Journal of Plastic, Reconstructive & Aesthetic Surgery (2014) 67, 205–211

JPRAS
An International Journal of Surgical Reconstruction
www.JPRASurg.com

Postoperative patency of the retrograde internal mammary vein anastomosis in free flap transfer☆

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Received 15 June 2013; accepted 7 October 2013

KEYWORDS
Internal mammary vein;
Free flap;
Retrograde

Summary *Background and aim:* A caudal limb of the internal mammary vein (IMV) can be used as an additional venous drainage route in free flap transfer. However, there remains the possibility that unrecognised occlusion of the retrograde IMV occurs in the early postoperative period due to non-physiologic flow, thus affecting venous drainage. There are no reports regarding the postoperative patency rates of the anastomosed retrograde IMV. This study aimed to clarify the efficacy of the retrograde IMV as an additional venous drainage route in the case of two-vein anastomosis in free flap transfer.
Patients and methods: We performed a hospital-based prospective case series study to clarify the patency rates of retrograde IMV anastomoses as an additional venous drainage route in cases of two-vein anastomosis in free flap transfer. Both antegrade and retrograde IMV anastomoses were performed in patients who underwent free flap transfer using the IMV as a recipient vein. The postoperative flow vector and peak blood velocity of the retrograde IMV anastomosis were examined using two-dimensional phase contrast magnetic resonance imaging (2D PC-MRI) and colour Doppler imaging.
Result: A total of five retrograde IMV anastomoses in five patients were performed in the study period. The postoperative patency rate of the retrograde IMV was 60%. In the patent group, the postoperative peak venous blood velocity of the retrograde IMV was significantly slower than that of the antegrade IMV (4.6 ± 0.5 vs 7.2 ± 0.8 cm s^{-1}, $P < 0.05$).

☆ Part of this work was presented at the 38th Annual Meeting of the Japan Society for Reconstructive Microsurgery, Niigata, Japan, 10–11 November 2011.

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http://dx.doi.org/10.1016/j.bjps.2013.10.013

Conclusion: We described the postoperative patency rate of retrograde IMV anastomosis in cases of two-vein anastomosis in free flap transfer. Further study is needed to evaluate the reliability of the retrograde IMV as an additional venous drainage route.

Background

Use of a caudal limb of the internal mammary vein (IMV) as an additional venous drainage route was first reported by Kerr-Valentic et al., with subsequent reports from other authors.[1–4] Initially, the efficacy of the retrograde IMV anastomosis was based on the hypothesis that because the IMV has no valves, venous blood should flow from the flap vein into the retrograde IMV in accordance with pressure gradients insofar as venous pressure of the flap vein is higher than that of the retrograde IMV. However, this hypothesis was disproven by Mackey et al., who showed that 44% of cadavers had valves in at least one IMV.[5] Mohebali et al. reported that intra-operative flow into the retrograde IMV occurred a few seconds later than that into the antegrade IMV in a study using laser-assisted indocyanine green angiography.[3] Venturi et al. reported that intra-operative mean blood flow in the retrograde IMV was less than that in the antegrade IMV in a study using a Doppler ultrasound technique.[2] This evidence suggests that non-physiologic flow from the retrograde IMV may generate an increased pressure gradient that needs to be overcome. No reports are available regarding the postoperative flow of the anastomosed retrograde IMV. We prospectively investigated the postoperative patency of such anastomoses.

Objective

The objective of this study is to clarify the efficacy of the retrograde IMV as an additional venous drainage route in the case of two-vein anastomosis in free flap transfer.

Study design, setting

We performed a hospital-based prospective case series study. The study protocol was approved by the ethical committee of Chiba University. All patients provided written informed consent to participate in this study.

Patients and methods

Patient selection and study protocol

Patients who underwent free flap surgery at Chiba University Hospital from August 2011 to March 2012 using the IMV as a recipient vein with both of the following conditions were included in the study:

A) only one IMV suitable for microanastomosis and
B) more than one flap vein suitable for microanastomosis.

Patient data regarding age, sex, body weight, height, medical co-morbidities, type of surgery, radiation, type of flap, number of perforators, donor vein, coupler size, postoperative course and postoperative patency and peak blood velocity of the retrograde IMV were collected prospectively.

Surgical procedure

Under general anaesthesia, internal mammary vessels were exposed via resection of one or two rib cartilages. The deep inferior epigastric artery (DIEA) was anastomosed to the internal mammary artery (IMA) in an end-to-end fashion. The IMV was cut at the mid-point of the exposed area. One of the free flap veins which had the largest calibre was anastomosed to the cephalad end of the IMV (antegrade IMV) in an end-to-end fashion using a coupler. One of the free flap veins, which had the second largest calibre, was anastomosed to the caudal end of the IMV (retrograde IMV) in an end-to-end fashion using a coupler. Intra-operative venous flow into the retrograde IMV was observed by microscope-integrated near-infrared indocyanine green angiography.[3,6]

Blood flow analysis

Analyses determining the patency and direction of flow were performed 6 months after the operation. Peak venous blood velocity was measured using colour Doppler imaging in all patients using the EUB-7500 ultrasound system (Hitachi Medical Corporation, Tokyo, Japan) with a 4—16-MHz linear probe held at an angle of 45° to the vein.[7]

Antegrade IMV

The flow vector of the antegrade IMV was determined by Doppler spectrum using the accompanying artery as a reference.[8]

Retrograde IMV

The flow vector of the retrograde IMV was determined by one or two imaging modalities, namely colour Doppler imaging and two-dimensional phase contrast magnetic resonance imaging (2D PC-MRI).[9–13] This technique was used if the superficial inferior epigastric vein (SIEV) was anastomosed to the retrograde IMV. It was not adopted if two deep inferior epigastric veins (DIEVs) were used for anastomosis because their close proximity decreases the technique's validity.