Percutaneous Coronary Intervention in Thammasat University Hospital: the First Three-Year Experience

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Objective: To study the results of percutaneous coronary intervention (PCI) and in-hospital outcomes in cardiac catheterization laboratory, Thammasat University Hospital since May, 2006 until April, 2009.

Material and Method: This is the prospective, single-center study. The consecutive patients who underwent PCI in Thammasat University Hospital since May 2006 to April 2009 were recruited in the study. Clinical data, angiographic data, and in-hospital outcomes were analyzed and demonstrated.

Results: Six hundred and seventeen patients undergoing 755 PCI procedures were enrolled in the study. 62.70% were male and 37.30% were female. Mean age was 65.45 ± 11.21 years (range 33-97 years) and 20.10% were more than 75 years old. The indications for PCI were non-ST segment-elevation acute coronary syndrome (NSTEACS) (41.72%), chronic stable angina (25.32%), acute ST segment elevation myocardial infarction (STEMI) (8.87%), staged PCI (15.76%). The other indications were heart failure, cardiomyopathy, post-cardiac arrest and etc. The procedure was single vessel PCI in 73.25% and multivessel PCI in 26.75% (double vessels PCI 24.64% and triple vessels PCI 2.11%). According to lesion locations, 45.21% were left anterior descending (LAD) artery lesions, 30.09% were right coronary artery (RCA) lesions, 23.28% were left circumflex (LCX) artery lesions, 1.19% were left main (LM) lesions and 0.24% were graft lesions. The overall angiographic success rate was 95.57%. During hospital stay the major adverse events developed as death in 0.93%, periprocedural myocardial infarction in 3.17%, emergency coronary artery bypass graft in 0.53%, and stroke in 0.26%.

Conclusion: During the first three years of PCI experience in Thammasat University Hospital, the overall success rate was high with low in-hospital adverse outcomes.

Keywords: Percutaneous coronary intervention (PCI), Coronary artery disease (CAD)

Since Gruentzig A. introduced the technique of percutaneous transluminal coronary angioplasty (PTCA) for treatment of coronary artery disease (CAD) patients in 1977[1], this procedure grew rapidly with evolving technology and expanding indications. The development includes various forms of catheter-based atherectomy, bare metallic stent (BMS), drug eluting stent (DES), etc which have largely solved earlier problems of the treated segments. The new term "percutaneous coronary intervention (PCI)" has been introduced instead of PTCA as it can represent either conventional balloon angioplasty or balloon angioplasty in combination with other devices. After more than 30 years, the numbers of annual PCI procedures grew to nearly 2,000,000 worldwide[2]. In Thailand PTCA was first introduced by Dr Chakorn T at the Central Chest Hospital in 1989[3] and the numbers of annual PCI procedures reached more than 12,000 in 2008 (data from Cardiac Intervention Society of Thailand).

Cardiac catheterization laboratory in Thammasat University Hospital has been opened since May, 2006 with two full-time interventionists. Most of the patients came from Northern Bangkok and suburb area. This study was aimed to describe the data of CAD patients who underwent PCI in this institution during the first three-year experience.

Material and Method

Study population

From May 2006 to April 2009, the patients who underwent PCI at Thammasat University Hospital were enrolled to the study. Demographic data, risk factors, clinical data, laboratory results, indications for PCI,

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angiographic data, initial results of treatment (angiographic success, procedural success), in-hospital outcomes were recorded prospectively.

Definition

Significant CAD was defined as luminal stenosis ≥ 50% in left main artery or ≥ 70% in other coronary territories. Percutaneous coronary intervention (PCI), commonly known as coronary angioplasty, is one therapeutic procedure used to treat the narrowed coronary arteries of the heart. Typically, PCI is performed by threading a slender balloon-tipped tube-a catheter-from an artery in the groin or arm to a trouble spot in coronary artery. The balloon is then inflated, compressing the plaque and dilating (widening) the narrowed coronary artery so that blood can flow more easily. This is often accompanied by inserting an expandable metal stent. Angiographic success was defined as a residual stenosis < 20% in the presence of grade 3 Thrombolysis In Myocardial Infarction (TIMI) flow. Procedural success was defined as angiographic success without major clinical complications (*e.g.* death, myocardial infarction (MI), emergency coronary artery bypass graft surgery) during hospitalization. Periprocedural MI was defined as a new CK-MB or troponinT rise greater than 5 times the upper limit of normal. Contrast-induced nephropathy (CIN) was defined as creatinine rising from baseline ≥ 25% or ≥ 0.5 mg/dL within 48 hours after PCI. Major bleeding is defined as intracranial, intraocular, or retroperitoneal hemorrhage or any

Table1. Baseline clinical characteristics of patients

Clinical characteristics	n = 617
Male (%)	387 (62.70)
Age (years) mean ± SD	65.45 ± 11.21
History/risk	
Previous MI > 7 days (%)	309 (49.9)
Previous PCI (%)	52 (8.4)
Previous CABG (%)	11 (1.8)
Previous CVA/TIA (%)	57 (9.2)
Peripheral artery disease (%)	42 (6.8)
Family history of premature CAD (%)	49 (7.9)
Hypertension (%)	477 (77.3)
Dyslipidemia (%)	467 (75.7)
Smoking: current (%)	119 (19.3)
Diabetes mellitus	275 (44.6)
Chronic renal failure	110 (17.8%)
Mean LVEF (%)	51.56
LVEF < 30% (%)	8.34
Congestive heart failure (%)	9.93

hemorrhage requiring a transfusion or surgical intervention or that results in a hematocrit decrease of greater than 15% or hemoglobin decrease of greater than 5 g/dL. Major hematoma is defined as hematoma of at least 5 cm in diameter at access sites.

Statistical analysis

Data was expressed as mean ± standard deviation (SD) for continuous variables and as frequencies for categorical variables. For continuous data, the two-tailed *t*-test was used to assess differences between the two groups. For categorical data, the Chi-square test was used to assess differences between the two groups. Statistical significance was defined as p-value < 0.05. All statistical analysis were performed using SPSS software version 16, SPSS inc, Chicago, Illinois.

Results

Six hundred and seventeen patients underwent 755 PCI (with 1263 lesions) procedures from May 2006 to April 2009. Baseline characteristics are shown in Table 1. Most of the patients were male (62.70%). The patients were aged from 33 to 97 years and 20.10% of patients were more than 75 years-old. From clinical history, 10.20% had previous revascularization (8.40% PCI and 1.80% CABG). Significant numbers of the patients had history of previous vascular diseases (previous MI more than 7 days, previous CVA/TIA, peripheral artery disease). The indications for PCI were non-ST-segment-elevation myocardial infarction (NSTEMI) (21.59%), unstable angina (20.12%), chronic stable angina (25.32%), acute ST-segment-elevation myocardial infarction (STEMI) (8.87%) and staged PCI (15.76%). Other indications were heart failure, cardiomyopathy, post-cardiac arrest, etc. 9.93% of patients had congestive heart failure and 1.72% had cardiogenic shock. Mean left ventricular ejection fraction (LVEF) was 51.56% and 8.34% had less than 30% LVEF.

Angiographic and procedural characteristics are shown in Table 2. The procedures were done via femoral approach in 99.6% and via radial approach in 0.4%. Most of the procedures were single vessel PCI (73.25%). According to ACC/AHA lesion type[2], 14.17% were type A, 40.62% were type B1, 14.25% were type B2 and 30.96% were type C. The lesions were bifurcation 18.92%, ostial 6.18%, chronic total occlusion (CTO) 6.49% and retaining thrombus was found in 4.75%, The mean of reference vessel size was 2.66 ± 0.43 mm (range from 1.40 mm to 4.89 mm). The mean of

Table 2. Angiographic and procedural charactistics

Angiographic and procedural charactistics	755 procedures (1263 lesions)
Lesion location (%)	
Left main	1.19
LAD	45.21
LCX	23.28
RCA	30.09
Grafts	0.24
Lesion types (%)	
A	14.17
B1	40.62
B2	14.25
C	30.96
Number of vessel PCI per procedure (%)	
1 vss PCI	73.25
2 vss PCI	24.64
3 vss PCI	2.11
Mean initial stenosis (%) (min-max)	83.62 (20-100)
Reference vessel diameter (mean in mm $\pm$ SD)	2.66 $\pm$ 0.43
Lesion length (mean in mm $\pm$ SD)	15.72 $\pm$ 8.22
Stent diameter (mean in mm $\pm$ SD)	2.85 $\pm$ 0.54
Stent length (mean in mm $\pm$ SD)	20.19 $\pm$ 9.21
Stent number per procedure	1.68
BMS/ DES usage (%/%)	36.72 / 63.28
Direct stenting (%)	4.75
High-pressure post dilatation (%)	24.70
Angiographic success (%)	95.57
Procedural success (%)	92.20

lesion length was 15.72 $\pm$ 8.22 mm (range from 1 mm to 52 mm). 93.38% of the treated lesions were stented and only 6.62% of the lesions were treated by plain old balloon angioplasty (POBA). More than half (63.28%) of stents used were DES and 36.72 % were BMS. The average of stents used was 1.68 per procedure with mean diameter 2.85 $\pm$ 0.54 mm and mean length 20.19 $\pm$ 9.21 mm. The techniques used were direct stenting in 4.75%, post-dilatation in 24.7%, final kissing balloon in 5.15%, with thrombus aspiration devices in 0.71% and with distal protection devices in 0.08%. Medication used prior and in the cardiac cath lab are shown in Table 3. Most of the patients received aspirin and clopidogrel prior to cath lab (92.84% and 72.98% respectively). Almost all the cases used heparin as anticoagulant in the cath lab (98.28%).

Glycoprotein IIb/IIIa inhibitors were used in 19 cases (2.51%). Intra-aortic balloon counterpulsation (IABP) was inserted in 1.19%. Vascular closure device was used in 11.13%. The average contrast media used per procedure was 173.11 $\pm$ 61.55 ml. The angiographic

Table 3. Medications prior and in the catheterization laboratory

Medications	Prior to cath lab	In the cath lab
Aspirin (%)	92.84	0.40
Clopidogrel (%)	72.98	27.15
Ticlopidine (%)	0.26	-
Low-molecular weight heparin (%)	36.49	0.13
Unfractionated heparin (%)	0.13	98.28
Eptifibatide (%)	0.13	2.38
Intravenous nitroglycerine (%)	6.50	36.82
Intravenous atropine (%)	-	0.79

complications were major dissection 1.9%, no reflow 0.24%, perforation 0.39%, side branch occlusion 0.32%. The overall angiographic success rate was 95.77% (95.13% in the first year, 95.46% in the second year and 96.08% in the third year respectively). Average luminal stenosis reduced from 83.61% to 5.32%. The procedural

success rate was 92.20%. During in-hospital stay death occurred in 0.93%, MI in 3.17%, stroke in 0.26% and emergency CABG in 0.53%. The other in-hospital complications were major bleeding/hematoma 6.36%, ventricular fibrillation/ventricular tachycardia (VF/VT) 0.66%, cardiac tamponade 0.13%, contrast-induced nephropathy (CIN) 5.83%, allergy to contrast agent 0.53% and vaso-vagal reaction 4.64%. All in-hospital adverse events are shown in Table 4.

Discussion

PCI is one of the standard treatments for CAD patients. There are several guidelines for PCI such as ACC/AHA/SCAI 2005 guideline and 2007 focused update guideline, etc. As other institutions, the practice in this study group mainly followed the major guidelines. The population mean age is 65.45 years with 20.10% older than 75 years old. The age of population is not different from previous studies in Thailand and other countries which the mean age of studied population were 61 to 68 years[4-7]. This is the natural course of CAD that usually occurs in elderly. Most of the patients had at least one risk factor for atherosclerosis such as hypertension, dyslipidemia, diabetes mellitus, current smoking or family history of premature coronary artery disease. Coexisting vascular diseases were found not infrequently *i.e.* previous CVA/TIA in 9.20%, peripheral arterial disease (PAD) in 6.80%. The most common indication was NSTEACS (41.71%). The reason is explained that Thammasat University Hospital is the referral center for heart disease and frequently admitted NSTEACS patients from other hospitals for coronary angiogram ± angioplasty. This is the same as the trend from previous report demonstrated the shift of PCI indication towards acute coronary syndrome[8]. We did multivessel PCI in 26.75% and type C lesion in 30.96% and this is the same as the trend towards more complex PCI in the last decade as well. The overall angiographic success rate was 95.57% that was not different from contemporary results from other studies in which success rates were 91-98%[3-6,9,10]. In the failed lesions (4.43%), all were lesion type C in which 50% were classified as chronic total occlusion (CTO). However, from all 82 CTO lesions which underwent PCI, 54 lesions (65.85%) were successfully treated. Major in-hospital complications are death which occurred in 0.93%. This is comparable to analyses from large registries that indicate overall unadjusted in-hospital death rate of 0.4-1.9%[9-13]. All causes of death were cardiac causes. The details of death cases are shown in Table 5. Periprocedural MI occurred in 3.17%. It was most commonly due to abrupt coronary occlusion or intracoronary embolization of obstructive debris. Rates of periprocedural MI in the previous reports have ranged from 0.4-4.9%[3,10,13,14] but gradually declined with the routine use of intracoronary stents. Emergency CABG and stroke occurred in 0.53% and 0.26% respectively. The rate of emergency CABG was low with the availability of stents as previously reported of about 0.4-1.6%[3,12,15,16], and the rate of stroke

Table 4. In-hospital outcomes of patients

In-hospital outcomes	%
Death	0.93
Periprocedural MI	3.17
Emergency CABG	0.53
Stroke	0.26
Major bleeding / hematoma	6.36
Non-entry site bleeding	0.26
Ventricular tachycardia/ fibrillation	0.66
Cardiac tamponade	0.13
Cardiogenic shock	0.66
Contrast-induced nephropathy	5.83
Allergy to contrast agents	0.53
Vaso-vagal reaction	4.64

Table 5. Details of death cases

Numberof cases	Indications for PCI	Death In cath lab	Day of death after PCI	Causes of death
1	STEMI	No	0	Acute inferior wall MI
2	STEMI	No	3	VT, ARF
3	NSTEMI	Yes	0	Cardiogenic shock, PEA
4	STEMI	No	4	Cardiogenic shock
5	Unstatble angina	No	0	Cardiogenic shock
6	NSTEMI	No	1	Sudden cardiac death (PEA)
7	NSTEMI	No	0	VF

was as low as reported in a contemporary period of about 0.2-0.4%[13,16].

Conclusion

During the first three years of PCI experience in Thammasat University Hospital, the overall success rate was high with low in-hospital adverse outcomes. When compared to the literatures, the results of PCI in this report is not different from others.

Acknowledgements

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การศึกษาผลของการรักษาผู้ป่วยหลอดเลือดหัวใจตีบโดยการถ่างขยายด้วยบอลลูนและขดลวดในระยะ 3 ปีแรก ในโรงพยาบาลธรรมศาสตร์เฉลิมพระเกียรติ

ดิลก ภิยโยทัย, พิสิษฐ หุตะยานนท์

วัตถุประสงค์: เพื่อศึกษาถึงผลการรักษาผู้ป่วยหลอดเลือดหัวใจตีบโดยการถ่างขยายด้วยบอลลูนและขดลวด ในผู้ป่วยที่มาเข้ารับการรักษา ตั้งแต่ เดือนพฤษภาคม พ.ศ. 2549 จนถึง เดือนเมษายน พ.ศ. 2552

วัสดุและวิธีการ: เป็นการศึกษาแบบ prospective study ในผู้ป่วยโรคหลอดเลือดหัวใจตีบที่เข้ารับการรักษาโดยการ ถ่างขยายด้วยบอลลูน และขดลวดที่ห้องปฏิบัติการตรวจสวนหัวใจ โรงพยาบาลธรรมศาสตร์เฉลิมพระเกียรติ ตั้งแต่เดือนพฤษภาคม พ.ศ. 2549 ถึงเดือนเมษายน พ.ศ. 2552 โดยข้อมูลผู้ป่วยทั้งลักษณะทางคลินิกลักษณะรอยโรค ที่หลอดเลือดหัวใจ ผลการรักษาด้วยการถ่างขยายด้วยบอลลูน และขดลวดจนกระทั่งถึงเมื่อผู้ป่วยออกจาก โรงพยาบาลจะถูกนำมาวิเคราะห์และนำแสดง

ผลการศึกษา: ผู้ป่วยโรคหลอดเลือดหัวใจตีบจำนวน 617 รายได้รับการรักษาด้วยการถ่างขยายด้วยบอลลูนรวม 755 procedures ส่วนมากเป็นเพศชายจำนวน ร้อยละ 62.70 ส่วนที่เหลือร้อยละ 37.30 เป็นเพศหญิง อายุเฉลี่ยผู้ป่วย 65.45 ± 11.21 ปี (ช่วงอายุ 33 ถึง 97 ปี) และมีจำนวนร้อยละ 20.10 ที่มีอายุมากกว่า 75 ปี ข้อบ่งชี้ของการรักษาได้แก่ non-ST segment-elevation acute coronary syndrome (NSTEACS) ร้อยละ 41.72, chronic stable angina ร้อยละ 25.32, acute ST segment elevation myocardial infarction ร้อยละ 8.87, staged PCI ร้อยละ 15.76 ส่วนข้อบ่งชี้อื่นๆ ได้แก่ heart failure, cardiomyopathy, post-cardiac arrest และอื่นๆ การรักษาเป็นการถ่างขยาย หลอดเลือด 1 เส้นจำนวนร้อยละ 73.25 และหลอดเลือดหลายเส้นจำนวนร้อยละ 26.75 (double vessels 24.64% and triple vessels 2.11%) ตำแหน่งที่รักษาเป็นหลอดเลือด left anterior descending (LAD) artery จำนวน ร้อยละ 45.21, หลอดเลือด right coronary artery (RCA) จำนวน ร้อยละ 30.09, หลอดเลือด left circumflex (LCX) จำนวนร้อยละ 23.28, หลอดเลือด left main จำนวนร้อยละ 1.19 และ grafts จำนวนร้อยละ 0.24 ผลสำเร็จในการขยาย หลอดเลือดเป็นจำนวนร้อยละ 95.57 และระหว่างเข้ารับการรักษาตัวในโรงพยาบาลมีผลข้างเคียงเกิดขึ้นดังนี้ การเสียชีวิตร้อยละ 0.93, ภาวะกล้ามเนื้อหัวใจตายเฉียบพลันร้อยละ 3.17, การผ่าตัดหลอดเลือดทางเบี่ยงหัวใจร้อยละ 0.53 และอัมพฤกษ์อัมพาตร้อยละ 0.26

สรุป: ผลการรักษาผู้ป่วยโรคหลอดเลือดหัวใจตีบด้วยการถ่างขยายด้วยบอลลูน และใส่ขดลวดในห้องปฏิบัติการ ตรวจสวนหัวใจ โรงพยาบาลธรรมศาสตร์เฉลิมพระเกียรติ ในช่วง 3 ปีแรก พบว่ามีอัตราความสำเร็จสูง และผล ข้างเคียงในระยะสั้นก่อนออกจากโรงพยาบาลต่ำ