



## Continuous Perfusion of Saphenous Vein by Oxygenated Blood during Beating Coronary Surgery

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### ABSTRACT

**Background:** The saphenous vein remains the most commonly used conduit for coronary artery bypass surgery (CABG). However, the long-term success of surgical revascularization is largely limited by development of occlusion in vein grafts.

**Objectives:** We sought to reduce graft ischemia by maintaining the blood flow into the harvested vein throughout surgery at lowest costs and without special devices.

**Patients and Methods:** This study was conducted on three hundred patients aged  $58.5 \pm 8$  years undergoing elective first-time off-pump CABG with saphenous veins.

**Results:** In addition to preserving nutritional materials and oxygen, the veins harvested via this novel technique did not go into spasm and were not subjected to high-pressure distension, eventually resulting in minimal damage to the endothelium.

**Conclusions:** This technique confers favorable myocardial function and protection in the presence of left ventricular dysfunction, especially in elderly patients.

### ► Implication for health policy/practice/research/medical education:

We sought to reduce graft ischemia by maintaining the blood flow into the harvested vein throughout surgery at lowest costs and without special devices. This technique confers favorable myocardial function and protection in the presence of left ventricular dysfunction, especially in elderly patients.

### 1. Background

The Saphenous Vein (SV) remains a widely used conduit for Coronary Artery Bypass Grafting (CABG). However, occlusion rates are high, with 15 - 30% occluding in the first year and more than 50% failing in 10 years (1, 2).

The main causes of vein graft failure are lack of perfusion during vein harvesting and the distension that is routinely imposed with normal saline, leading to graft ischemia (3). Besides, high pressure can damage endothelial layer even when we use blood in lieu of crystalloid solutions (4).

### 2. Objectives

We, therefore, sought to reduce graft ischemia and avoid distention by maintaining the blood flow into vein grafts throughout surgery at lowest costs and without special devices.

### 3. Patients and Methods

This study was conducted on three hundred patients aged  $58.5 \pm 8$  years undergoing elective first-time off-pump CABG with saphenous veins between October 2010 and July 2012. All the patients showed three-vessel coronary artery disease. The patients' medication and cardiovascular risk factors were recorded. The patients with peripheral vascular disease were excluded from the study.

After median sternotomy, the pericardium was opened along the midline. Heparin was administered intravenously (8000 - 10000 IU), and an activated clotting time of higher than 200 was maintained throughout the procedure. Through insertion of a cardioplegia cannula with side arms, an area of the upper ascending aorta was cannulated before it was subsequently connected to the vein graft. The cardioplegia cannula was thereafter connected to an extension tube. A perfusion set with two male ends was made (Figure 1) and was then connected to the proximal part of the harvested vein. Intraoperatively, the proximal adjacent SV segments were harvested from the thigh. Throughout harvesting and

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**Figure 1.** A Perfusion Set with Two Male Ends Connected to the Proximal Part of the Harvested Vein

until end distal anastomosis, vein infusion with oxygenated blood was maintained (Video 1 (To see the videos, refer to the html Version)).

**Video 1.** Maintaining the Continuous Perfusion of Saphenous Vein with Oxygenated Blood throughout the Harvesting and Until End Distal Anastomosis

#### 4. Results

The left anterior descending coronary artery was the first artery to be grafted and then, the best part of the harvested vein was grafted to the vessels on the lateral and posterior walls (mostly obtuse marginal). Perfusion was continued throughout the procedure. After each distal anastomosis was performed, the coronary bed was also infused with the side branches of the same cannula. The right coronary artery was the last artery to be grafted. Perfusion of the left coronary circulation was completely established so as to reduce the possibility of hemodynamic instability. Anastomosis of the right coronary artery and its branches was performed lastly. In cases with a dominant right coronary artery, the intracoronary shunt was utilized.

Conversion to on-pump surgery was required in only 2 of these patients. All the patients were discharged in good condition, except for 4 because of respiratory failure and sternal problems.

#### 5. Discussion

The outcome of Saphenous Vein Graft (SVG) can be influenced by complex, multifactorial interactions. Nevertheless, based on all the previous clinical studies, few therapeutic interventions seem to enjoy sustained benefits in the clinical setting (5).

Khaleel et al. (3) suggested that the pressure used in graft preparation procedures could induce expression of inflammatory mediators and might be the inciting factor that led to intimal hyperplasia and eventual graft failure. The “No-touch” technique, whereby the SV is harvested along with the perivascular tissue, is believed both to prevent vasospasm and to obviate the need for

distention of the vein (2, 5). Be that as it may, other than the technique of harvesting, the integrity of the endothelial lining is affected by a large number of factors, including the preservation solution. Destruction of the endothelial lining of the vein graft prior to graft implantation results in a more thrombogenic graft and medial smooth muscle cell proliferation (1). To address this issue, several different storage solutions for the intraoperative conservation of free vascular grafts have been tested so far. All previous investigations have demonstrated the detrimental effects of saline on the vascular endothelium and, thus, graft patency. There is, however, some disagreement in the literature as to whether autologous whole blood is superior as a storage medium (4).

Based on our experience, in patients in whom this technique is not used, the average of total SVG ischemic time (the duration from the beginning of SV harvesting to the termination of anastomosis and release of the aortic cross-clamp) is approximately 80 minutes in 4 grafts, 60 minutes in 3 grafts, and 43 minutes in 2 grafts. Our method focused on the blood supply and continuous perfusion of endothelial cells; therefore, the ischemic time was eliminated. In addition to preserving nutritional materials and oxygen, the veins harvested via this novel technique did not go into spasm and were not subjected to high-pressure distension, eventually resulting in minimal damage to the endothelium. The authors recommend comparing long-term outcomes between the groups treated with conventional method and the proposed new approach in future studies.

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#### Authors' Contribution

Study concept and design: Mandegar, Roshanali, Moradi; Acquisition of data: Moradi; Analysis and interpretation

of data: Mandegar, Moradi; Drafting of the manuscript: Moradi; Critical revision of the manuscript for important intellectual content: Mandegar; Statistical analysis: Moradi; Administrative, technical, and material support: Mandegar, Roshanali; Study supervision: Mandegar

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