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HOW TO DO IT

Novel harvesting technique of no-touch saphenous vein graft using THUNDERBEAT

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Abstract

The no-touch technique of saphenous vein involves harvesting the vein as a pedicled graft and avoidance of direct contact with the vein or excessive high-pressure expansion. This technique provides long-term graft patency as that of internal mammary artery; however, the wound complications could be greater than conventional skeletonized technique. To solve the problem of leg wound trouble and to harvest the vein simpler, we have developed a novel harvesting technique using a newly developed energy device, THUNDERBEAT. This technique has the ability of efficacious tissue dissection, safer sealing of branches, and less wound complications without thermal damage to the graft. This strategy was successfully used in 35 patients.

Keywords Coronary artery bypass grafting · No-touch saphenous vein graft · Harvesting technique · THUNDERBEAT

Introduction

The no-touch (NT) technique of saphenous vein (SV) involves harvesting the vein as a pedicled graft and avoidance of direct contact with the vein or excessive high-pressure expansion [1]. With this technique, long-term graft patency may be possible, similar to that of the internal mammary artery [2]. However, wound complications using the NT-SV technique could be greater than with conventional skeletonised technique [3]. In our initial series of 42 cases, after introducing the NT-SV technique which used electrocautery, 10 wound complications occurred, including 8 mild cases cured with ointment treatment, and 2 moderate cases that required surgical procedures such as re-suturing or negative-pressure wound therapy (NPWT).

THUNDERBEAT (Olympus Medical Systems Corp., Tokyo, Japan) is a newly developed surgical energy device, which integrates both electrical bipolar and ultrasonic frictional heat energy. To reduce the complications with leg wounds and to harvest the NT-SV simpler, we have developed a novel harvesting technique using THUNDERBEAT.

Technique

NT-SVs of 35 consecutive patients who underwent coronary artery bypass grafting between January and December 2018 were harvested using THUNDERBEAT. NT-SVs were harvested mainly from the patients' lower legs. Preoperative SV mapping using contrastless 3-dimensional computed tomography (3D-CT) and ultrasonography was used to determine the accurate location of the SV and its side branches. The skin was incised with one or two skin skips, and approximately 3–5 cm of skin was left intact. The SV was harvested with a pedicle of surrounding tissue of about 5 mm attached to the main trunk of the SV and the deep fascia remained intact. THUNDERBEAT was set to level 1 "SEAL & CUT" mode and was used to cut and coagulate the perivascular adipose tissues or seal the side branches smaller than 7 mm in diameter. During harvesting, the perivascular tissue was used to grasp the vein, thereby avoiding direct contact between the vein and instrument (Video 1). In the early cases, harvested veins were cannulated and lightly flushed with heparinised saline, whereas in the later cases, the veins were harvested after systemic heparinization and were neither cannulated nor flushed. In all the cases, the NT-SVs were handled with our 'proximal first' technique [4] which

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anastomose the graft to the ascending aorta prior to the distal anastomosis. The proximal anastomosis was performed with our original technique [5] using HEARTSTRING III Proximal seal system (MAQUET Holding B.V. & Co. KG, Rastatt, Germany). After the insertion of a 7-mm flat and round silicone drain (Jackson-Pratt type; Redax SpA, Poggio Rusco, Italy) in the SV harvest site, the skin was closed in two layers. We did not adopt any anticoagulant therapy after surgery, and usually only antiplatelet therapy with aspirin alone was adopted.

Comment

The NT-SV technique provides long-term graft patency [1]; however, the incidence of wound complications is still higher than that of the conventional skeletonised technique, because of the wide harvesting area and defects of the subcutaneous tissue [3]. Thermal injury to the skin due to the use of electrocautery is also involved in wound complications.

Due to the structures by which the ultrasonic sealing and cutting energy can be achieved centrally and the bipolar heat energy can be applied laterally, THUNDERBEAT has a higher versatility with faster tissue dissection speed, acceptable thermal spread, and better sealing efficacy in comparison with the other ultrasonic or electrical devices [6]. It can grasp the tissue with uniform pressure, and the burst pressure is significantly high, which can safely seal vessels smaller than 7 mm in diameter. The maximum temperature during activation with THUNDERBEAT (200 °C) was lower than that with electrocautery (> 300 °C). Therefore, less tissue thermal damage can be expected. Moreover, THUNDERBEAT has the function of holding or peeling tissue during surgery, thereby potentially reducing the need for instrument exchange and performing the surgery efficiently.

We have utilized this novel harvesting technique for 12 months in 35 consecutive patients. No leakage from the branches occurred. All side branches were successfully sealed with THUNDERBEAT. Hemoclips were used prophylactically for several large-sized branches and stitches for hemostasis were not needed. The histological analysis shows an intact endothelium of the lumen and normal appearance of the tunica media, elastic membrane, and adventitia (Fig. 1). Therefore, there was no thermal damage to the vascular tissue. Postoperative imaging showed patency of 94.3% (33/35 grafts). The cause of occlusion of the two grafts was considered to be misrecognition of the target vessel. We anastomosed the grafts to other coronary arteries without stenosis.

Wound complications were less with THUNDERBEAT than with electrocautery: [2/35 (5.7%) vs. 10/42 (23.8%); $p = 0.029$ (Chi square test)] in the included patients. Two wound complications in the THUNDERBEAT group were mild and did not require any surgical treatment; however, 2 out of 10 wound complications in the electrocautery group required surgical re-suture or NPWT. Special care must be taken to not place the active blade of the device too close to both the SV and the skin.

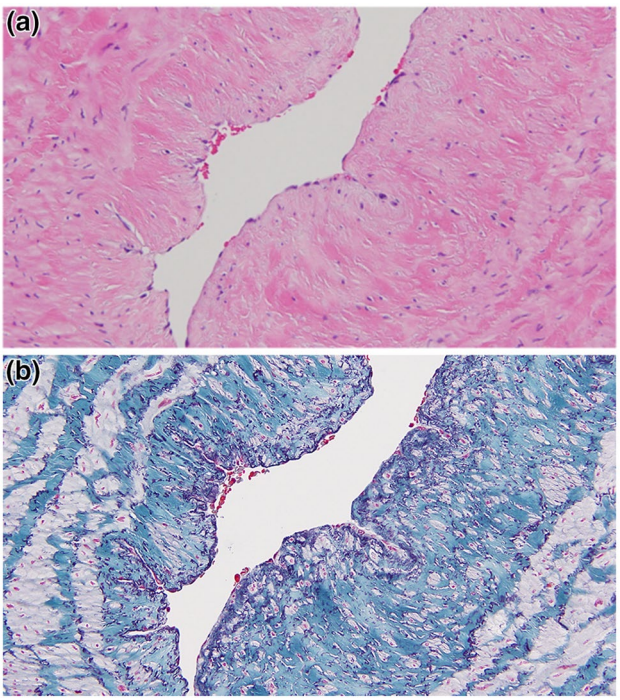

Fig. 1 Histological analysis of the saphenous vein harvested using THUNDERBEAT demonstrates intact endothelium and normal appearance of tunica media, elastic membrane, and adventitia. **a** hematoxylin eosin stain, **b** elastica Masson stain

In conclusion, our novel NT-SV harvesting technique using THUNDERBEAT has the advantage of higher versatility with fast and simple tissue dissection, safer sealing efficacy of branches and acceptable wound complications without thermal damage to the graft in comparison with the other ultrasonic or electrical devices. Moreover, THUNDERBEAT has the function of holding or peeling tissue, thereby it is the greatest advantage that THUNDERBEAT can carry out from peeling or dissection of tissue to sealing of branches efficiently without instrument exchange.

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Compliance with ethical standards

Conflict of interest All the authors declare that they have no conflict of interest.

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