Original Research Paper

Volume-9 | Issue-10 | October - 2019 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Cardiology

OUTCOMES OF PRIMARY ANGIOPLASTY IN PATIENTS WITH ST-ELEVATION MYOCARDIAL INFARCTION – A HIGH VOLUME TERTIARY-CARE CENTRE STUDY

Kala Jeethender Kumar	MD, DM, Assistant professor, Department of cardiology, Nizams institute of medical sciences
Sudhakar Kanumuri*	DM, Department of cardiology, Nizams institute of medical sciences *Corresponding Author
O. Sai Satish	MD, DM, HOD & Professor, Department of Cardiology, Nizams institute of medical sciences
M. Jyotsna	MD.,DM, Professor, Department of Cardiology, Nizams institute of medical sciences
B. Srinivas	MD, DM, Additional professor, Department of Cardiology, Nizams institute of medical sciences
N. Rama Kumari	MD, DM, Additional Professor, Department of Cardiology, Nizams institute of medical sciences
K. Satya Bharathi Lakshmi	Assistant professor, Department of Cardiology, Nizams institute of medical sciences
Rajender Betham	DM, Department of Cardiology, Nizams institute of medical sciences
Anil Kumar Enikapalli	DM, Department of Cardiology, Nizams institute of medical sciences

ABSTRACT

Aim: To determine the clinical safety and outcomes of primary angioplasty in ST-Elevation Myocardial Infarction (STEMI) patients.

METHODS: A retrospective, observational study included 548 STEMI patients who underwent primary percutaneous coronary intervention (PPCI) in our hospital within 12–hours of symptom onset between January 2013 and December 2014 were included in the study. Primary endpoint was considered as in-hospital mortality and secondary endpoint was considered as 6-months clinical outcomes (Death, myocardial infarction, target lesion revascularization, target vessel revascularization (TVR), stent thrombosis and major/minor bleeding).

RESULTS: In-hospital mortality was observed in 20 (3.6%) patients. TVR, major and minor bleeding was observed in 5 (0.9%), 5 (0.9%) and 11 (2.0%) patients, respectively. At 6-months follow-up, 5 (0.9%) patients died and 5 (0.9%) patients had TVR.

CONCLUSION: This study suggests that PPCI for STEMI can be safely performed in a regional institution with an acceptable door-to-balloon time and low major adverse cardiac event rates.

KEYWORDS : Coronary artery disease; door-to-balloon time; percutaneous coronary intervention; ST-segment elevation myocardial infarction

INTRODUCTION

Acute ST-elevation myocardial infarction (STEMI) is caused by the rupture or erosion of an atherosclerotic plaque of a coronary artery and initiates intra-luminal thrombosis which results in partial or complete occlusion of the affected coronary artery (Davies & Thomas, 1984; Falk, 1983). Reperfusion therapy with the primary percutaneous coronary intervention (PCI) has become the current standard treatment of choice for STEMI patients. However, reperfusion therapy has been indicated for acute STEMI patients only if they arrive within the ideal time. Over the period of time, the prognosis of in-hospital mortality rates has improved from 11.2% to 9.4% (W. J. Rogers et al., 2000). This decline in mortality rate is due to the use of thrombolytic agents and the advent of primary PCI.

Primary PCI is defined as an intervention of the infarct-related vessel within 12–hours after the onset of symptoms and without prior thrombolytic therapy (Silber et al., 2005). It has been performed since 1979 but the randomized clinical trials conducted in 1993 showed superior efficacy and safety of primary PCI over thrombolysis (Gibbons et al., 1993; Grines et al., 1993; Rentrop, Blanke, Wiegand, & Karsch, 1979; Zijlstra et al., 1993). Since then, primary PCI has been implemented in daily clinical practice and has become available for a broad range of patients. In a hospital with angioplasty facilities, primary PCI is considered to be superior to thrombolytic treatment for STEMI patients (Andersen et al., 2003; E. Keeley & Grines, 2005; Members et al., 2004). Door-to-balloon time (D2B) plays an important key role in the success of primary PCI (Cannon, Antman, Walls, & Braunwald, 1994; Cannon et al., 2000). Therefore, this study was conducted to determine the clinical safety and survival outcomes of primary angioplasty in patients with STEMI.

MATERIALS AND METHODS

Study Design and Patient Population

This was a retrospective, observational study conducted at a tertiary-care center in India between January 2013 and December 2014. A total of 548 STEMI patients who underwent primary PCI in our catheterization laboratory within 12 hours of symptom onset were included in the study. Also, patients were included if the electrocardiogram (ECG) at admission showed ST-segment elevation of at least 0.1 mV in minimum two contiguous leads as well as true posterior myocardial infarction or new (or presumably new) left bundle branch block. Signed inform consent forms were obtained from all the patients enrolled in the study. The protocol of the study was approved by the institutional ethics committee of the hospital.

Study intervention

All these patients underwent primary PCI as a mode of reperfusion through the femoral route. Before the intervention, all patients were administered with dual antiplatelet drugs (aspirin 325 mg upon arrival, and then 100 mg daily, clopidogrel 300 or 600 mg) as a loading dose, unfractionated heparin 100 U/Kg body weight or 60 U/Kg body weight if abciximab was given. The intravenous administration of abciximab was at the discretion of the operator. After the intervention, heparin therapy was stopped in all the cases but it was continued in the patients who underwent intra-aortic balloon counterpulsation (IABP). If administered, Abciximab infusion was continued for 12 hours after the procedure. If not contraindicated, beta-adrenergic blockers, angiotensin-converting-enzyme (ACE) inhibitors, and statins were

used as an in-hospital standard therapy. The ECG was recorded in all patients to assess the left ventricular ejection fraction (LVEF) by Simpson's rule (E. Rogers, Feigenbaum, & Weyman, 1979) and to exclude mechanical complications (i.e. cardiac tamponade, interventricular septum or left ventricular free wall rupture, acute mitral regurgitation due to papillary muscle rupture).

Data Collection and Follow-Up

Patient demographic details such as history of diabetes (defined as a fasting glucose > 126 mg/dl or on treatment), hyperlipidemia (fasting cholesterol > 200 mg/dl or on treatment), hypertension (systolic blood pressure > 140/90 mmHg or on treatment), left ventricular function (visually estimated, using either echocardiography or left ventriculography), presence of cardiogenic shock (defined as a systolic blood pressure of < 90 mmHg or requirement of inotropes to maintain a systolic blood pressure > 90 mmHg) were collected from the medical records. Clinical and angiographic characteristics (culprit vessel, number of diseased vessels, and the use of stents) were also collected from the patient's clinical records. Follow-up information was obtained from the patient's general physician or through a telephonic interview with the patient.

End-Points and Definitions

In this study, the primary endpoint was considered as in-hospital mortality. The secondary endpoint was 6-month outcomes such as death from any cause, recurrent myocardial infarction, target lesion revascularization (TLR), target vessel revascularization (TVR), stent thrombosis and major or minor bleeding. Myocardial infarction was defined as the reoccurrence of clinical symptoms or new ECG changes or re-elevation of creatine kinase MB fraction. TLR was defined as re-interventions inside the implanted stent during the index procedure or within 5 mm proximal or distal to the stent. TVR was defined as the other repeated PCI in the same vessel. Stent thrombosis was defined as definite and probable according to the Academic Research Consortium (Mauri et al., 2007). Bleeding was defined according to the Thrombolysis in Myocardial Infarction (TIMI) classification (Cannon et al., 2001).

Statistical Analysis

Continuous variables were expressed as mean ± standard deviation and categorical variables were expressed as counts and percentages. The event-free survival curve was calculated according to the Kaplan-Meier method. Analysis was performed by using statistical package for social sciences (SPSS version 15; Chicago, Illinois, USA) software.

RESULTS

Baseline Demographics and Lesion Characteristics

A total of 548 patients were included in the study. The mean age of the study population was 54.5 ± 11.5 years. There was a male predominance [463 (84.5%) patients]. Among 463 patients, 389 (71%) male patients were aged <60 years. Risk factors such as smoking [267 (48.7%) patients] was observed in majority of the population followed by hypertension [208 (38.0%) patients] and diabetes [196 (35.8%) patients]. At hospital admission, Cardiogenic shock, complete heart block and ventricular tachycardia/ ventricular fibrillation were encountered in 31 (5.7%), 40 (7.3%) and 49 (8.9%) patients, respectively. The mean left ventricular ejection fraction (LVEF) was found to be 44.0 ± 7.9% and 51 (9.3%) patients experienced Killip's class III/IV acute myocardial infarction. The average D2B time was 62.5 ± 15.0 minutes. In 110 (20.1%) patients, estimated glomerular filtration rate (eGFR) was less than 60ml/min. The demographic and clinical characteristics of the study population are summarized in

Table 1.

Angiographic characteristics

The most common culprit vessel involved in this study was the left anterior descending (LAD) [318 (58.0%) patients] artery. The angiographic and procedural details of the patients undergoing primary PCI are shown in **Table 2**. Thrombus aspiration was performed in 159 (29.0%) patients. Stents were deployed in 529 (96.5%) patients with an average stent length of 19.2 ± 5.2 mm.

Clinical Outcomes

In-hospital and 6-months clinical outcomes are mentioned in **Table 3**. Death in the catheterization laboratory or within 24 hours of hospital admission was occurred in 20 (3.6%) patients out of which 15 (2.7%) patients died from the cardiac cause. Target vessel revascularization, major bleeding and minor bleeding observed in 5 (0.9%), 5 (0.9%) and 11 (2.0%) cases respectively. After patient discharge from the hospital, 6-months outcomes of the studied showed no major complications except, 5 (0.9%) deaths and 5 (0.9%) cases of TVR.

DISCUSSION

Our primary PCI registry holds data on consecutive patients with acute STEMI, from single high volume tertiary-care center with enormous operator experience in performing primary PCI. Primary PCI improved patients' prognosis compared to intravenous thrombolytic therapy (E. C. Keeley, Boura, & Grines, 2003). Due to the superior efficacy and safety of primary PCI over thrombolysis, primary PCI has become the routine clinical practice in our center. Both European and American guidelines state that primary PCI is the preferred therapeutic option in patients with STEMI admitted within 90 min after diagnosis (Members et al., 2004; Van de Werf et al., 2003).

Several randomized clinical trials have shown the association between stent use in combination with primary PCI and outcomes but the results remained unknown (Ahmad, Webb, Carere, & Dodek, 1995; Antoniucci et al., 1998; De Luca et al., 2006; E. Rogers et al., 1979). Few studies from India including a study by Reddy et al. concluded that primary PCI is safe and effective with high procedural success (99%) and lower rates of recurrent ischemic events (5%) (Reddy et al., 1999). Also, a Study by Ranjan et al. (Ranjan et al., 2005) showed a good procedural success rate (98%) even with transradial approach which is technically more demanding. Primary PCI continues to evolve and it has changed most radically with adjunctive therapy glycoprotein IIb/IIIa inhibitors, thienopyridines as well as reliance on stent implantation (Antoniucci et al., 1998; Montalescot, Borentain, Payot, Collet, & Thomas, 2004; Sabatine et al., 2005; Suryapranata, van't Hof, Hoorntje, de Boer, & Zijlstra, 1998). Furthermore, extensive use of aspirin, statins, beta-blockers and the common use of ACE inhibitors may further reduce morbidity and mortality (Collins, Peto, Baigent, & Sleight, 1997; Hennekens, Albert, Godfried, Gaziano, & Buring, 1996; Pfeffer et al., 1992) Many clinical trials comparing the efficacy of thrombolysis and primary PCI have concluded that superior outcomes can be obtained with an invasive approach.

A meta-analysis by Keeley and colleagues (E. C. Keeley et al., 2003) demonstrated that primary PCI was better than thrombolytic therapy in reducing overall short-term death (p=0.0002), non-fatal reinfarction (p<0.0001), stroke (p=0.0004), and the combined endpoint of death, non-fatal reinfarction, and stroke (p<0.0001). A more recent evaluation of patients recruited into the PRAGUE-2 Study found that the incidence of reinfarction, revascularization, and death from all causes was considerably reduced in those patients randomized to the PCI arm compared to thrombolytic arm with p-value of 0.009, <0.001 and 0.06, respectively after 5 years of the procedure (Widimsky et al., 2007). The possible risks associated with primary PCI include bleeding, procedure-related immediate complications and radiographic contrast related acute renal failure (Aversano et al., 2002). The majority of the study population included in this study were from rural areas and support the guidelines based on the approach to primary PCI for STEMI in the rural population.

The study group has demonstrated the younger age of patients with a high prevalence of smoking, diabetes, and hypertension. Dedicated teamwork made possible to achieve short D2B time, high procedural success rate, reduced mortality along improved survival. Results are sustained at 6 months follow-up. This study shows that primary PCI for STEMI can be delivered successfully in rural setting of India with satisfactory D2B time, low mortality and minimal adverse effect. Mortality during hospital admission and after 6-month follow-up was 3.6% and 0.9% respectively. This compares favorably with data from randomized controlled trials. The Meta-analysis of 23 trials showed short-term mortality rate of 7% (E. C. Keeley et al., 2003). In this study, the mean D2B time was found to be 63 minutes and within the range (90 min) recommended by both the American and European guidelines (Members et al., 2004; Van de Werf et al., 2003).

A further decrease in D2B time is desirable, however it might be not essay to achieve it due to the time consuming procedures required prior to ballooning such as diagnosis, moving the patient to the coronary care unit, initiation of pre-PCI medication taking the patient to the cath-lab then beginning of PCI procedure and finally balloon dilatation. Thrombus aspiration during primary PCI showed better reperfusion and clinical outcomes in patients with primary PCI for STEMI when compared with conventional PCI(Svilaas et al., 2008). However, Thrombus aspiration during STEMI did not reduce 30 day

mortality(Fröbert et al., 2013). In the present study, patients who underwent manual thrombus aspiration had higher post procedure TIMI-flow and ST-segment resolution. Presence of baseline renal failure was associated with increased short term and long term mortality.

STUDY LIMITATIONS

This study does have few limitations. First of all, this is not a comparative study with other hospitals. Secondly, our work represents a retrospective study, and is therefore subject to the limitations of such analyses. Third, the data are derived from a single-center, which limits the extension of the applicability of the results. In addition, we analyzed only the 6-months mortality. Therefore, it is not possible to extend the results beyond the acute phase and to other major cardiovascular events. Finally, the confounders of aneurismal dilation, recurrent MI by biomarkers, other predisposing factors are not excluded, that may have negative impact on study.

CONCLUSIONS

Primary PCI is a reperfusion strategy that can be performed safely and effectively in unselected high-risk STEMI patients in a regional institution with acceptable D2B time and low major adverse cardiac event rates. Due to wider availability of primary PCI, this procedure can be performed more frequently as a first-line treatment for STEMI patients by eliminating thrombolytic therapy as first choice therapy.

ACKNOWLEDGEMENT: None
DECLARATION:
Funding source: None
Conflict of interest: None

TABLE LEGENDS

Table 1: Patient demographics and clinical characteristics of the study population
Table 2: Angiographic characteristics of the study population
Table 3: Clinical Outcomes of the study population

Table 1: Patient demographics and clinical characteristics of the study population

Variables	Total (n=548)
Age (mean ± SD, years)	54.5 ± 11.5
Male, n (%)	463 (84.5%)
Body mass index (mean ± SD, kg/m2)	24.1 ± 4.1
Cardiac risk factors	
Diabetes mellitus, n (%)	196 (35.8%)
Current smokers, n (%)	267 (48.7%)
Renal insufficiency, n (%)	4 (0.7%)
Random blood sugar (mg/dl)	179.4 ± 79.0
Prior cerebral vascular accident, n (%)	22 (4.0%)
Hypertension, n (%)	208 (38.0%)
Door-to-balloon time (mean ± SD, minutes)	62.5 ± 15.0
First monitored rhythm	
Cardiogenic shock, n (%)	31 (5.7%)
Complete Heart Block, n (%)	40 (7.3%)
Ventricular tachycardia / Ventricular Fibrillation, n (%)	49 (8.9%)
Atrial fibrillation, n (%)	10 (1.8%)
Re-Infract, n (%)	15 (2.7%)
Bleeding, n (%)	33 (6.0%)
Renal failure, n (%)	39 (7.1%)
Cerebrovascular accident, n (%)	4 (0.7%)
Pericarditis, n (%)	9 (1.6%)
Left ventricular failure / Pulmonary edema, n (%)	40 (7.3%)
Left ventricular Ejection fraction (%)	44.0 ± 7.9
Hemodynamic Parameters	
Systolic Blood Pressure (mean ± SD, mmHg)	122.4 ± 24.5
Diastolic Blood Pressure (mean ± SD, mmHg)	78.4 ± 15.2
Killip's Class	
Class - 1, n (%)	320 (58.4%)
Class - 2, n (%)	177 (32.3%)
Class - 3, n (%)	37 (6.8%)
Class - 4, n (%)	14 (2.5%)
Laboratory findings	
Estimated Glomerular Filtration Rate (mean ± SD, mL/min)	84.2 ± 30.3
GFR > 60, n (%)	438 (79.9%)
GFR < 60, n (%)	110 (20.1%)

Table 2: Angiographic characteristics of the study population

Variables	Total (n=548)
Number of diseased vessels	
Single vessel disease, n (%)	366 (66.8%)
Double vessel disease, n (%)	147 (26.8%)
Triple vessel disease, n (%)	35 (6.4%)
Culprit vessel	
Left anterior descending, n (%)	318 (58.0%)
Left circumflex, n (%)	66 (12.0%)
Right coronary artery, n (%)	164 (29.9%)
Percutaneous coronary intervention patients	
Thrombus Aspiration, n (%)	159 (29.0%)
Stent Placement, n (%)	529 (96.5%)
Average stent length (mean ± SD, mm)	19.2 ± 5.2
Average stent diameter (mean ± SD, mm)	2.9 ± 0.6
Plain old balloon angioplasty, n (%)	19 (3.5%)
Direct Stenting, n (%)	43 (7.8%)
Temporary pacing implant, n (%)	71 (13.0%)
Thrombolysis in myocardial infarction (TIMI) Flow after procedure	
TIMI I/II, n (%)	21 (3.8%)
TIMI III, n (%)	527 (96.2%)
ST–segment resolution (mean ± SD, %)	57.2 ± 23.4
Procedure Time (mean ± SD, minutes)	25.9 ± 9.5
Fluoroscopic Time (mean ± SD, minutes)	8.5 ± 4.9

Table 3: Clinical Outcomes of the study population

Variables	Total (n=548)
In-hospital events	
Death, n (%)	20 (3.6%)
Cardiac Death, n (%)	15(2.7%)
Non-Cardiac Death, n (%)	5 (0.9%)
Target vessel revascularization, n (%)	5 (0.9%)
Major bleeding, n (%)	5 (0.9%)
Minor bleeding, n (%)	11 (2.0%)
Non infarct-related artery revascularization, n (%)	114 (20.8%)
6-months follow-up events	
Cardiac Death, n (%)	5 (0.9%)
Target vessel revascularization, n (%)	5 (0.9%)
Non infarct-related artery revascularization, n (%)	6 (1.1%)

REFERENCES

1. Ahmad, T., Webb, J. G., Carere, R. R., & Dodek, A. (1995). Coronary stenting for acute myocardial infarction. The American journal of cardiology, 76, 77-80.
2. Andersen, H. R., Nielsen, T. T., Rasmussen, K., Thuesen, L., Kelbaek, H., Thayssen, P., . . . Grande, P. (2003). A comparison of coronary angioplasty with fibrinolytic therapy in acute myocardial infarction. New England Journal of Medicine, 349, 733-742.
3. Antoniucci, D., Santoro, G. M., Bolognese, L., Valenti, R., Trapani, M., & Fazzini, P. F. (1998). A clinical trial comparing primary stenting of the infarct-related artery with optimal primary angioplasty for acute myocardial infarction: results from the Florence Randomized Elective Stenting in Acute Coronary Occlusions (FRESCO) trial. Journal of the American College of Cardiology, 31, 1234-1239.
4. Aversano, T., Aversano, L. T., Passamani, E., Knatterud, G. L., Terrin, M. L., Williams, D. O., . . . Team, A. C. P. O. R. (2002). Thrombolytic therapy vs primary percutaneous coronary intervention for myocardial infarction in patients presenting to hospitals without on-site cardiac surgery: a randomized controlled trial. Jama, 287(15), 1943-1951.
5. Cannon, C. P., Antman, E. M., Walls, R., & Braunwald, E. (1994). Time as an adjunctive agent to thrombolytic therapy. Journal of thrombosis and thrombolysis, 1, 27-33.
6. Cannon, C. P., Battler, A., Brindis, R. G., Cox, J. L., Ellis, S. G., Every, N. R., . . . Simoons, M. L. (2001). American College of Cardiology key data elements and definitions for measuring the clinical management and outcomes of patients with acute coronary syndromes: a report of the American College of Cardiology Task Force on clinical data standards (acute coronary syndromes writing committee) endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation, American College of Emergency Physicians, American Heart Association, Cardiac Society of Australia & New Zealand, National Heart Foundation of Australia, Society for Cardiac Angiography and Interventions, and the Taiwan Society of Cardiology. Journal of the American College of Cardiology, 38, 2114-2130.
7. Cannon, C. P., Gibson, C. M., Lambrew, C. T., Shoultz, D. A., Levy, D., French, W. J., . . . Tiefenbrunn, A. J. (2000). Relationship of symptom-onset-to-balloon time and door-to-balloon time with mortality in patients undergoing angioplasty for acute myocardial infarction. Jama, 283, 2941-2947.
8. Collins, R., Peto, R., Baigent, C., & Sleight, P. (1997). Aspirin, heparin, and fibrinolytic therapy in suspected acute myocardial infarction. New England Journal of Medicine, 336, 847-860.
9. Davies, M. J., & Thomas, A. (1984). Thrombosis and acute coronary-artery lesions in

sudden cardiac ischemic death. New England Journal of Medicine, 310, 1137-1140.
10. De Luca, G., Suryapranata, H., van't Hof, A. W., Ottervanger, J. P., Hoorntje, J. C., Dambrink, J.-H., . . . de Boer, M.-J. (2006). Impact of routine stenting on myocardial perfusion and the extent of myocardial necrosis in patients undergoing primary angioplasty for ST-segment elevation myocardial infarction. American heart journal, 151, 1296. e1291-1296. e1296.
11. Falk, E. (1983). Plaque rupture with severe pre-existing stenosis precipitating coronary thrombosis. Characteristics of coronary atherosclerotic plaques underlying fatal occlusive thrombi. Heart, 50, 127-134.
12. Fröbert, O., Lagerqvist, B., Olivecrona, G. K., Omerovic, E., Gudnason, T., Maeng, M., . . . Danielewicz, M. (2013). Thrombus aspiration during ST-segment elevation myocardial infarction. New England Journal of Medicine, 369, 1587-1597.
13. Gibbons, R. J., Holmes, D. R., Reeder, G. S., Bailey, K. R., Hopfenspirger, M. R., & Gersh, B. J. (1993). Immediate angioplasty compared with the administration of a thrombolytic agent followed by conservative treatment for myocardial infarction. New England Journal of Medicine, 328, 685-691.
14. Grines, C. L., Browne, K. F., Marco, J., Rothbaum, D., Stone, G. W., O'Keefe, J., . . . Timmis, G. C. (1993). A comparison of immediate angioplasty with thrombolytic therapy for acute myocardial infarction. New England Journal of Medicine, 328, 673-679.
15. Hennekens, C. H., Albert, C. M., Godfried, S. L., Gaziano, J. M., & Buring, J. E. (1996). Adjunctive drug therapy of acute myocardial infarction—evidence from clinical trials. New England Journal of Medicine, 335, 1660-1668.
16. Keeley, E., & Grines, C. (2005). Should patients with acute myocardial infraction be transferred to a tertiary center for primary angioplasty or receive it at qualified hospitals in the community? The case for emergency transfer for primary percutaneous coronary intervention. Circulation, 112, 3520.
17. Keeley, E. C., Boura, J. A., & Grines, C. L. (2003). Primary angioplasty versus intravenous thrombolytic therapy for acute myocardial infarction: a quantitative review of 23 randomised trials. The Lancet, 361, 13-20.
18. Mauri, L., Hsieh, W.-h., Massaro, J. M., Ho, K. K., D'Agostino, R., & Cutlip, D. E. (2007). Stent thrombosis in randomized clinical trials of drug-eluting stents. New England Journal of Medicine, 356, 1020-1029.
19. Members, W. C., Antman, E. M., Anbe, D. T., Armstrong, P. W., Bates, E. R., Green, L. A., . . . Kushner, F. G. (2004). ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction—executive summary: A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (writing committee to revise the 1999 guidelines for the management of patients with acute myocardial infarction). Journal of the American College of Cardiology, 44, 671-719.
20. Montalescot, G., Borentain, M., Payot, L., Collet, J. P., & Thomas, D. (2004). Early vs late administration of glycoprotein IIb/IIIa inhibitors in primary percutaneous coronary intervention of acute ST-segment elevation myocardial infarction: a meta-analysis. Jama, 292, 362-366.
21. Pfeffer, M. A., Braunwald, E., Moyé, L. A., Basta, L., Brown Jr, E. J., Cuddy, T. E., . . . Flaker, G. C. (1992). Effect of captopril on mortality and morbidity in patients with left ventricular dysfunction after myocardial infarction: results of the Survival and Ventricular Enlargement Trial. New England Journal of Medicine, 327, 669-677.
22. Ranjan, A., Patel, T., Shah, S., Malhotra, H., Patel, R., Vayada, N., . . . Tanwar, N. (2005). Transradial primary angioplasty and stenting in Indian patients with acute myocardial infarction: acute results and 6-month follow-up. Indian heart journal, 57, 681-687.
23. Reddy, N., Raju, P., Kapoor, S., Rao, M., Reddy, R., Sastry, B., & Raju, B. (1999). Prospective observational study of primary angioplasty of the infarct-related artery for acute myocardial infarction. Indian heart journal, 51, 167-172.
24. Rentrop, P., Blanke, H., Wiegand, V., & Karsch, K. (1979). Recanalization by catheter of the occluded artery after acute myocardial infarction (transluminal recanalization (author's transl). Deutsche medizinische Wochenschrift (1946), 104, 1401-1405.
25. Rogers, E., Feigenbaum, H., & Weyman, A. (1979). Echocardiography for quantitation of cardiac chambers. Progress in cardiology, 8, 1-28.
26. Rogers, W. J., Canto, J. G., Lambrew, C. T., Tiefenbrunn, A. J., Kinkaid, B., Shoultz, D. A., . . . Every, N. (2000). Temporal trends in the treatment of over 1.5 million patients with myocardial infarction in the US from 1990 through 1999: the National Registry of Myocardial Infarction 1, 2 and 3. Journal of the American College of Cardiology, 36, 2056-2063.
27. Sabatine, M. S., Cannon, C. P., Gibson, C. M., López-Sendón, J. L., Montalescot, G., Theroux, P., . . . Braunwald, E. (2005). Effect of clopidogrel pretreatment before percutaneous coronary intervention in patients with ST-elevation myocardial infarction treated with fibrinolytics: the PCI-CLARITY study. Jama, 294, 1224-1232.
28. Silber, S., Albertsson, P., Avilés, F. F., Camici, P. G., Colombo, A., Hamm, C., . . . Ruzyllo, W. (2005). Guidelines for percutaneous coronary interventions: the Task Force for Percutaneous Coronary Interventions of the European Society of Cardiology. European heart journal, 26, 804-847.
29. Suryapranata, H., van't Hof, A. W., Hoorntje, J. C., de Boer, M.-J., & Zijlstra, F. (1998). Randomized comparison of coronary stenting with balloon angioplasty in selected patients with acute myocardial infarction. Circulation, 97, 2502-2505.
30. Svilaas, T., Vlaar, P. J., van der Horst, I. C., Diercks, G. F., de Smet, B. J., van den Heuvel, A. F., . . . Suurmeijer, A. J. (2008). Thrombus aspiration during primary percutaneous coronary intervention. New England Journal of Medicine, 358, 557-567.
31. Van de Werf, F., Ardissino, D., Betriu, A., Cokkinos, D. V., Falk, E., Fox, K. A., . . . Ruzyllo, W. (2003). Management of acute myocardial infarction in patients presenting with ST-segment elevation. European heart journal, 24, 28-66.
32. Widimsky, P., Bilkova, D., Penicka, M., Novak, M., Lanikova, M., Porizka, V., . . . Aschermann, M. (2007). Long-term outcomes of patients with acute myocardial infarction presenting to hospitals without catheterization laboratory and randomized to immediate thrombolysis or interhospital transport for primary percutaneous coronary intervention. Five years' follow-up of the PRAGUE-2 Trial. European heart journal, 28, 679-684.
33. Zijlstra, F., de Boer, M. J., Hoorntje, J., Reiffers, S., Reiber, J., & Suryapranata, H. (1993). A comparison of immediate coronary angioplasty with intravenous streptokinase in acute myocardial infarction. New England Journal of Medicine, 328, 680-684.