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ORIGINAL ARTICLES

Coronary Stenting in Diabetic Patients: Evaluation of Immediate Procedural Success & Adverse Outcomes

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Abstract

Diabetes mellitus (DM) itself increases the risk of Coronary Artery Disease (CAD) by 2-4 fold and in out country we are treating a good number of patients having CAD with DM. On the other hand several studies have reported increased risk of adverse outcomes following balloon angioplasty in diabetic cases. In this situation this study had been carried out at National Institute of Cardiovascular Diseases (NICVD) cath lab to determine the immediate procedural success & in-hospital adverse outcomes in this population. In our study 100 cases were enrolled. Out of which, 40 patients had type II DM & rest were non-diabetic.

Diabetic patients were compared with non- diabetic and found no major difference between the two patient group except for a higher number of LCX (Left Circumflex) lesion in the non-diabetic (25% VS 35%, *P* value 0.038). The lone case of renal complication came from the diabetic group. No MACE (Major Adverse Cardiovascular or Cerebrovascular Events) or death was occur in this series. Angiographic, procedural and clinical success in diabetic was 97.5%, 97.5% & 95% respectively whereas 100% found in non-diabetic group at its all segment. But this results are statistically insignificant and P value is 0.4000 for angiographic success, 0.4000 for procedural success and 0.158 for clinical success. P value for hospital stays is also insignificant i.e. 0.250 (while p value of < 0.05 was considered significant). Therefore in the setting of diabetes mellitus the outcomes of the stenting procedure are quite encouraging.

Key words : Coronary Stenting, Diabetic, Outcomes

Introduction

In 1984, Jarret [1] speculated that both diabetes and cardiovascular disease (CVD) shared common antecedents rather that one being a complication of the other. Later studies have confirmed the fact that they share common genetic & environmental antecedents, i.e. they spring from a "common sail" [2]. Recent Indian studies [3,4] show that prevalence of coronary artery disease (CAD) in the country matches the high prevalence in the migrant Indian populations.[5,6] Conventional risk factors do not explain the excess of prevalence of CAD in Asian Indians in the UK and US.[7, 8] Insulin resistance has been considered to be the probable cause to the higher risk of CAD in Indians. Insulin resistance is one of the primary cause for diabetes [9] and is a risk factor for CAD. India is facing a major health burden from the raising prevalence of type II diabetes and the early subclinical stages of glucose intolerance namely impaired fasting glucose (IFG) and impaired glucose tolerance (IGT).[10] Not only this, South Asians (Indians, Pakistanis, Bangladeshis and Srilankans) have the highest incidence of coronary artery disease (CAD) in the world compared to any other ethnic group. [11]

World Health Organization has reported that global prevalence of diabetes will increase more than double from 135 million to 300 million by 2025. India stands as the first in the whole world to have the largest number of diabetics.[12,18] On the other hand a frequently cited prediction is that cardiovascular disease will become the leading cause of death sometimes in 21st century. By the year 1990, according to the global burden of Disease Study, [19] ischemic heart disease was the leading cause of death in developed country and second leading cause of death in developing country.

During the last decade, the introduction of intracoronary stents and a number of randomized controlled trials revealed that, for a wide variety of clinical presentation and lesion

characteristics, the outcome of PCI is superior when stents rather than balloon angioplasty alone is utilized because of reduced incidence of acute periprocedural events, restenosis and urgent revascularization procedures.[15] Coronary stent implantation has therefore become the major mode of myocardial revascularization throughout the world.

Several studies have reported specific factors associated with increased risk of adverse outcomes following balloon angioplasty. These factors include advanced age, female sex, unstable angina, congestive heart failure, diabetes and multivessel coronary artery disease. And we planned this study to determine wheather diabetics are amenable to safe angioplasty with stenting.

Patients and Methods

The study was conducted in the Cardiology department of the National Institute of Cardiovascular Diseases (NICVD), Sher-e-Bangla Nagar, Dhaka. It was prospective non-randomized comparative observational study using consecutive patients undergoing multivessel stenting as a single stage procedure. The study was conducted between the periods of July 2002 to June 2003, the study population consisted of 100 patients who had undergone stent based angioplasty procedure. The selected patients were divided into two groups according to the number of treated vessels (one group with single vessel stenting and another group with two or more vessel stenting).

Subject Enrolment

All the cases were collected from NICVD on the basis of informed written consent. Patients for enrolment into the study were selected according to the selection criteria.

Patient with two or three vessel interventions requiring stent implantation during a single session, all indication for stent use (elective use, provisional use to improve acute procedural success, and urgent use to treat abrupt or threatened closure) with EF% - > 25% (by Echocardiography) were included in the study.

Patients with left main disease (protected and unprotected), Patients requiring staged procedures, patients with prior CABG or prior PTCA, any severe systemic illness (liver/ kidney disease), patients with uncontrolled CHF, patients with diffuse coronary arterial disease not suitable for CABG or PTCA and Patients with EF% - <25% by Echocardiography were excluded from this study.

Methodology

All patients had pre-intervention and post intervention 12 lead ECG to detect ischemic changes, appearance of new pathologic Q-wave. Blood samples were routinely taken from all patients every 8 hourly for 24 hours following the procedure for CK-MB. Following the initial balloon angioplasty, coronary stents were be implanted. Adjunct high-pressure balloon inflation was added after initial stent deployment in every patient. In suitable cases direct balloon mounted stenting were done. Procedural results and adverse outcomes are defined according to American College of Cardiology as described below:-

Acute Outcome - Definition of PTCA Success: Acute outcome of PTCA is measured the success of the procedure and procedural complications. A successful PTCA is defined by angiographic, procedural and clinical criteria.

1. Angiographic Success. A successful PCI produces substantial enlargement of the lumen at the target site. The consensus definition prior to the widespread use of stents was the achievement of a minimum stenosis diameter reduction to <50% in the presence of grade 3 TIMI flow. However, with the advent of coronary stents, a minimum stenosis diameter reduction to <20% has been the clinical benchmark of an optimal angiographic result.

2. **Procedural Success.** A successful PCI should achieve angiographic success without in-hospital major clinical complications (e.g., death, MI, emergency coronary artery bypass surgery) during hospitalization the definition of procedure-related MI has been debated. The development of Q-waves in addition to a threshold value of CK elevation has been commonly used. However, the significance of enzyme elevations in the absence of Q-waves remains a subject of investigation and debate. Several reports have identified non–Q-wave MIs with CK-MB elevations 3 to 5 times the upper limit of normal as having clinical significance. Thus a significant increase in CK-MB without Q-waves is considered by most to qualify as an associated complication of PCI.

3. Clinical Success. In the short term, a clinically successful PCI includes anatomic and procedural success with relief of signs and/or symptoms of myocardial ischemia after the patient recovers from the procedure.

Procedural Complications: procedural complications are divided into six basic categories: death, MI, emergency coronary artery bypass graft (CABG) surgery, stroke, vascular access site complications and contrast agent nephropathy.

- **Death** - Patient died during hospitalization.
- **Periprocedural MI** - The NEW presence of an MI as documented by at least 1of the following criteria:

1. Evolutionary ST-segment elevations, development of new Q-waves in 2 or more contiguous ECG leads, or new or presumably new LBBB pattern on the ECG.

2. Biochemical evidence of myocardial necrosis; this can be manifested as 1) CK-MB $\geq$ 3 the upper limit of normal or if CK-MB not available 2) total CK $\geq$ 3 upper limit of normal.

Comparison of the characteristics and procedural variables among diabetic and non-diabetic patients.

Comparison of the study outcome variables in the diabetic patients with those of non-diabetic patients revealed no significant difference in the incidence of any of the major variables, except for the number of LCX lesions which was significantly higher in non-diabetic group. This finding is in contrast to expected results. The duration of hospital stay was also higher in the diabetic group but the difference was not statistically significant.

The procedure results were also similar in the two groups (diabetics versus non-diabetics) with the incidence of success being higher in the non-diabetic group, but the difference was not statistically significant. The duration of hospital stay was higher in the diabetics although the difference between the two groups in this respect was not statistically significant.

Comparison of the Clinical, Angiographic and Procedural Characteristics of Diabetics vs. Non-diabetics.

Variables	Diabetics n=40(%)	Non-diabetics n=60(%)	*P* Value
Diagnosis			
CCS II-IV Angina	19(47.5%)	30(50%)	0.908
Unstable Angina	18(45%)	24(40%)	
Recent MI	1(2.5%)	3(5%)	
Atypical Chest Pain	2(5%)	3(5%)	
Stent Group			
Single Vessel Stent	22(55%)	28(46.7%)	0.541
Multivessel Stent	18(45%)	32(53.3%)	
Prior MI	26((65%)	28(46.7%0	0.101
CAD Category			
SVD	20(50%)	25(41.7%)	0.653
DVD	15((37.5%)	28(46.7%)	
TVD	5(12.5%)	7(11.7%)	
Vessel involved			
LAD	29(72.5%)	45(75%)	0.819
Diagonals	0	2(3.3%)	0.515
LCX	10(25%)	21(35%)	0.038
OM	3(7.5%)	5(8.3%)	1.000
RCA	22(55%)	28(46.7%)	0.541
Ramus	0	1(1.7%)	1.000
Procedure Results			
Angiographic Success	39 (97.5%)	60 (100%)	0.400
Procedural Success	39 (97.5%)	60 (100%)	0.400
Clinical Success	38 (95 %%)	60 (100%)	0.158
Duration of hospital Stay			
Mean+SD	3.28+1.658	2.98+0.357	0.250

CCS= Canadian Cardiovascular Society Angina Grading; MI=Myocardial Infarction; CAD=Coronary Artery Disease; SVD=Single Vessel Disease; DVD=Double Vessel Disease; TVD=Triple Vessel Disease; LAD= Left Anterior Descending; LCX=Left Circumflex; OM=Obtuse Marginals; RCA=Right Coronary Artery; SD=Standard Deviation. *P Value of <0.05 was considered significant.*

Figure 1 : Cluster Bar Chart of the Number of Stents Deployed by Coronary Artery Disease Extent. CAD= Coronary Artery Disease.

Figure 2. Cluster Bar Chart of Number of Stents Deployed in Patients of the Two Study Group.

Discussion

This non-randomized, prospective observational study showed that single stage multivessel stenting is no more hazardous than and equally feasible with single vessel stenting in diabetic

The patients in this study were relatively young (mean age 53±10.3 years) compared to the patients cohorts of similar multivessel stenting studies. For example, Moussa et. al.[21] reported results of m ultivessel stenting in 100 patients, the mean age of the patient population was 59±9 years; the series of Cowley et al.[22] had a mean age of 55±10 years whereas the mean age of the patients in the ARTS, SoS, BARI were >60 years.

Female patients constituted a very small fraction in the current study (6% overall) whereas most of the reports referred to above had a female population ranging from 20-30%. The reason for this low proportion of females in the present study is poorly understood, but might be socio-cultural. CAD in females gets much less attention than in males, both during diagnosis and therapy.

Diabetics constituted 40% of the total study sample, a very high percentage compared to the 23-24% of Kornowski et. al.[23], 24-25% of the BARI [24] investigation and slightly higher than the ARTS trial results (14-16% diabetics). The SoS [25] trial had the lowest percentage of diabetics (14-16%). Interestingly however, both these studies reported a higher percentage of three vessel disease (38-47% in SoS and 30-33% in ARTS)[26], whereas the BARI study population with a high percentage of diabetics also reported a high (40-41%) proportion of triple vessel disease patients. Considering all the above statistics, the prevalence of triple vessel disease in the present study (24%, 12 patients) may be considered low. The prevalence of two-vessel disease however in the present study is comparable to the above studies (ranging from 53 to 68%).

Hypertension figured high in the multivessel stenting group, compared to the results of the French Monocentric Study Carrie et. al.[27] at 31% but was comparable to those of ARTS (45%), SoS (43%) and the BARI study on NHLBI Registry (49%). The incidence of hypertension was significantly higher in the multivessel stenting group (17 vs. 28 patients, *p* value 0.044).

Analysis of the clinical CAD status of the patients shows that a high proportion of patients had prior history of MI (overall incidence 54%), similar to that in BARI, but slightly higher than ARTS (44%) and SoS (44%) and the series of Kornowski et al. (47%).

The LAD was involved in the highest percent of lesions in both the groups, followed by RCA and LCX in that order. Similar distribution of lesions was seen in the SoS trial, whereas in ARTS trial RCA and LCX lesions had equal incidence following LAD, and in ERACI trial LAD was the predominant vessel involved followed by LCX and RCA in that order. In the Kornowski series, RCA lesions predominated whereas LAD and LCX followed in that order. The multivessel stenting group had a significantly higher number of LCX and RCA lesions (*p* value ≤0.001) whereas LAD lesion was significantly higher (*p* value 0.013).

The type of lesion in the present study showed a higher proportion of A/B1 lesion compared to Moussa et al. (40%) but similar to that of Kornowski. There was no difference between the two groups with regards to type of lesion in the current study. Therefore, the present study contained patients with a higher risk lesion than the Kornowski series but lower risk group than Moussa et al. but a lower risk group than the BARI trial, where the type C lesion was present in 74% of cases.

Outcomes of the present study revealed a high overall success rate of 99% by angiographic analysis. In one patient in the multivessel stenting group one attempted lesion could not by dilated, whereas two other lesions were successfully stented, giving a partially successful result and accounted for the difference between the two groups in terms of angiographic and procedural success.

Summary

This study was carried out in the department of cardiology at the National Institute of Cardiovascular Diseases in a prospective, comparative observational design on 100 consecutive patients of single and multivessel stenting (50 in each group) as a single stage procedure. The angioplasty procedure involved the standard current practice with fixed dose periprocedural IV heparin anticoagulation. Pre- and post-procedure angiographic analysis was done quantitative method using the online analysis software available in the catheter laboratory. All patients received the enhanced antiplatelet regimen of ASA, clopidogrel which was continued post-procedure (ASA at a dose of 150 mg per day). All data were recorded in an approved data collection form after informed written consent from the patient.

A comparison of the study variables between diabetics (40 patients) and non-diabetics (60 patients) revealed both groups had comparable clinical (CCS Class II-IV angina 47.5% vs. 50%, unstable angina in 45% vs. 40% recent MI 2.5% vs. 5%, atypical angina in 5% in each subset and Prior MI in 65% vs. 46.7% of diabetics and non-diabetics, respectively; the *p* value for 0.101 for prior MI comparison and 0.908 for other clinical categories). Single vessel stenting was done in 55% of diabetics and 46.7% of non-diabetics while MVS was done in the rest, the difference between the groups being statistically insignificant (*p* value 0.541). The

extent of CAD was similar in the two groups (*p* value 0.653). The distribution of lesions showed statistically significant difference in the involvement of LCX only (25% in diabetics vs. 35% in the non-diabetics, *p* value 0.038). The procedural outcome variables were 100% for each of angiographic, procedural and clinical success in the non-diabetics whereas 97.5%, 97.5% and 95% respectively in the diabetics, due to unsuccessful attempt at dilatation in one lesion and recurrence of angina in-hospital in two patients in the diabetic group. However, the difference in proportions was not statistically significant (*p* value of 0.400, 0.400 and 0.158 respectively for angiographic, procedural and clinical success). The mean (±SD) duration of hospital stays was 3.28(1.658) days vs. 2.98(0.357) days in the diabetics vs non-diabetics, respectively with a *p* value for the difference of 0.250.

Comparison of the in-hospital adverse events between SVS and MVS group showed no death, periprocedural MI, tamponade, CVA, heart failure or cardiogenic shock, vascular access site complications like occlusion, dissection, A-V fistula in any group. However minor adverse events occurred at an overall rate of 6% in SVS group and 12% in MVS group, consisting of transient hypotension not requiring ionotropic or IABP support in 2% of SVS group and 45 of MVS group. Arrhythmia of transient nature responding to IV drugs only without necessity of DC Shock or CPR or long term antiarrhythmic medications occurred in 4% of SVS group and 6% of MVS group patients. One patient in the MVS group developed transient renal failure requiring prolonged hospital observation with conservative management, not requiring renal replacement therapy. Local bleeding at vascular access site occurred in 45 of SVS group and 6% of MVS group although none required surgery for such complications. The difference in the proportion of events in the two groups was not statistically significant in any category (*p* value 0.558 for hypotension, 0.646 for arrhythmia. 0.645 for renal failure, 0.646 for bleeding complications). The duration of hospital stay ranged from 2-3 days in SVS group and 2-12 days in MVS group, the mean(±SD) being 2.96±0.198 vs. 3.36±1.827 respectively with a *p* value of 0.130 for difference between two group, denoting an insignificant difference statistically.

Conclusion

In conclusion, stenting is a feasible procedure in diabetic patients without significant increase in adverse events or prolong duration of hospital stay with a high degree of angiographic, procedural and clinical success.

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