

Treatment of Iatrogenic Coronary Artery Dissection in Resource Constraint in Cath-Lab, A Retrospective Study

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Abstract

Introduction: Coronary Artery Dissection is a well-known serious complication of invasive procedures (e.g. coronary angiography, balloon angioplasty and surgical cardioplegia) and is due to mechanical injury of the arterial wall by interventional devices used during procedures needing skilled operator to manage it timely.

Objective: We wanted to look at these large tears that can dramatically affect blood flow and result in severe complications to understand where they happen most and how efficient are we at managing them for our patients in limited resources of the Cath-labs in developing countries.

Methods: We reviewed the record of 28 (3.4%) cases of large dissection found in 806 patients who underwent coronary angioplasty in Cath lab of Cardiology Department of Dow University of Health Sciences Karachi. We analyzed as per American College of Cardiology/American Heart Association (ACC/AHA) criteria of the type of lesion, chronic total occlusion, calcification, intra-procedural dissection, and vessel site, related complications and management strategies.

Results: Among the 806 patients that underwent per-cutaneous coronary intervention during 3 years (2014-2017) period at Cath-lab of Cardiology Department of Dow University of Health Sciences Karachi, 28 (3.4%) patients were found to have extensive dissection. Out of 10 patients who had immediate angioplasty and stenting for closure of dissection 8 patients were successfully treated and 2 (7.1) died during procedures. 8 (28.5%) needed immediate coronary artery bypass surgery. 10 (35.7%) out of the 28 (3.4%) patients were managed by further hospitalization with medical treatment out of them 3 patients needed angioplasty procedures. There were no late deaths.

Conclusion: Coronary artery dissection remains a common occurrence during PCI since pre-stent procedures and clinical sequelae have been minimized by the routine use of coronary stents. Rapid recognition and attention to the angiographic appearance of the dissection is essential to the successful management of this complication. None the less, patients with extensive dissection who are free from the manifestation at the end of the procedure can be managed conservatively. Attempts should be made to stabilize extensive dissection during coronary angioplasty so that surgical intervention can be delayed or avoided altogether if possible.

Keywords: Cath-lab: Catheterization Laboratory, PCI: Per-cutaneous Coronary Intervention, BMS: Bare Metal Stent, DES: Drug-Eluting Stents, TIMI: Thrombolysis in Myocardial Infarction, LCX: Left Circumflex Artery, RCA: Right Coronary Artery, LAD: Left Anterior Descending Artery, MI: Myocardial Infarction, CABG: Coronary Artery Bypass Graft, IVUS: Intravascular Ultrasound, PTCAs: Per-cutaneous Transluminal Coronary Angioplasties.

Introduction

A 'controlled tear' is the mechanism by which angioplasty over dilates the blocked vessels. A large tear, or spiral dissection, that continues almost entirely down the artery, however is associated

with serious complications. When such a dissection occurs, the interior wall of the artery is torn, causing it to fold into the path of blood flow and sometimes block flow of blood in the artery altogether [1,2]. Blockages in the right coronary artery and those in

bending areas of the coronary arteries are the most common places for coronary dissection. Coronary dissections occur frequently after balloon dilation of coronary atherosclerotic plaques procedures performed in the pre-stent area and now-a-days due to use of coronary bare-metal stents (BMS) and coronary interventional devices e.g. de-bulking devices intended to remove or ablate tissue, Trans-luminal extraction coronary atherectomy and Excimer laser coronary angioplasty [3,4]. Indeed, flow-limiting dissections occur during or at the end of the procedure and persisting post-procedural area may be a consequence of extensive vessel trauma or due to lesion complexity, can provide a pro-thrombotic milieu leading to abrupt vessel closure, thrombosis, with ensuing myocardial ischemia and necrosis [5]. However, the adverse role of minor and non-obstructive procedural dissections has been questioned including target lesion revascularizations during hospitalization and follow up [4,6].

Objectives

“We wanted to witness large tears that can dramatically affect blood flow and result in severe complications to understand where they happen most and how good we are at fixing them for our patients” in a resource constrained Cath-lab of public sector hospital of low socio economical country.

Methods

We reviewed the records of 28 (3.4%) cases of large dissection in 806 patients that underwent coronary angioplasty in Cath lab of Cardiology department of Dow university of Health Sciences Karachi. All the patients had history of administered bolus of unfractionated heparin at a dose of 70 IU/kg to achieve an activated clotting time ≥ 250 s at the beginning of the procedure. Patients were administered 300-mg clopidogrel loading dose in non-pre-treated patients. Glycoprotein IIb/IIIa (GpIIb/IIIa) inhibitors were used electively or as bail-out at the discretion of the operator. Coronary angioplasty and stenting were performed with the aim to fully cover the diseased segment. In the case of dissection after stent deployment, the recommended management strategy was either to refrain from further percutaneous maneuvers because the dissection was not associated with impaired epicardial flow or myocardial ischemia or to try managing per-cutaneously. Whenever dissections were found resistant to balloon inflations and stenting, approaches were not feasible for lesion characteristics (e.g. due to very distal lesion, calcifications, or vessel tortuosity) or for the impossibility of tracking other DES in place (e.g. bifurcation), dissections were left in place and managed conservatively. Only dissections occurring either before or after stent implantation and persists after the last balloon inflation were adjudicated as final dissections [7,8].

These were classified according to the National Heart Lung and Blood Institute (NHLBI) criteria:

- (i) minor radiolucent areas within the coronary lumen during contrast injection, with little or no persistence of contrast after the dye has cleared
- (ii) parallel tracts or a double lumen separated by a radiolucent area during contrast injection, with minimal or no persistence after dye clearance
- (iii) contrast outside the coronary lumen with persistence of contrast after dye has cleared from the lumen
- (iv) spiral luminal filling defects

- (v) appearance of a new, persistent filling defects within the coronary lumen, and
- (vi) dissections leading to total occlusion of the coronary lumen without distal ante grade flow [9,10].

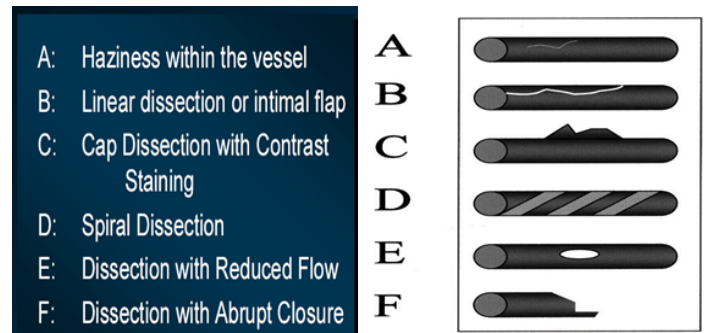


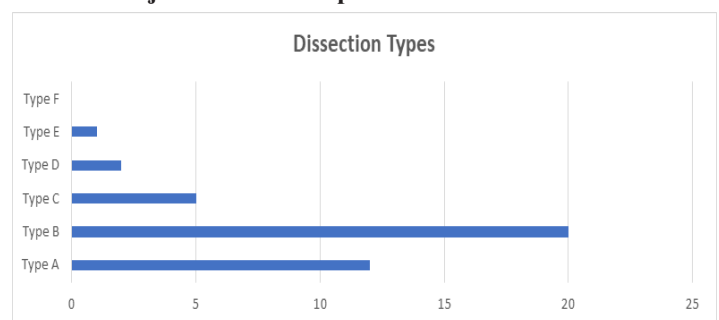
Figure 1

Final distal coronary flow was assessed according to the epicardial thrombolysis in myocardial infarction (TIMI) flow classification (from 0 to 3) in patients without persistent dissections and in those with dissections type A. We saw for as per American College of Cardiology/American Heart Association (ACC/AHA) criteria lesion type, chronic total occlusion, calcific lesion, intra-procedural dissection, bifurcation with balloon-only dilation of the side branch, use of GpIIb/IIIa inhibitors, and vessel site [11].

Results

Among the 806 patients that underwent percutaneous coronary intervention during 3 years (2014-2017) period at Cath-Lab of Cardiology Department of Dow University of Health Sciences Karachi, 28 (3.4%) patients had extensive dissection (defined as a dissection extending beyond the limits of the dilated angioplasty balloon) in the coronary artery, Dissection type was found A in 12 (42.8%) cases, B in 20 (71.4%), C in 5 (17.5%), D in 2 (7.1%), E in 1 (3.5%), and F in 0 (0.0%) Table 1.

Table 1: Major baseline and procedural characteristics

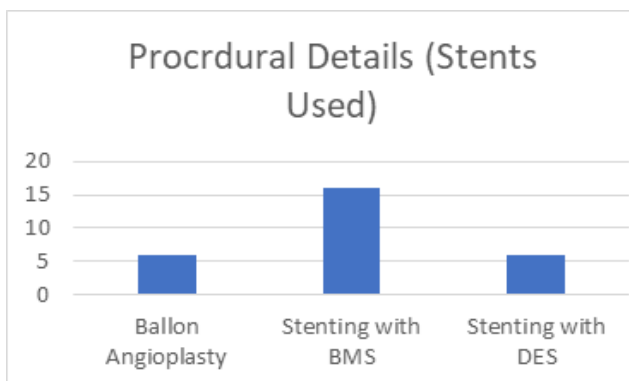
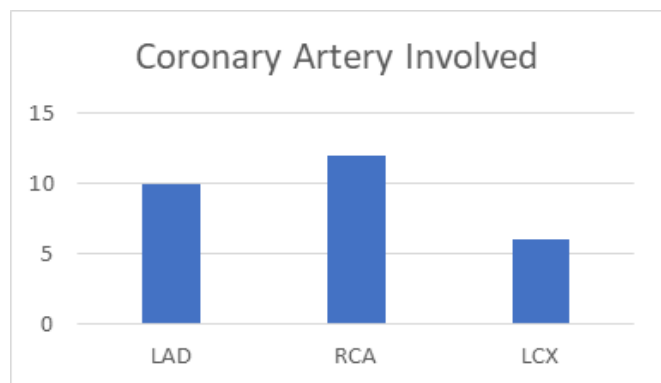


Angiographic Predictors of Coronary Dissections in patients who underwent angioplasty because of Myocardial infarction or unstable angina that was refractory to medical treatment were calcified lesions in 15 (53.5%), eccentric lesions in 12 (42.8%), long lesions in 16 (57.1%), complex lesion morphology and vessel tortuosity in 06 (21.4%), A balloon to artery ratio >1.2 in 14 (50%) patients Table 2.

Table 2: Angiographic Predictors of Coronary Dissections		
Total patients of MI and Unstable Angina having dissection		
1.	Calcified lesions	15
2.	Eccentric lesions	12
3.	Long lesions	16
4.	Complex lesion morphology and vessel tortuosity	06
5.	A balloon to artery ratio > 1.2	14

Dissection occurred in 6 patients with balloon angioplasty and in 22 patients during procedure of angioplasty with stenting. Overall, final dissections occurred with increased frequency, as expected in longer and more complex lesions, 10 (35.7%) patients with left anterior descending artery, in 6 (21.4%) patients with side branches of the LCX. In 12 (42.8%) patients with RCA complicated by propagating dissection compared to other coronary arteries.

Table 3:



Lesions on a bend of 45 degrees or greater were 12 times more likely to develop a dissection compared to lesions that were not on a bend Table 4 and in patients with normal distal epicardial flow i.e. TIMI 3 present with dissections in 13 (46.4%). 10 patients had immediate angioplasty with stenting, out of them 8 patients successfully treated and 2 (7.1) died during procedures of closure of dissection with stenting, 8 (28.5%) needed immediate coronary artery bypass surgery. Table 4A and Table 4B.

Table 4A

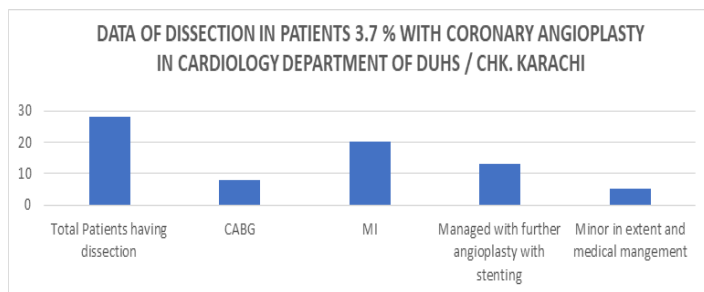


Table 4B

Outcomes of the Dissection in Cath-lab			
1.	Immediate Coronary artery Bypass	8 pt	
2.	Immediate Angioplasty	10 pt	8 pt successfully treated
			2 Pt died
3.	Management during Post PCI hospitalization	10 pt	7 pt medically treated

10 (35.7%) out of the 28 patients were managed by further hospitalization with medical treatment; out of them 3 patients needed angioplasty procedures. There were no late deaths.

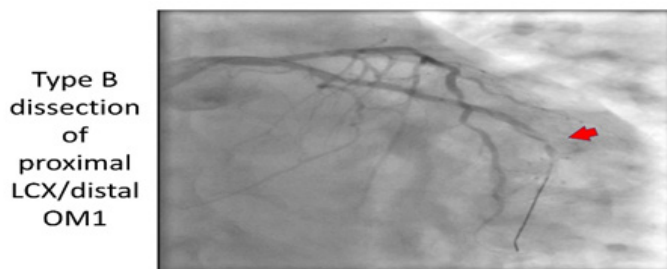
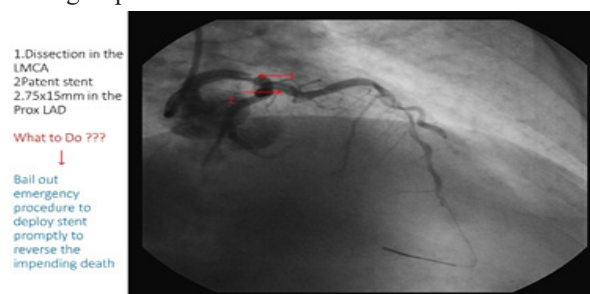


Figure 2

Stenting was successful in treating the dissection in 11 (39.2%) percent of patients. Major in-hospital adverse coronary events (heart attack, need for emergent bypass surgery, stent thrombosis or death) occurred in 18 (53.5%) percent of patients in the large dissection group.



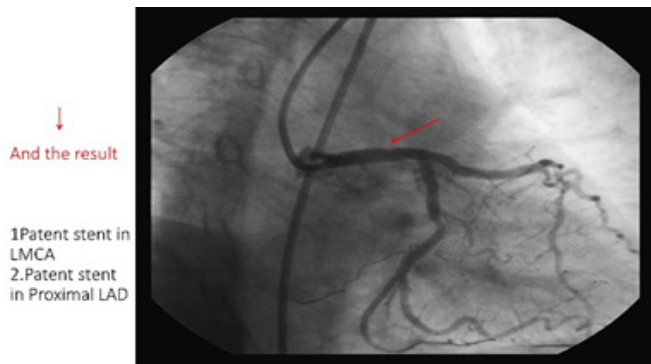


Figure 3: Predictors of final dissection

Discussion

Despite its numerous benefits, serious and potentially life-threatening complications can occur up to 30% of all conventional balloon angioplasties and may result in angiographically significant coronary artery dissection. With the advent of coronary stents, the incidence of acute closure in elective PCI is now less than 1%. But plaque fracture and tearing when occurs are critical in plaque redistribution and reduction of elastic recoil, as well as in later positive coronary remodeling [12-16]. However, plaque disruption with exposure of its prothrombotic milieu and concomitant intimal flaps may promote thrombosis and distal embolization or even impair distal flow directly when large dissections are present. These pathophysiological events and data underlie in the association between angiographically evident coronary dissections and adverse clinical outcomes seen with increased frequency in resource constrained Cath-lab. Our study is reporting for the first time on the incidence, occurrence of dissection during procedure, and outcomes of final residual dissections after coronary angioplasty and stenting. Our study confirms the detrimental clinical impact of this procedural complication dissection in 3.4% patients which is more than Cath-labs of developed countries after the advent of stents, associated with significantly increased rate adverse events. In 10 patients undergoing stenting for closure of dissection. 2 (7.1%) died during procedure. 8 (28.5%) needed immediate coronary artery bypass surgery. 11 patients had successful PCI with DES stenting in patient with dissection. Thus, our study provides compelling data in support of a safe strategy of managing residual dissections and related complications with limited resources.

Cappelletti et al. showed that benign non-occlusive (type A–D) dissections after balloon-only angioplasty were associated with a significantly decreased risk of re-stenosis ($P < 0.001$) and apparently favorable clinical outcomes as seen in our study [4]. However, the detrimental clinical role of final dissections on major adverse thrombotic events such as ST has been confirmed in the BMS era, even in the presence of optimal antiplatelet therapy by producing MI. In our study, the occurrence of dissections after DES implantation is incompletely characterized as few DES were implanted in initial procedures, as no study has reported specific data concerning their incidence of dissection and its angiographic predictors of Coronary Dissections yet. Calcified lesions 15 (53.5%), eccentric lesions 12 (42.8%), long lesions 16 (57.1%), complex lesion morphology and vessel tortuosity 06 (21.4%), A balloon to artery ratio > 1.2 14 (50%) as found in our study is impossible to be compared with non-availability of evidence-based data in Pakistan or

with other developing countries. Despite the improvements in adjunctive medical therapy (i.e. GpIIb/IIIa inhibition and long-term thienopyridine use), the pattern of patients undergoing coronary revascularization has dramatically changed. This is verified by the inclusion of complex lesion and patient subsets in the present study, the adverse events were likely to stem from coronary thrombosis, either in-stent or peri-stent, eventually leading to death, non-fatal MI, urgent TVR, or bypass grafting. This detrimental impact of final dissections is probably due to the lesion complexity pattern in delay in approaching the cath lab [17].

However, the inherent risk of confounding, the clustering of several unfavorable risk factors in the same patients experiencing dissections cannot be excluded. As, patients with coronary dissections represent a small but with many additional problems and risk-factors, both present and acquired during the procedure, which may contribute to the increased adverse event rate use of bare-metal stent and availability size of balloon likely to complicate any mechanistic analysis [18]. However, many authorities have suggested that whenever a dissection cannot be sealed by means of stents or prolonged balloon inflations, maximal medical therapy should be enforced (including GpIIb/IIIa inhibitors and/or anticoagulants) and CABG be considered in the case of impaired TIMI flow in a proximal lesion or refractory myocardial ischemia. Such recommendations probably hold true nowadays in the DES era even [17-19].

Nonetheless, considering the propensity for edge (< 5 mm) or more distal re-stenosis near deployed stent and whenever lesions are treated with only balloon angioplasty. Finally, the role of IVUS in better defining the characteristics of lesion and management of dissections should not be dismissed [20]. Although angiography has a very limited discriminatory power in identifying low-risk dissections, an IVUS cross-sectional study should be considered a reliable hint that the index dissection is not likely to bear adverse consequences [8,21]. Perforation and acute vessel closure is the most feared complication in equipped modern Cath-labs. The recent registries show perforation occurring in 0.3 0.6% of all patients undergoing PCI and acute vessel closure due to coronary dissection up to 11% of all elective PTCAs. Unfortunately, cost and logistic hurdles obviously limit the scientific testing and clinical application of this strategy in Cath-labs of other developing countries may have resulted in such data of dissection in our study [1,22,23].

Limitation of this Study

Drawbacks of this work are inherent to a retrospective study and include selection bias, and confounding. While we tried to address these potential sources of systematic error by systematic data entry, the risk of persistent underlying bias may be borne in mind. Dissections left untreated after BMS stent implantation, the continuing difficulty for angiography to well evaluate if a dissection is benign or not without IVUS support were the major weak points as, However, dissections are quite common and logistic, technical, but especially ethical issues would likely make unfeasible any randomized controlled trial concerning their optimal management

Conclusion

Coronary artery dissection remains a common occurrence during PCI but clinical sequelae have been minimized by the routine use

of coronary stents. Rapid recognition and attention to the angiographic appearance of the dissection is essential to the successful management of this complication in resource constrained Cath-labs. None the less, patients with extensive dissection who are free from the manifestations of acute ischemia at the end of the procedure can be managed conservatively and have a good immediate output. Attempts should be made to stabilize extensive dissection during coronary angioplasty so that surgical intervention can be delayed or avoided altogether if possible.

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