

Results of a hybrid procedure for patients with proximal left subclavian artery stenosis and coronary artery disease

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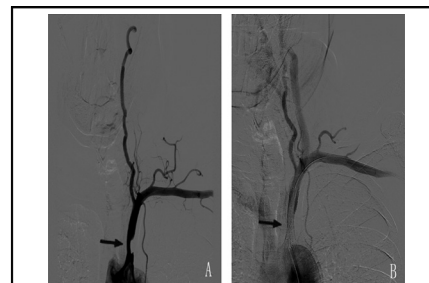
ABSTRACT

Objective: To assess whether a hybrid approach to the treatment of coronary artery disease with proximal left subclavian artery stenosis is superior to a staged approach.

Methods: We retrospectively analyzed 20 patients who underwent percutaneous transluminal angioplasty (PTA) and stenting treatment combined with coronary artery bypass grafting on the same day (hybrid group) between January 2013 and October 2015, and compared them with 23 patients who underwent PTA and stenting followed by coronary artery bypass graft 4 weeks later (staged group) between January 2008 and December 2012. Demographic data, preoperative risk factors, intraoperative measures, and postoperative outcomes were analyzed.

Results: The demographic data and preoperative risk factors were similar in the 2 groups. The total hospital length of stay was similar in the 2 groups, with a median of 9 days (range, 6-12 days) in the hybrid group versus 9 days (range, 8-15 days) in the staged group ($P = .299$). There were no postoperative complications (eg, myocardial infarction, stroke, renal failure) in either group. In both groups, the mortality rate was 0 in the hospital, at 1 month, and at 3 months. All patients in both groups had no symptom recurrence at follow-up. Angiography showed no significant difference in postoperative stenosis between the 2 groups at 3 months ($P = .762$).

Conclusions: The hybrid procedure of PTA and stenting followed by coronary artery bypass grafting may be an effective approach for patients with concomitant proximal left subclavian artery stenosis and coronary artery disease. (*J Thorac Cardiovasc Surg* 2016; ■:1-6)



A, Angiogram showing left subclavian artery stenosis. B, No residual stenosis after stenting.

Central Message

A hybrid procedure of PTA and stenting followed by CABG may be an effective approach for patients with proximal LSA stenosis and CAD.

Perspective

Stenosis within the proximal LSA can lead to reversal of flow in patients with LIMA to LAD, resulting in myocardial ischemia after CABG. This lesion should be revascularized before CABG. The objective of this study was to assess whether a hybrid approach to the treatment of CAD with proximal LSA stenosis is superior to a staged approach.

Use of the left internal mammary artery (LIMA) during coronary artery bypass grafting (CABG) surgery has become the gold standard for revascularization. Grafting the LIMA to the left anterior descending coronary artery (LAD) during CABG operations has the highest reported angiographic patency rate and is associated with the best survival and the fewest complications compared with other

conduits.¹⁻³ Any interruption in the hemodynamic integrity of this conduit, which includes proximal left subclavian artery stenosis (SAS), may jeopardize the clinical benefit and result in the coronary-subclavian steal syndrome (CSSS).⁴

Stenosis within the proximal left subclavian artery (LSA) is central in the pathophysiology of this syndrome. SAS can lead to reversal of flow in patients with a LIMA to LAD graft, resulting in myocardial ischemia. Any CABG candidate with a ≥ 10 -mm Hg difference in systolic blood pressure between the 2 arms should have a presumptive diagnosis of SAS, and this lesion should be revascularized before CABG.

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Abbreviations and Acronyms

CABG	= coronary artery bypass graft
CAD	= coronary artery disease
CSSS	= coronary-subclavian steal syndrome
ICU	= intensive care unit
LAD	= left anterior descending coronary artery
LIMA	= left internal mammary artery
LSA	= left subclavian artery
MI	= myocardial infarction
PTA	= percutaneous transluminal angioplasty
SAS	= subclavian artery stenosis
SD	= standard deviation

Percutaneous intervention in the subclavian artery before CABG appears to be an attractive approach and is becoming the most popular in patients; however, there are little published data comparing hybrid and staged surgical approaches to concomitant SAS and coronary artery disease (CAD). Currently, there is no consensus as to which surgical approach is superior. We report the experience accumulated at a single institution for treatment of patients with CAD with SAS since 2008.

METHODS

After obtaining Institutional Review Board approval, we retrospectively reviewed the medical records of 20 patients who underwent PTA and stenting treatment combined with CABG on the same day between January 2013 and October 2015 (hybrid group). We compared their outcomes with those of a group of 23 patients who underwent PTA and stenting followed by CABG 4 weeks later between January 2008 and December 2012 (staged group). In all patients, the proximal LSA and coronary lesions were documented by angiography. Patients with stenosis corresponding to $\geq 50\%$ (estimated reduction in vessel cross-sectional area) of the proximal LSA were treated.^{5,6} Preoperatively, all patients were reviewed by cardiac and vascular surgeons. Patients who had undergone emergency CABG surgery and those with left main coronary artery stenosis, right SAS, brachiocephalic artery stenosis, or stenosis located in the LSA distal to the LIMA were excluded from this analysis.

Demographic data, preoperative risk factors, intraoperative measures, and postoperative outcomes in the 2 groups were analyzed. Postoperative complications were defined as the presence of postoperative myocardial infarction (MI), cerebrovascular accident, renal failure, or death. Clinical follow-up was by thorough routine outpatient examination, with blood pressure measurements in both upper extremities and duplex ultrasound scanning of the treated subclavian artery. Patients underwent angiography at 3 months after the procedure. Symptom recurrence was defined as a return of angina, MI, and a bilateral blood pressure differential >10 mm Hg. Significant recurrent stenosis corresponded to stenosis of $\geq 50\%$, as defined by the Ad Hoc Subcommittee on Reporting Standards of the Society for Vascular Surgery and the North American Chapter of the International Society of Cardiovascular Surgery.^{5,6}

Operative Technique

In the staged group, PTA and stenting were performed in the interventional operative suite with the patient under local anesthesia. In all patients, a transradial blood pressure monitoring line was placed in the opposite side to accurately compare blood pressure values between both upper

extremities before and after treatment. A 6F or 7F sheath was used. Fluoroscopic guidance and road-mapping were used in all cases. Typically, the lesion was crossed with a 0.035-inch angled hydrophilic guide wire (Glidewire; Boston Scientific, Watertown, Mass). The lesion was generally predilated with an angioplasty balloon (size, 5-8 mm), followed by deployment of a balloon-expandable stent (Palmas stent; Optapro, Cordis Endovascular, Miami, Fla). Stent size was chosen based on the size of the adjacent normal subclavian artery. Poststenting dilation was performed whenever residual stenosis occurred. After PTA and stenting of SAS, patients received a combination of aspirin (100 mg/day) and clopidogrel (75 mg/day) for 3 weeks. Therapy with dual antiplatelet agents was stopped 1 week before the CABG operation.

Off-pump CABG was routinely performed in the cardiac operating room. In brief, surgery was performed via a median sternotomy. The heart was displaced using a posterior pericardial stitch and large gauze swabs. The anastomotic site was secured with a suction-type tissue stabilizer (Octopus Tissue Stabilization System; Medtronic, Dublin, Ireland). The sequence of grafting in all patients was the LAD first, followed by the left circumflex coronary artery, diagonal artery, and right coronary artery. The LIMA was anastomosed to the LAD in all cases, and other grafts were performed using the saphenous vein. An intracoronary shunt was used during grafting on the LAD and distal right coronary artery. The patient was transferred to the intensive care unit (ICU) after surgery and received standardized postoperative care.

For the hybrid group, all procedures were performed on the same day in the hybrid operating room with the patient under general anesthesia. PTA and stenting were performed first, followed immediately by off-pump CABG. The patient was transferred to the ICU after surgery and received standardized postoperative care.

At discharge, all patients in the 2 groups were prescribed a combination of aspirin 200 mg/day and clopidogrel 75 mg/day for 1 year, followed by aspirin 200 mg/day over the long term.

Statistical Analysis

All continuous variables are expressed as mean \pm standard deviation (SD). The independent *t* test was used to compare continuous variables between groups with a normal distribution. Nonparametric variables are expressed as median and range (minimum to maximum). Nonparametric variables were compared using the Mann-Whitney *U* test, and dichotomous variables were compared by χ^2 analysis. All statistical analyses were done using SPSS version 17 (SPSS Inc, Chicago Ill).

RESULTS

Demographic data, preoperative risk factors, intraoperative measures, and postoperative outcomes in the 2 groups are summarized in [Tables 1-4](#). Demographic data and preoperative risk factors were similar in the hybrid and staged groups ([Table 1](#)).

PTA and Stenting

In both groups, all SAS lesions were atherosclerotic in etiology and located in the LSA proximal to the LIMA ([Figure 1, A](#)). All patients were treated using femoral access. The pre-PTA stenosis and gradient were similar in the 2 groups ([Table 2](#)). The technical success rate was 100% in both groups ([Figure 1, B](#)). Post-PTA stenosis and gradient also were similar in the 2 groups ([Table 2](#)). All patients in both groups exhibited equalization of arm blood pressures after the procedure, and thus were considered initially clinical successful.

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