



Original Article

The feasibility of surgical patch osteoplasty for management of isolated left main coronary stenosis

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Abstract

Background: Coronary artery bypass grafting (CABG) is perceived as the most common treatment for left main coronary artery (LMCA) disease with good results compared to left-main stenting or medical therapy. Surgical patch angioplasty (SPA) may present a substitute to the standard CABG in patients with isolated LMCA disease, and it offers physiological antegrade myocardial perfusion, keeps ostial patency and saves bypass material. The objective of this study is to demonstrate the feasibility of patch osteoplasty in patients with isolated LMCA stenosis.

Methods: This is a retrospective study performed on eight patients with angiographically proven ostial or proximal LMCA stenosis who underwent surgical patch angioplasty. Two of them had associated right coronary artery bypass grafting. All patients were performed with cardiopulmonary bypass and saphenous vein patch. An anterior approach with transverse aortotomy was utilized in all cases. Patients were followed-up clinically for a mean period of 14 months (ranging from 26 to 6 months) for recurrence of symptoms and any postoperative complications.

Results: The early postoperative period was uneventful in all patients. No perioperative mortality was reported. Two patients had postoperative atrial fibrillation, and one patient with poor left ventricular function required preoperative intra-aortic balloon pump. Angiography was done in the first three cases, and all showed no restenosis and no vein patch dilatation.

Conclusion: Surgical patch angioplasty may be a safe and suitable alternative to CABG in selected patients with isolated ostial LMCA stenosis. Further studies are needed to compare the results of the SPA with those of standard CABG and LMCA stenting.

KEYWORDS

Coronary artery disease; Patch osteoplasty; Left-main stenosis; Coronary artery bypass grafting

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Introduction

Isolated left main coronary artery (LMCA) stenosis occurs in less than 1% of patients with coronary artery disease [1,2]. LMCA stenosis, including ostial lesions, is traditionally managed with coronary artery bypass grafting (CABG). Despite the successful reestablishment of myocardial blood flow, CABG may lead to flow resistance in non-occluded coronaries because of the retrograde perfusion of an extended area of the myocardium [3,4]. Recent advances in interventional cardiology have widened the indications of percutaneous coronary intervention (PCI), and reports from the SYNTAX trial acknowledged that PCI has almost similar results to CABG for non-severe left-main coronary lesions. However, unprotected left-main stem PCI has the concern of instant restenosis and increased need for repeated revascularization [5].

Surgical patch angioplasty (SPA) provides an alternative option to revascularize isolated ostial LMCA stenosis with the advantage of reestablishing physiological coronary perfusion without utilizing conduit material. By keeping up antegrade perfusion all through the coronary tree, SPA prevents the problem of retrograde blood flow with a later drop in pressure in several coronary branches [6,7] seen with traditional coronary bypass utilizing arterial or venous conduits. Additionally, the SPA doesn't preclude percutaneous coronary intervention of any subsequently developing distal stenosis, as it maintains the ostial patency.

The hemodynamic parameters reported after surgical angioplasty of a stenotic LMCA are superior to those achieved after traditional aortocoronary bypass to the major branches of the left coronary system [3,8]. Because perfect conditions are seldom accomplished and the repair is technically demanding, surgical angioplasty of the LMCA is not generally used [8,9]. The objective of this study is to demonstrate the feasibility of patch osteoplasty in patients with isolated non-calcified LMCA stenosis.

Patients and Methods:

This study is a retrospective case series of eight patients with angiographically proven significant isolated ostial or proximal LMCA stenosis who

underwent surgical patch angioplasty in the period from March 2012 to November 2018 in two cardiac centers. All patients had the procedure on an elective basis.

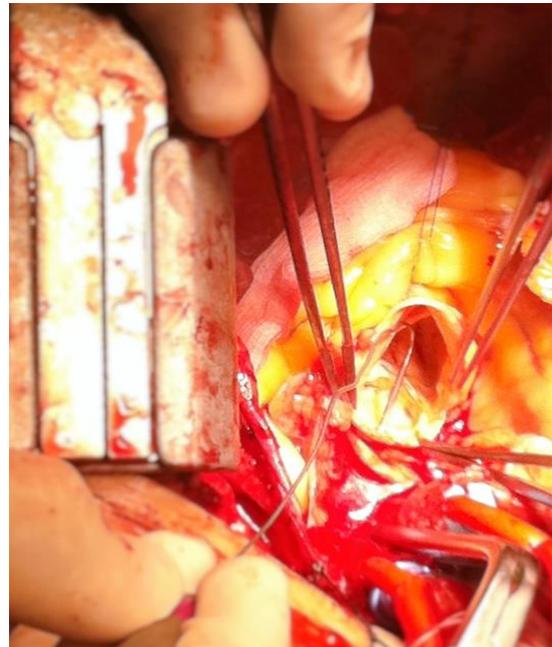


Figure 1: Left main ostium passing one mm probe

Two patients had concomitant right coronary artery bypass grafting. All patients had the procedure using the cardiopulmonary bypass. Patients with suspected calcification of the LMCA ostium or those who had significant distal stenosis and or concomitant aortic stenosis were subjected to conventional CABG.

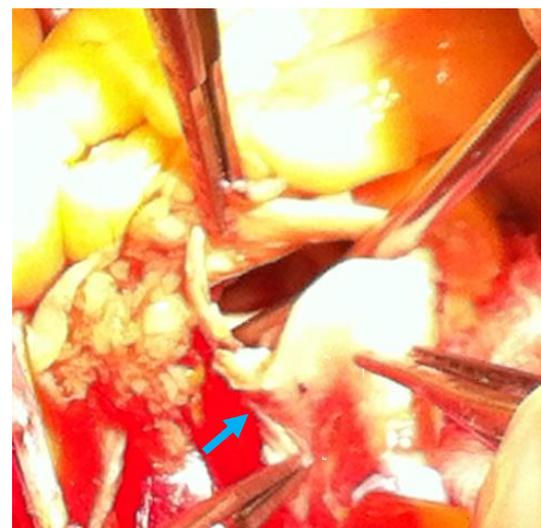


Figure 2: Closure of aortotomy with the patch in place (arrow)

Cardiopulmonary bypass was instituted using aortocaval cannulation, and the patient was

cooled to 32° C. Antegrade, and retrograde cold blood cardioplegia with topical cooling were used in all patients. We cross-clamped the aorta and dissected the main pulmonary artery then encircled it with a silicone loop and retracted it laterally to expose the origin of LMCA. Before incising the coronary ostium, the pericardial fat was dissected and excised from the LMCA. The aorta was incised at the anteromedial wall, and the incision was directed towards the ostium of the LMCA and extended through the LMCA to its midportion but did not reach the bifurcation. Ostial reconstruction was performed with an autologous saphenous vein which was tailored accurately and laid over to expand the diameter of the vessel and enlarging not only LMCA but also the adjacent zone of the aortic incision. Continuous (6-0) polypropylene sutures were utilized to design the new funnel-shaped LMCA part (Figure 1 & 2). No endarterectomies were needed in any of these patients.

In the patients who had associated right coronary disease, its distal anastomosis using a reversed saphenous vein was performed first. Then direct cold blood cardioplegia solution was injected through this graft during the whole procedure in association with the retrograde cardioplegia. After complete closure of the aortotomy, the aortic cross-clamp was released, and the proximal vein graft end going to the right coronary artery was anastomosed to the ascending aorta using a side-biting clamp.

The Research Ethics Committee approved the study and patients' consents for the use of data for research purpose was obtained during the procedure consent.

Results

Eight patients had left-main patch osteoplasty, seven of them were males (87.5%). The mean age was 58.2 years (range: 52-63 years). Three patients (37.5%) had diffuse non-significant coronary disease. Left ventricular ejection fraction (LVEF) was good (>50%) in two patients, moderate (35-50%) in 5 and poor (<35%) in one patient.

No significant ostial calcification of the LMCA was diagnosed angiographically or intra-operatively. All patients had autologous saphenous vein for patching the LMCA, and no endarterectomies were done for these patients. One patient with left ventricular dysfunction

required preoperative intra-aortic balloon pump (IABP) insertion on an elective basis, and it was removed the second postoperative day (Table 1).

The mean cross-clamp time was 34.5 minutes, and the mean bypass time was 53.2 minutes. The mean intensive care unit (ICU) stay was 40.2 hours, and the mean hospital stays 7.6 days. No perioperative mortality or myocardial infarction were reported. The hospital stay period was uneventful, no renal impairment, no strokes, no re-sternotomy, and no major bleeding were reported. The mean follows up period was 14 months (ranging from 26 to 6 months). Angiography was done in the first three cases, and all showed no restenosis and no vein patch dilatation.

Discussion

Left main disease was reported in 9-14% of the patients undergoing CABG, and 22% of these patients could be potential candidates for left-main angioplasty [10], while isolated left-main disease represents less than 1% of all cases of coronary artery disease [1,2].

The early surgical experiences for management of left-main disease was performed with endarterectomy and on lay patch angioplasty with a documented high incidence of mortality, thrombosis, and restenosis [11,12]. These drawbacks prohibited the procedure for many years. Because better myocardial protection and cardiopulmonary bypass techniques have developed, Hitchcock and coworkers [6] recreated and adjusted the angioplasty of the LMCA procedure by introducing the posterior approach with good outcomes. Dion and colleagues [3] improved the procedure and published the largest series of 47 patients, and an expanding number of surgeons have been stimulated to adopt surgical angioplasty again using several surgical techniques, approaches and patch material, with variable surgical outcomes [11-14]. Since then, coronary osteoplasty was classified as an alternative surgical procedure to conventional CABG in patients with proximal obstructive non-calcified coronary artery disease.

Several surgical approaches were described for patch osteoplasty. Hitchcock and colleagues in 1983 operated nine patients using a posterior aortotomy incision [6]. Another report by Effler

Table 1: Preoperative, operative, and postoperative data of the patients

No.	Age (years) /Gender	Risk Factor	LV EF	Symptoms	Surgery	Postop. Course	Follow-up months
1	61/M	HTN, DM, DLP	45%	Angina II	SPA	Uneventful	13
2	54/M	HTN, DM, DLP	60%	Angina I	SPA	Uneventful	12
3	52/M	HTN, DM, DLP	50%	Angina II	SPA	AF managed medical	6
4	63/M	HTN, Smoker, DLP	40%	Angina I, Dyspnea II	SPA+ RCA	Uneventful	26
5	58/F	DM, DLP, Family History	55%	Angina I	SPA	Uneventful	12
6	62/M	HTN, DM, DLP, Smoker	30%	Dyspnea II	SPA	Preop. IABP & Moderate Inotropic support	10
7	56/M	HTN, DM, DLP	50%	Angina III	SPA+ RCA	AF managed medical	18
8	60/M	HTN, DM, DLP, Smoker	45%	Angina II	SPA	Uneventful	15

AF: atrial fibrillation; DM: diabetes mellitus; DLP: dyslipidemia; F: female; IABP: Intra-aortic balloon pump; HTN: hypertension; LVEF; left ventricle ejection fraction; M: Male; SPA: surgical patch angioplasty

and coworkers dated back to 1965 [15] reported an anterior approach and endarterectomy of the segment involved was proposed. Dion and associates [3] reported surgical angioplasty in 22 patients using anterior and posterior aortotomy approaches. They found that the anterior approach was superior and gave better exposure. In our cases, the anterior approach was done in all cases as it offered direct access to the LMCA root.

The most widely used patch materials for left main osteoplasty are saphenous vein and pericardium, although the internal mammary artery and the pulmonary artery were also used as graft materials [8]. The safety of autologous pericardium appeared to be comparable to the saphenous vein patch. Dion and colleagues found that the saphenous vein patch might be advantageous to autologous pericardium because of its potential fibrinolytic activity [3]. Theoretically, the autologous vein may undergo proliferative degeneration corresponding to that occurring with the saphenous vein graft after conventional CABG. In our cases, we used

autologous saphenous vein patch in all patients, and it can be easily fashioned to make a funnel-shaped ostium. The pericardium is harvested easily, promptly obtainable and allows for the conservation of future conduit material. However, its lack of fibrinolytic characteristics may theoretically enhance calcification and future restenosis. Malyshev and colleagues found that the restenosis percentage was 3.4% when the autologous saphenous vein was used for surgical osteoplasty and 4.9% when autologous pericardium was used as patch material [13]. The right mammary artery can be used as a patch, but essentially abolishes future utilization of this conduit; additionally, the size of the right mammary artery patch does not permit for creating a funnel-shaped ostium as preferred by Dion and colleagues [16].

Theoretically, surgical osteoplasty for the LMCA is superior to conventional CABG; however; it is considered somewhat debatable. Surgical patch osteoplasty is more demanding, and as a surgeon, you will not be capable of achieving the

same value of exposure as conventional coronary artery bypass grafting surgery, which is a well-established and secure surgical treatment. Another drawback of this technique is the restenosis and calcification of the patch.

The main limitation of our study is the short follow up period, which may be due to the recent experience with this procedure. Follow up was done clinically, by ECG, transthoracic echocardiography, and postoperative angiography. The threshold for diagnostic angiography was low in the first three cases, so any anginal pain was an indication for it. The later five patients did not have cardiac catheterization postoperatively because they were asymptomatic. Another limitation is the lack of a control group with conventional CABG to compare the results. However, this is an exploratory study that shows the feasibility of patch osteoplasty and more extensive comparative study is recommended.

Conclusion

Surgical patch angioplasty is a potential alternative to conventional CABG in selected patients with isolated non-calcified stenosis of the proximal and middle part of the left main coronary artery. Further studies are needed to compare the results of the SPA with those of standard CABG and LMCA stenting.

Conflict of interest: Authors declare no conflict of interest.

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