Correlation between Percutaneous Coronary Intervention Volume, Door-to-Balloon Time and Mortality of Patients with Acute ST-Segment Elevation Myocardial Infarction

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Background: *Reperfusion therapy with percutaneous coronary intervention (PCI) is the preferred method for treatment of STEMI if it can be done in a timely manner in a high volume center. The present study aimed to evaluate the correlation between total PCI volume, emergency PCI volume, elective PCI volume, mean door-to-balloon (DTB) time and in-hospital mortality of patients with STEMI treated with emergency PCI.*

Material and Method: *Using Prince of Songkla university emergency PCI registry, the authors analyzed the study population of STEMI patients who underwent emergency PCI between January 2007 and December 2010. Pearson's Correlation Coefficient was used to determine the correlation.*

Results: *One thousand five hundred one PCI procedures including 355 emergency PCI procedures were done during the present study period. All types of PCI volume increased in each consecutive year between 2007 and 2010 while mean DTB time and in-hospital mortality continuously declined. The mean DTB time had positive correlation (r = 0.932) with in-hospital mortality. The emergency PCI volume was strongly negatively correlated with in hospital mortality (r = -0.953) and was statistically significant. There were negative correlations of elective PCI volume (r = -0.796), total PCI volume (r = -0.848), and in-hospital mortality but the correlations were not statistically significant.*

Conclusion: *For emergency PCI, shorten mean DTB time in each consecutive year was associated with lower in-hospital mortality. Regarding to procedural volume, increase in each type of PCI procedure especially emergency PCI procedure was associated with a decrease in-hospital mortality.*

Keywords: *Percutaneous coronary intervention volume, Emergency percutaneous coronary intervention volume, Door-to-balloon time, In-hospital mortality, ST segment elevation myocardial infarction*

J Med Assoc Thai 2012; 95 (3): 325-9
Full text. e-Journal: *http://www.jmat.mat.or.th*

Reperfusion therapy with either thrombolytic drug or primary percutaneous coronary intervention (PCI) reduces mortality for eligible patients with ST-segment elevation myocardial infarction (STEMI)[1-5]. Primary PCI is the preferred method if it can be performed in a timely manner. Multiple studies show that shorter door-to-balloon (DTB) time is associated with improved clinical outcomes including in-hospital mortality, re-infarction, recurrent ischemia, stroke, and cerebral bleeding[6-11]. Moreover, many studies demonstrate that patients with STEMI at hospitals performing more primary PCI procedures have lower mortality rates than those at hospitals with less primary PCI volume[12-14]. Based on this evidence, the American College of Cardiology/American Heart Association/Society for Cardiovascular Angioplasty and Intervention (ACC/AHA/SCAI) PCI clinical practice guideline recommends that primary PCI is the preferred approach if an institution can achieve a DTB time of no longer than 90 minutes and the minimum institutional volume requirement for hospitals offering primary PCI for STEMI should be 400 elective and 36 primary PCI procedures per year[15].

However, nearly all of these studies are multicenter, cross sectional studies, which make it unclear whether DBT is a surrogate of overall institutional expertise rather than an independent predictor of outcomes. Moreover, there were no data

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regarding rescue PCI and DTB time despite the fact that both primary PCI and rescue PCI need to be performed in an emergency situation. The authors report an initial experience with primary PCI at Prince of Songkla University Hospital and sought to evaluate the correlation between mean DTB time, total PCI volume, emergency PCI volume, and in-hospital mortality of patients with STEMI treated with emergency PCI in each consecutive year.

Material and Method

Using Prince of Songkla University Hospital emergency PCI registry, the authors analyzed a study population of consecutive patients who presented with STEMI at Prince of Songkla University Hospital emergency department or referred from other hospitals for emergency PCI between January 2007 and December 2010. All patients undergoing emergency PCI for STEMI, primary or rescue PCI,were considered for this analysis. Primary PCI is indicated in all patients with history of chest pain of less than 12 hours and with persistent ST segment elevation or (presumed) new left bundle branch block. Primary PCI was also considered if there is clinical and/or ECG evidence of ongoing ischemia even if symptoms started more than 12 hours before. For rescue PCI, patients had evidence of failed Fibrinolysis (either persistent ischemic chest pain or more than 50% residual ST-segment elevation in lead with maximal ST-segment elevation after 1.5 million units of Streptokinase).

The patients who received emergency coronary angiography only were included. For example, the patient with no more than 70% residual stenosis and TIMI 3-flow were excluded. DTB was defined as the time from the patient arrival at Prince of Songkla University Hospital emergency department until the start of balloon inflation or aspiration with thrombo aspiration catheter. Mean value of DTB in each year was used for analysis.

Emergency PCI was performed according to the standard protocol. A 300 mg of aspirin, at least 300 mg of clopidogrel and 80 to 100 units/kg of unfractionated heparin were given at the emergency department. Glycoprotein IIb3a inhibitor was left for the operator discretion. Thromboaspiration was done for significant thrombus burden. The emergency PCI (primary PCI plus rescue PCI) volume, elective PCI volume and total PCI (emergency PCI plus elective PCI) volume were analyzed for their correlation with in-hospital mortality in each year. The report was approved by Ethics Committee, Faculty of Medicine, Prince of Songkla University.

For statistical analysis, Pearson‘ s Correlation Coefficient (r) was calculated. T-test with degree of freedom = n-2 and $\alpha = 0.05$ were used to determine statistic significant of the correlation.

Results

Total PCI, elective PCI, emergency PCI volume, DTB time, and in-hospital mortality in each year are shown in Table 1. Overall, 1,501 PCI procedures included 355 emergency PCI procedures were done during the study period. Primary PCI and rescue PCI accounted for 85% and 15% of all emergency PCI procedures, respectively. Total PCI, elective PCI, and emergency PCI volumes were increased in each consecutive year between 2007 and 2010. In contrast, mean DTB time and in-hospital mortality were continuously decreased. Fig. 1 shows relationship of mean DTB time and in-hospital mortality. DTB time has positive correlation with in-hospital mortality ($r = 0.932$) and the correlation was statistically significant. The emergency PCI volume was strongly negatively correlated with in-hospital mortality ($r = -0.953$) and was statistically significant. There were negative correlation of elective PCI volume ($r = -0.796$), total PCI volume ($r = -0.848$) and in-hospital mortality but the correlation was not statistically significant.

Discussion

The present study include primary and rescue PCI together for analysis because both are

Table 1. Show PCI volume, mean DTB time and in-hospital mortality of patients with STEMI treated with emergency PCI in each year from 2007-2010

Year	Total PCI volume	Elective PCI volume	Emergency PCI volume	Mean DTB (minutes)	In-hospital mortality
2007	217	176	41	120	18.6
2008	305	215	90	81	12.1
2009	377	276	101	73	5.0
2010	602	479	123	45	4.1

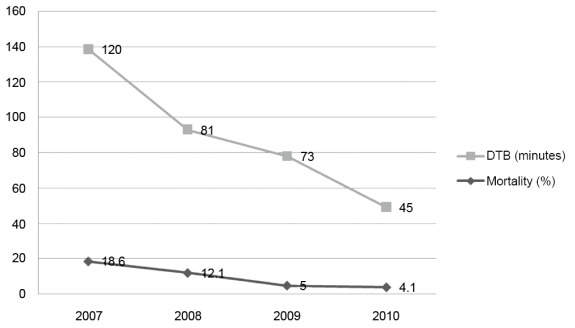

Fig. 1 Demonstrate door-to-balloon time (DTB) and in-hospital mortality

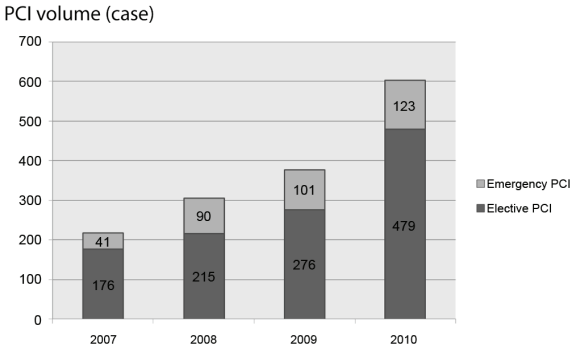

Fig. 2 Demonstrate emergency and elective PCI volume between 2007-2010

practically performed in emergency situation and aim to keep DTB time as short as possible. Data regarding rescue PCI and DTB time was scanty so the results of the present study may be useful. However, the authors did not analyze the correlation between DTB of rescue PCI alone and in-hospital mortality rate due to too small a number of rescue PCI procedure.

By using the mean DTB times of emergency PCI procedures for analysis, the positive correlation of DTB time and in-hospital mortality rate in each year has been confirmed. The shorter DTB time results in lower in-hospital mortality. The present study was different from the previous reported studies that used the different DTB time in each patient group for analysis. Another important finding of the present study was the inverse relationship of emergency PCI volume and in-hospital mortality. This relationship was statistically significant. That means the more the authors do emergency PCI procedures, the less the in-hospital mortality rate. The inverse associations, though not statistically significant, were also found between elective PCI and total PCI volume and in-hospital mortality.

Previous studies that analyzed data from different hospitals found a higher volume of primary PCI procedures performed by physicians and/or hospitals associated with a lower mortality[13,14]. The present study showed that above associations also found in a single hospital. As physician and hospital primary PCI experience increases, in-hospital mortality is reduced. Higher PCI volume did not worsen the quality of patient care but improved the patient outcomes. It should be stated that there was no association between patient volume and mortality for thrombolytic therapy[13].

Study Limitation

Several limitations should be considered. First, this was an observational study with no randomization to different DTB times. The authors cannot deny the possibility of many confounders including the difference in baseline characteristics and severity in illness; for example: Killip's class, hemodynamic status and the difference in patient care in different years. The patients with unstable hemodynamic or respiratory failure needed more time for initial treatment at the emergency room and inevitably longer DTB. Second, DTB time definition in the present study starting from the patient's arrival at Prince of Songkla University Hospital emergency department was different from those of previously reported studies. Again, DTB time may be only a surrogate of our team's experience in emergency PCI and treatment of patients with STEMI.

Conclusion

For emergency PCI, shortened DTB time, from any reasons, in each consecutive year was associated with lower in-hospital mortality. Regarding to procedural volume, increase in each type of PCI procedure especially emergency PCI procedure was associated with a decrease in-hospital mortality.

Potential conflicts of interest

None.

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ความสัมพันธ์ระหว่างปริมาณการทำหัตถการหลอดเลือดหัวใจระยะเวลา door to balloon และอัตราการเสียชีวิตภายในโรงพยาบาลของผู้ป่วยโรคกล้ามเนื้อหัวใจตายเฉียบพลันชนิดที่มีการยกของคลื่นไฟฟ้าหัวใจส่วน ST

นพดล ชำนาญผล, ตรีชฎา วิสารทพงศ์, สิริชัย ชีวธนากรณ์กุล

ภูมิหลัง: *การรักษาผู้ป่วยโรคกล้ามเนื้อหัวใจตายเฉียบพลันชนิดที่มีการยกของคลื่นไฟฟ้าหัวใจส่วน ST โดยการเปิดการไหลเวียนด้วยการทำหัตถการหลอดเลือดหัวใจแบบฉุกเฉินเป็นวิธีการรักษาที่ดีกว่า หากสามารถทำได้ตามกรอบเวลาในโรงพยาบาลที่มีประสบการณ์สูง จุดมุ่งหมายของการศึกษานี้ เพื่อประเมินความสัมพันธ์ระหว่างการทำหัตถการหลอดเลือดหัวใจชนิดต่าง ๆ ค่าเฉลี่ยของระยะเวลา door to balloon และอัตราการเสียชีวิตภายในโรงพยาบาลของผู้ป่วยโรคกล้ามเนื้อหัวใจตายเฉียบพลันชนิดที่มีการยกของคลื่นไฟฟ้าหัวใจส่วน ST ที่ได้รับการรักษาด้วยการทำหัตถการหลอดเลือดหัวใจแบบฉุกเฉิน*

วัสดุและวิธีการ: *ผู้นิพนธ์ทำการวิเคราะห์ข้อมูลจากทะเบียนผู้ป่วยโรคกล้ามเนื้อหัวใจตายเฉียบพลันชนิดที่มีการยกของคลื่นไฟฟ้าหัวใจส่วน ST และได้รับการรักษาด้วยการทำหัตถการหลอดเลือดหัวใจแบบฉุกเฉินที่โรงพยาบาลสงขลานครินทร์ ระหว่างเดือนมกราคม พ.ศ. 2550 ถึงเดือนธันวาคม พ.ศ. 2553 การวิเคราะห์ความสัมพันธ์กระทำโดยใช้สัมประสิทธิ์ความสัมพันธ์ของเพียร์สัน*

ผลการศึกษา: *มีการทำหัตถการหลอดเลือดหัวใจทั้งสิ้น 1,501 ครั้ง ในจำนวนนี้รวมถึงการทำหัตถการหลอดเลือดหัวใจแบบฉุกเฉินทั้งหมด 355 ครั้ง ปริมาณการทำหัตถการหลอดเลือดหัวใจโดยรวม แบบฉุกเฉินและไม่ฉุกเฉินเพิ่มขึ้นต่อเนื่องทุกปี โดยที่ค่าเฉลี่ยของระยะเวลา door to balloon และอัตราการเสียชีวิตภายในโรงพยาบาลลดลงอย่างต่อเนื่องเช่นกัน เมื่อวิเคราะห์ความสัมพันธ์พบว่า ค่าเฉลี่ยของระยะเวลา door to balloon มีความสัมพันธ์เชิงบวกในทางตรงข้ามปริมาณการทำหัตถการหลอดเลือดหัวใจทุกแบบ มีความสัมพันธ์เชิงลบกับอัตราการเสียชีวิตในโรงพยาบาลตามลำดับ*

สรุป: *ค่าเฉลี่ยของระยะเวลา door to balloon ที่สั้นลง ด้วยสาเหตุใด ๆ ก็ตาม สัมพันธ์กับการลดลงของอัตราการเสียชีวิตภายในโรงพยาบาล ปริมาณการทำหัตถการหลอดเลือดหัวใจที่มีจำนวนมากขึ้น โดยเฉพาะการทำหัตถการหลอดเลือดหัวใจแบบฉุกเฉินมีความสัมพันธ์กับอัตราการเสียชีวิตภายในโรงพยาบาลที่ลดลงเช่นกัน*