

Review Article

Revascularization Failure: Percutaneous Coronary Intervention or Coronary Artery Bypass Grafting

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Abstract:

Coronary artery disease (CAD) is one of the leading causes of mortality and morbidity in our Bangladeshi patient population. Percutaneous coronary intervention (PCI) or Coronary artery bypass grafting (CABG) are the gold standard of revascularization to treat these group of patients. Both treatment modalities may contribute to both short term and long-term excellent benefit with the relief of symptoms and improves quality of life. Beside the availability of modern techniques along with 3rd generation Drug eluting stents (DES) for PCI and uses of arterial conduit in bypass surgery, in long-term follow-up, many of the patient needs repeat revascularization. In Bangladesh, many of the centers are doing state of the art treatment with the available of most of interventional aids in treating complex PCI as well as primary PCI. Similarly, CABG with the advent and available expertise, minimal invasive bypass surgery or beating heart surgery, facilitate CABG more convenient for patient and surgeons as well. Exact data on stent occlusion or graft failure that may leads to repeat revascularization is not well understood in our circumstances. We need to form a common consensus, if needed, to form a national registry or database to follow up PCI or CABG patients who develop subsequent revascularization failure and address the reason behind. Thus, to reduce the needs of repeat revascularization and improve long term quality of life.

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Key Words :
 Coronary Artery
 Disease, PCI,
 CABG

Coronary artery disease (CAD) is one of the leading causes of mortality and morbidity in our patient perspective. Treating clogged artery either by percutaneous Coronary Intervention (PCI) and or Coronary artery bypass graft (CABG) is key mode of treating these group of patient population. Despite progressive advances in safety and effectiveness in CABG, their effectiveness is limited by restenosis after PCI and Graft Failure or disease progression in non-revascularized lesion in both therapies.

Iterations in Coronary stent technologies, technique, and pharmacotherapies have enhanced the efficacy and safety of percutaneous coronary interventions (PCI) leading to lower rates of stent thrombosis, restenosis, and the need for repeat revascularization.¹⁻³ Outcomes of coronary artery bypass grafting (CABG) have also improved with

the uses of minimally invasive techniques and optimal medical therapy.⁴⁻⁶

The need for repeat revascularization is more common in PCI than CABG, although the techniques are diminishing overtimes.⁷⁻⁸ With the advent of different techniques by using radial, distal radial and ulnar routes as compared to conventional femoral routes limited the procedure more user friendly with less bleeding complications or development of hematoma at puncture site. On the contrary the development of different interventional aids or tools for instances IVUS, OCT, IVL, Opien Balloon, cutting balloon, has contributed to doing complex PCI with reduction of repeat revascularization.

Needs for repeat revascularization is associated with worse quality of life and exposes patients to

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new hospitalizations and procedural risks.⁹⁻¹⁰ In addition, the need for repeat revascularization of the Left main coronary artery may be associated with substantial mortality and morbidity given the large amount of subtended myocardium at risk.¹¹

As the acute morbidity and mortality of CABG progressively declines, Long-term outcomes have become an increasingly more important consideration in decisions regarding revascularization. Although CABG patients are generally thought to require fewer repeat revascularization than PCI. Studies have demonstrated definite longevity of SVG, modern techniques in harvesting, greater uses of arterial graft and secondary prevention, all of which may reduce need for repeat revascularization.¹²⁻¹³ Conversely the ability to treat saphenous vein graft disease by PCI also evolved and carried out.³¹

Historically, the need for repeat revascularization after CABG was driven both by the progression of native vessel disease and by relatively low rates of vein grafts patency. Clinical registry and trials data have showed a repeat revascularization rate 5% at 5 years post CABG.¹⁴⁻¹⁵ CABG in patients over 65yrs, 10% need repeat revascularization with 5 yrs., 13% within 10 yrs., by the 18 yrs., fewer than 1 in 25 patients require repeat CABG.¹⁶ The observed lower rate of repeat revascularization may reflect in the rate of progression of atherosclerosis in elderly, uses of arterial graft and uses of statins, which have mitigated the development of both native vessel and vein graft disease.

Patients with diabetes itself carries a risk of stent occlusion or graft failure. The risk of redo-CABG in diabetic patient carries high long-term mortality except for severe heart failure, PCI be strongly considered in all patients for whom percutaneous treatment is alternative.¹⁷

Revascularization by CABG, patients expect to survive may years after CABG. This longevity increases likelihood of repeat coronary intervention, secondary to the development of atherosclerotic disease in this patient bypass grafts or progression of diseases in their native vessel.¹⁸ Patients who present in need of repeat revascularization after CABG or PCI have two options either re-do CABG or PCI. In many

instances it is not clear which is suitable for whom. Elderly frail patient who had CABG, PCI might be a good option of repeat revascularization. In a study Bypass Angioplasty Revascularization (BARI) trial, 19% of patients who were diabetic had 81% five-year survival rates when treated with CABG but only 66% five-year survival when treated with PCI.¹⁹ Coronary angioplasty versus bypass revascularization trial (CABRI) study, higher mortality for diabetic but not in nondiabetic when treated with PCI as opposed to CABG.²⁰ CABG offers better outcome than PCI for a first revascularization procedure in diabetic patients with multivessel disease cannot be generalized to diabetic patients with previous CABG. It may be appropriate to look at clinical and angiographic criteria specific to a given patient to choose PCI or CABG. Advent of newer stent technique along with uses of aggressive statin, ACE may allow diabetic patients to have better outcomes after PCI.²¹

CAD is most frequent cause of death globally and the most common cause of heart failure in resource abundant countries.²²⁻²³ Incidence of systolic myocardial dysfunction is increasing among in patients with CAD. The ESC guidelines recommended revascularization, with a preference for CABG over PCI, in patients with reduced ejection fraction, and multivessel disease.²⁴ The US guidelines favor the use of CABG but do not provide recommendation about PCI.²⁵ Sun et al, has demonstrated that patient with severely reduced LV ejection fraction, has higher rates of mortality and MACE were seen in patients who received PCI compared to CABG.²⁶ A meta-analysis comparing PCI with CABG in patients with severely reduced LVEF found CABG to be associated with improved survival (HR, 0.82;95% CI, 0.75-0.90) a lower rate of MI (HR 0.50; 95% CI, 0.36-0.68) and a lower rate of subsequent revascularization (HR, 0.34;95%CI, 0.24-0.47).²⁷ The study had a considerable follow-up window (median 5.2 yrs. and maximum 9.2 yrs.) and supports a potential benefit of CABG in patients with CAD and severely reduced LVEF; those who underwent CABG had lower risk of all cause death, death from cardiovascular disease, MACE, subsequent revascularization and hospitalization for MI and HF.

Bngalore et al.,²⁸ had shown patients with multivessel disease and LVEF<35% who underwent either PCI with everolimus Eluting stents (n+1063) or CABG (n+1063) with propensity score matching from New York state percutaneous coronary intervention reporting system. In short term, PCI was associated with lower risk of stroke in comparison with CABG. A long-term follow-up (median 2.9+ yrs.), PCI was associated with similar risk of death, a higher risk of MI, a lower risk of CVA and higher risk of repeat revascularization. Another study, by *Fosbol et al.*, has demonstrated that repeat revascularization is performed in frequently among older patients who undergo CABG.²⁹

Despite progressive advances in safety and effectiveness of PCI or CABG, their effectiveness is limited by restenosis after PCI, graft failure after CABG or disease progression in non-revascularized lesions or territories after both therapies. *Giustino et al.*,³⁰ analysis of incidences and outcomes of patients who had repeat revascularization in the EXCEL trial. Repeat revascularization were more common among those initially treated by PCI than CABG. And was most often treated by PCI rather than CABG. The location of lesion for repeat revascularization was of most often the Circumflex artery for PCI assigned patients and LM artery for CABG.³¹ In the SYNTAX trial patient with TVD or LMCAD were randomized to CABG or PCI. In this study, PCI was Associated with higher risk of revascularization at 5 years;⁸⁻⁹ repeat revascularization was an independent predictor of the composite death, MI or stroke after initial PCI but not after initial CABG, a finding driven mostly by increased risk of MI.³²

Repeat revascularization associated with an increased risk of death, although only in instances in which repeat revascularization performed for recurrence of disease at a lesion or artery previously treated. Excel trial was distal lesion, likely requiring more complex PCI with bifurcation stenting and potentially increasing risk of target lesion revascularization.¹

Before PCI, angiographic estimation of lesion, if possible IVUS study for more better lesion

assessment and post PCI IVUS study for better stent optimization could aid in getting better outcome along with the reduction of early need of repeat revascularization. Intermediate lesion could be assessed by FFR/dFR prior intervention, thus may aid in inappropriate stenting of the intermediate or insignificant lesion which by angiographic eye-ball estimation seems to be significant. OCT though it is not available in many of the centers, could aid in better understanding the lesions character. CTO lesion is very difficult to deal with, if not properly prepared before stenting either by cutting or scoring balloon, or rotablation or Intra vascular lithotripsy (IVL), may need in short term needs of repeat revascularization.

Among PCI treated LM stent thrombosis restenosis may result in sudden death and not allow an opportunity for repeat revascularization. With CABG group sudden death could have occurred from other mechanism, lesion progression from sub-total to total occlusion and proximal to the graft anastomosis. Strategies that should be mandatory for all complex PCI such as lesion analysis, lesion preparation, availability of hard wire, IVUS, OCT, cutting balloon or score balloon or Opien balloon and IVL could aid in proper stent optimization with less chances of restenosis and repeat revascularization.

Almost 30 years, our journey towards PCI and CABG in treating CAD patients. Many of the centers provides state of the arts treatment with the availability of hardware and skilled manpower. We need to develop common consensus, if needed national registry databases. We need to address the reason or needs of early or late repeat revascularization. Specially, stent thrombosis early or late due to inappropriate stent optimization or graft failure by progression of atherosclerotic lesion at or proximal to anastomosis site, may be the reason or play key role in necessitating repeat revascularization. Patient factor, underlying comorbidities also crucial and need to address. For this, we need heart team, lesion analysis, proper planning, keeping shelves ready with essential tools and overall skilled operator or surgeon to reduce the needs of repeat revascularization.

Conflict of Interest - None.

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