart failure, cardiac arrhythmias, stroke and major bleeding (44.06, 29.12, 2.5 and 7.9% respectively), 92.43% of the patients with heart failure occurred within the first 48 hours. The prevalence of heart failure, cardiac arrest, and shock were higher than the reports from other parts of the world, however the prevalence of heart failure in the presented registry was comparable to the Jose et al report (44.06 vs. 41.5%)[2].

The in-hospital treatments in Thai STEMI patients included the medical treatment and reperfusion therapy, either thrombolysis or primary PCI; 30.37% of the STEMI patients received thrombolysis, the majority with Streptokinase while 22.24% of patients underwent primary PCI, 19.84% underwent elective PCI and only 6% of the patients underwent CABG. The medical treatment included ASA, ADP inhibitors, beta-blocker, ACE inhibitor/ARB and statin.

The recommended revascularization procedures for STEMI patients from many reports are thrombolysis and primary PCI[12-15]. The rate of revascularization procedures were different in many countries[16], the India's STEMI registry reported 82.8% of patients

received thrombolysis with Streptokinase[2], while the Chinese registry reported 48.9% of STEMI patients underwent primary PCI[9].

The mortality rate of Thai STEMI patients was 17% (86.8% from cardiac death and 61.3% of cardiac death caused by pumping failure). The mortality rate in the presented registry was very high compared with previous reports, however, the presented mortality rate was comparable to the India's STEMI registry (17 vs. 16.9%)[2]. The high mortality rate in the presented registry may be due to delay of admission and reperfusion therapy[10].

The multivariate analysis revealed the predictors of in-hospital mortality included; older age $\geq$ 75 years, patients with diabetes, shock and cardiac arrhythmias (OR 95% CI of 1.93, 1.38, 1.97 and 3.73 respectively). The predictors that decreased the in-hospital mortality in STEMI patients were primary PCI, medical treatment with ASA, beta-blocker, ACE inhibitor/ARB, and statin (OR 95% CI of 0.65, 0.35, 0.37, 0.45 and 0.33 respectively). However, the reduction in mortality may not be from these medications alone, but may be due to the revascularization procedures by primary PCI and thrombolytic therapy.

Conclusion

The clinical predictors of in-hospital mortality in Thai STEMI patients from our registry were older age $\geq$ 75 years, patients with diabetes, shock, and cardiac arrhythmias. The treatment which decreases the mortality was the primary PCI, ASA, beta-blocker, ACE inhibitor/ARB and statin. Public awareness and the improvement of the treatment guidelines may reduce the high mortality of STEMI patients in Thailand.

Study limitation

The Thai ACS Registry may not represent all ACS patients in Thailand, because the Registry cannot enroll all ACS patients from every hospital in the Country. Other predictors for long-term outcomes, such as the cardiac enzyme, serum creatinine level, and left ventricular systolic function were not included in the registry. Thus, further study may be needed.

Contributors

The Thai Acute Coronary Syndrome Registry (TACSR) was supported by The Heart Association of Thailand under the Royal Patronage of H.M. the King, Thai Health Promotion Foundation, Clinical Research Collaboration Network (CRCN) and the Health Systems Research Institute (HSRI).

Acknowledgements

The authors wish to thank the personnel of the ICU/CCU, the patients and their relatives and most of all, the investigators and research nurses who patiently and diligently assisted in all aspects of patient care data collection and entry.

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ปัจจัยบ่งชี้การเสียชีวิตในผู้ป่วยกล้ามเนื้อหัวใจตายเฉียบพลัน:ผลการศึกษาในผู้ป่วยไทย

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ภูมิหลัง: *ปัจจัยบ่งชี้ในผู้ป่วยกล้ามเนื้อหัวใจตายเฉียบพลัน (ST segment elevation myocardial infarction, STEMI) ที่มีความเสี่ยงสูงต่อการเสียชีวิตจะช่วยให้แพทย์ให้การรักษาได้อย่างเหมาะสม โดยผู้ป่วยอาการหนักจะได้รับการดูแลรักษาอย่างใกล้ชิดและเต็มที่ ยังไม่เคยมีการรวบรวมข้อมูลในผู้ป่วยไทยมาก่อน*

วัตถุประสงค์: *เพื่อหาปัจจัยบ่งชี้ในผู้ป่วยกล้ามเนื้อหัวใจตายเฉียบพลัน (STEMI) ที่มีความเสี่ยงสูงต่อการเสียชีวิตในการลงทะเบียนผู้ป่วยกล้ามเนื้อหัวใจตายเฉียบพลันในประเทศไทย (Thai ACS Registry)*

วัสดุและวิธีการ: *การลงทะเบียนผู้ป่วยกล้ามเนื้อหัวใจขาดเลือดเฉียบพลันในประเทศไทย เริ่มตั้งแต่ 1 สิงหาคม พ.ศ. 2545 ถึง 31 ตุลาคม พ.ศ. 2548 ทำการบันทึกและวิเคราะห์ลักษณะพื้นฐาน ปัจจัยเสี่ยงต่อโรคหลอดเลือดหัวใจ อาการและอาการแสดง การรักษา ภาวะแทรกซ้อน และผลการรักษาของผู้ป่วย*

ผลการศึกษา: *ผู้ป่วยกล้ามเนื้อหัวใจตายเฉียบพลันชนิด STEMI จำนวน 3,836 ราย มีอายุเฉลี่ย 62.2 $\pm$ 12.8 ปี เป็นชายร้อยละ 68 อัตราการเสียชีวิตในผู้ป่วยสูงถึงร้อยละ 17 โดยการเสียชีวิตเกิดจากสาเหตุทางหัวใจ (cardiac cause) ถึงร้อยละ 86.8 และในจำนวนนี้เกิดจากกล้ามเนื้อหัวใจล้มเหลว (pump failure) ร้อยละ 61.3 ผู้ป่วยที่มีอายุมากกว่าหรือเท่ากับ 75 ปี เป็นเบาหวาน ช็อก มีภาวะหัวใจเต้นผิดปกติ มีอัตราการเสียชีวิตร้อยละ 29.4, 21.2, 43.4 และ 37.24 ตามลำดับ โดยผู้ป่วยที่ได้รับการรักษาเพื่อเปิดหลอดเลือดหัวใจด้วยการทำ Primary PCI มีอัตราการเสียชีวิตเพียงร้อยละ 12.66 ผู้ป่วยที่ได้รับยา ASA, Beta-blocker, ACE inhibitor/ARB และ statin มีอัตราการเสียชีวิตในโรงพยาบาลต่ำกว่ากลุ่มที่ไม่ได้รับยาดังกล่าว*

สรุป: *ปัจจัยบ่งชี้ความเสี่ยงต่อการเสียชีวิตในโรงพยาบาลของผู้ป่วยกล้ามเนื้อหัวใจตายเฉียบพลันชนิด STEMI จากการศึกษานี้ได้แก่ อายุมากกว่าหรือเท่ากับ 75 ปี โรคเบาหวาน ช็อก มีภาวะหัวใจเต้นผิดปกติ การรักษาเพื่อเปิดหลอดเลือดหัวใจโดยการทำ primary PCI และการได้รับยา ASA, Beta-blocker, ACE inhibitor/ARB และ statin จะช่วยลดอัตราการเสียชีวิตของผู้ป่วย*