Pedicled Vein Grafts in Coronary Surgery: Perioperative Data From a Randomized Trial

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Background. **Less-than-optimal long-term patency of the saphenous vein is one of the main obstacles for the success of coronary artery bypass grafting (CABG). Results from the IMPROVE-CABG trial has shown that harvesting the saphenous vein with a pedicle of perivascular tissue less than 5 mm while using manual distention provides comparable occlusion rates but significantly less intimal hyperplasia at early follow-up. The impact of pedicled veins on duration of operations, leg wound infections, and postoperative bleeding is unknown.**

Methods. **One hundred patients undergoing first-time elective CABG were randomly assigned to conventional or pedicled vein harvesting. Perioperative and postoperative data were collected prospectively during the hospital stay and at follow-up.**

Results. **Duration of extracorporeal circulation was significantly longer in the pedicled vein group (mean: 76 min versus 65 min, $p = 0.006$); however, no significant difference was found in the cross-clamp time. No significant difference was found in intraoperative vein graft flow, postoperative bleeding, or leg wound infections (4% in each group). No reoperations were due to vein graft bleeding.**

Conclusions. **Harvesting a pedicled vein provides comparable postoperative bleeding and leg wound infection rates in selected patients. The technique is associated with a slightly longer duration of extracorporeal circulation than harvesting conventional veins. Promising early results using the pedicled vein technique may contribute to a change in standard vein harvesting technique for CABG in selected patients.**

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Coronary artery disease is a leading cause of death and morbidity in developed countries [1]. Despite recent advances in percutaneous coronary intervention (PCI), coronary artery bypass grafting (CABG) remains the preferred treatment for patients with moderate and highly complex coronary disease [2]. The main grafts used for CABG are the left internal mammary artery (LIMA) and the right internal mammary artery (RIMA), the radial artery, or the great saphenous vein (SV). Despite strong evidence to suggest superior patency and improved clinical end points using RIMA and radial artery over SV [3–5], the SV is still the most widely used graft in addition to LIMA [6]. Some patients do not have suitable arterial graft material. Furthermore, harvesting both LIMA and RIMA involves an increased risk of mediastinitis and should be used with great caution in patients with risk factors for reduced sternal wound healing [7]. Consequently, improving SV patency continues to be a major goal.

Although SV graft failure in the weeks after CABG is mostly due to technical errors, SV disease during the first year is dominated by intimal hyperplasia, predisposing the vein graft to accelerated atherosclerosis [8]. Souza and colleagues [9, 10] introduced a "no-touch" harvesting technique, reporting significantly slower progression of atherosclerosis and long-term patency comparable with that of the IMA. In this technique, the SV is harvested with an extensive pedicle of surrounding tissue, aiming to preserve the entire vein wall, including the vasa vasorum. The vein is then connected to the aortic cannula to test for leakage and is stored in heparinized blood. The proposed advantage of this technique is that it reduces the damage to the vein from the harvesting, and the retained perivascular tissue serves as mechanical support to improve adaptation to the arterial circulation [11]. However, the testing procedure is unfamiliar for most surgeons, and concerns have been raised over a potential increase in postoperative bleeding, surgical duration, and that the invasive nature of this technique may increase the incidence of leg wound infections.

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Abbreviations and Acronyms

CABG = coronary artery bypass grafting
ECC = extracorporal circulation
LIMA = left internal mammary artery
OCT = optical coherence tomography
PCI = percutaneous coronary intervention
RIMA = right internal mammary artery
SV = saphenous vein

We wanted to compare conventional vein harvesting with a simplified no-touch technique, whereby the vein was harvested as a pedicle with less than 5 mm of tissue on each side. Grafts were manually distended to check for leakage and were stored in solution of heparinized blood and saline, as in conventional vein harvesting at our clinic. A 6-month angiographic follow-up has revealed comparable occlusion rates but less intimal hyperplasia and a more uniform intima in pedicled veins [12]. In this study we provide novel information on the safety and simplicity of using pedicled vein grafts harvested with our simplified technique. This study reports our perioperative and postoperative data on leg wound infection rates, postoperative bleeding, and surgical duration from a study of 100 patients who were randomly assigned to pedicled harvesting or conventional harvesting. Our hypothesis was that there was no such difference.

Material and Methods

Study Design

This study was a single-center randomized controlled trial. One hundred patients undergoing first time nonemergent CABG using SV as a conduit for revascularization were randomly assigned to either conventional or pedicled vein harvesting to investigate differences in vein graft patency in a planned 5-year angiographic follow-up study. Study sample size calculations are provided in the Appendix. Samples sizes were determined for the variables at the angiographic follow-up and not for the end points that are the focus of this study. Main exclusion criteria were insulin-dependent diabetes mellitus, malignancies, acute or chronic inflammatory diseases, smoking during the past 6 months, and serum creatinine greater than 120 μmol/L. Full list of inclusion and exclusion criteria are given in Appendix. All patients underwent vein mapping before random assignment. Patients were randomly assigned by logging into a web-based randomization service and were blinded for randomization. Randomization was not blocked or stratified. All patients received statins and acetylsalicylic acid postoperatively. All patients were offered a clinical follow-up at 6 weeks, including a leg wound assessment. Leg wound infection was defined as leg wound infection treated surgically or with antibiotics or as a wound with positive microbial culture. The assessment was not blinded. The first 60 patients were offered a 6-month angiographic follow-up, including optical coherence tomography (OCT). The aim of the 6-month follow-up was to investigate the development of early vein graft disease.

The study protocol was approved by the regional ethics board (REK Midt-Norge). The study is registered at Clinicaltrial.org (NCT01834846, https://clinicaltrials.gov/ct2/show/NCT01834846). The study complied with the Consolidated Standards of Reporting Trials criteria. A Data Safety Monitoring Board consisting of two cardiothoracic surgeons and one cardiologist monitored study safety.

Surgical Techniques

All patients underwent on-pump CABG after median sternotomy. Crystalloid cardioplegia was used in all patients. LIMA-to-left anterior descending artery graft was performed in all patients, and SV was used for further revascularization. Proximal anastomoses were performed using an aortic side clamp. On completion of the operation, graft flow was measured using transit-time flow measurement (VeriQ; Medistim, Oslo, Norway).

Conventional Technique

The SV was exposed by a longitudinal leg incision and dissected from surrounding tissue, and side branches were ligated. Manual distension was performed to distend the vein and to check for leakage. The vein was stored and tested using a combination of heparinized saline and blood according to the hospital's standard procedure.

Pedicled Technique

The SV was exposed by a longitudinal incision, and all visible side branches were ligated. The vein was then isolated along with a pedicle of surrounding tissue. No more than 5 mm of surrounding tissue was taken from either side of the vein. After removal from the leg, the vein was distended manually to check for leakage. The vein was stored and tested using a combination of heparinized saline and blood. This technique differs from the no-touch technique by not using the aortic cannula to check for leakage.

Images of a pedicled vein (Supplemental Figure 1) and a proximal anastomosis performed using a pedicled vein graft (Supplemental Figure 2) are available online.

Angiography at 6 Months

At 6 months, conventional angiography of all vein grafts was conducted in each patient [12]. In each patient, one vein graft was selected by the surgeon to be the graft of interest (GOI). This was the graft deemed to be the most important vein graft, preferably a graft supplying the circumflex artery. If the GOI was occluded on angiography, the vein graft deemed to be the secondary GOI was examined further. OCT of vein grafts requires a high dose of contrast, and to reduce the risk of contrast-induced nephropathy OCT was restricted to one vein graft in each patient. After conventional angiography had been performed, the GOI was examined using OCT. OCT pullbacks were obtained using a commercially available, frequency-domain OCT imaging system