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Coronary Artery Bypass Grafting Using Side-to-Side Anastomosis with Distal End Clipping of the Saphenous Vein Graft

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Abstract

Although the Saphenous Vein Graft (SVG) is commonly grafted to the coronary artery with an end-to-side anastomotic technique, there is often a significant mismatch between the diameters of the SVG and the coronary artery, which may cause SVG failure. To overcome such a drawback of the standard end-to-side SVG anastomosis, we introduce a novel side-to-side anastomosis with distal end clipping of the SVG in coronary artery bypass grafting.

The long-term outcome of Coronary Artery Bypass Grafting (CABG) depends predominantly on graft patency. Although an arterial graft is preferably used to improve long-term graft patency, a Saphenous Vein Graft (SVG) is also still widely used as a second bypass graft. The reported SVG patency ranging from 25% to >50% within 10 years was inferior to that of an arterial graft, despite considerable efforts to prevent SVG failure. Although the SVG is commonly grafted to the coronary artery with an end-to-side anastomotic technique, there is often a significant mismatch between the diameters of the SVG and the coronary artery, which may cause SVG failure. Moreover, the end-to-side anastomotic configuration has been reported to have an adverse effect on local hemodynamics, resulting in intimal hyperplasia in the long-term. The intimal hyperplasia, which is a major cause of late graft failure, has been shown to occur predominantly at the toe, heel, and bed of the host coronary artery around the distal anastomosis.

Technique

CABG is performed routinely with an off-pump technique in our unit. Initially, the skeletonized left internal mammary artery is grafted to the left anterior descending artery in a fundamental fashion. When the right internal mammary artery is used, it is grafted to the circumflex system through the transverse sinus. The gastroepiploic artery or the radial artery is rarely used. The SVG is used for the remaining coronary vessels such as the right coronary artery, the circumflex artery, and the diagonal branch. Sequential anastomoses with the SVG are performed in a diamond-shape or parallel fashion using a 7-0 polypropylene continuous suture, depending on coronary anatomy. The most distal side-to-side anastomosis is usually performed in a parallel fashion with a 7-0 polypropylene continuous suture (Figure 1). The distal end of the SVG is closed with surgical clips as close to the anastomosis as possible, paying attention not to cause any deformity at the anastomotic site (Figure 2). The SVG is then fixed to the epicardium at the heel of the anastomosis to avoid kinking. The proximal anastomosis is constructed on the ascending aorta with a 6-0 polypropylene continuous suture using a suture device.

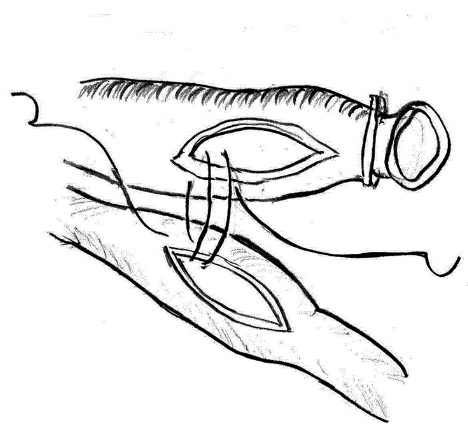

Figure 1: The distal end of the SVG is grafted to the coronary artery in a parallel end-to-end fashion with a 7-0 polypropylene continuous suture.

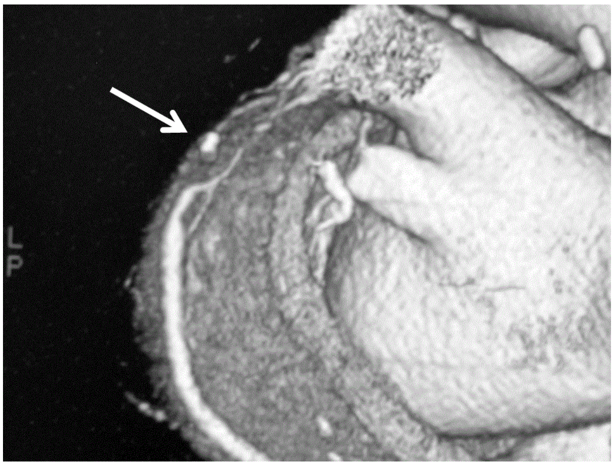

Figure 2: Postoperative computed coronary angiogram showing a smooth anastomotic area in the anastomosis of the SVG to the atrioventricular branch in a side-to-side configuration. The arrow shows distal end surgical clips of the SVG.

Clinical Application

Between January 2008 and February 2014, 216 patients underwent isolated CABG at the Tajimi Prefectural Hospital and Tokyo Medical University. A total of 386 anastomoses using SVG were assessed, including 308 distal end anastomoses and 78 sequential anastomoses. Although the distal end-to-side anastomosis has been performed at our practice in the past, the distal side-to-side anastomosis has recently become the main procedure performed. The SVG patency was confirmed 7 to 10 days after surgery by postoperative computed tomography or coronary angiography. The early patency rates of the distal end-to-side and side-to-side anastomoses were 98% (225/230) and 100% (78/78), respectively (P=0.19).

Comment

Intimal hyperplasia is highly associated with local homodynamic adverse factors such as large wall shear stress gradients and high disturbed flow [1,2]. Moreover, there is a higher degree of compliance mismatch between the coronary artery and SVG, which might cause elevated intramural stress of the suture line, resulting in intramural hyperplasia [2]. The optimizing geometric shape and angle of the end-to-side anastomosis have been shown to be larger anastomotic flow areas, smoother curvatures at and near the anastomosis, and smaller anastomotic angle at 10° [3,4]. However, these optimal anastomoses are technically difficult in the clinical setting, because most SVGs with a larger diameter and thickened wall are grafted to the circumflex artery or the distal right coronary artery system, which often has a small diameter or poor distal run-off. Subsequently, a significant graft/artery mismatch tends to occur, which might cause early SVG failure.

A recent report demonstrated the usefulness of side-to-side anastomosis using an arterial graft [5]. However, there have been no reports of the distal end anastomosis in a side-to-side fashion using a SVG. Side-to-side anastomoses, which are preferred in the parallel configuration, have several technical advantages. First, even if a significant graft/artery mismatch in diameter exists, proportional suturing with the same anastomotic size can be carried out without adjusting the suture balance between the SVG and coronary artery. As a result, anastomotic bleeding is less likely, owing to the matched anastomotic size. Moreover, the proportional suturing is associated with minimal retraction of the native coronary artery, especially at the toe of the anastomosis. Second, kinking of the anastomosis seems unlikely to occur. Moreover, there is no need to consider the anastomotic angle. The SVG with side-to-side configuration should be laid to either side at the anastomosis, which carries the risk of the graft kinking. Third, when anastomotic inspection is needed, it can be performed by cutting back the SVG from the distal side and by checking the inside after the removal of the surgical clips, allowing the repair to be easily performed. On the other hand, the disadvantage is that there may be a risk of thromboembolism from the distal end of the SVG in the early stage. To avoid this complication, ligation or clipping of the distal end of the SVG should be performed as close to the anastomosis as possible, not to leave some residual space. Overall, our patients never experienced any cardiac events such as myocardial infarction due to thromboembolism related to side-to-side anastomoses.

Finally, the determinant of the reduced intimal hyperplasia observed in the sequential grafts, where side-to-side anastomosis are performed [6]. On the other hand, this novel technique doesn't seem to have any reason to improve the long term patency of the anastomosis. Moreover, consistent evidence in the late postoperative period has not been reported. At the moment, this technique could be an alternative to the standard only in the few cases where an important mismatch between the SVG and the coronary artery is found.

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