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Radial forearm flaps with venous compromise: correlations between salvage techniques and their rates of success

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Abstract

We retrospectively analysed the reliability of anastomosis of the deep venous system as a salvage technique for a free radial forearm flap that has developed venous compromise. The primary predictors were the salvage techniques, which comprised anastomosis of the deep venous system and a repeat of the original anastomosis, and the primary outcome measure was the rate of success. The potential confounders included original venous outflow, the original causes of the venous compromise, and the number of venous anastomoses. The chi squared test, Fisher's exact test, and the Cochran–Mantel–Haenszel test were used for statistical analysis as appropriate. The final sample comprised 42 patients who required re-exploration for venous compromise. The salvage rates were 15/18 when anastomosis of the deep venous system was chosen as a salvage technique and 9/24 and when the original anastomosis was done again ($p = 0.003$, OR 2.222, 95% CI 1.274 to 3.876). The salvage rate of venous compromise was higher in patients who had anastomoses of the deep venous system than in those in whom the original anastomosis was repeated.

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Keywords: salvage technique; venous drainage; venous compromise; radial forearm flap; head and neck reconstruction; free flap

Introduction

The radial forearm free flap (RFFF) was first described by Yang in 1981.¹ It has two different sources of venous drainage, including a superficial system and a deep system. The superficial venous drainage system is composed of subcutaneous veins that drain into the cephalic vein and basilic veins, whereas the deep system is formed by two venae comitantes that travel parallel to the radial artery.^{2–4}

Since its original description, the RFFF has been one of the most commonly used free flaps in reconstruction in the head and neck.^{3,4} It is characterised by a long, large calibre vascular pedicle, which is thin, pliable, viable, and convenient to harvest. Although it has many advantages, it may be compromised postoperatively, and require reoperation and, at worst, may fail.⁵ Successful rates of salvage have been reported in between 28% and 87.5% of cases.⁶ Previous reports have confirmed the success of salvage techniques, but detailed data are still lacking about whether there were any differences between patients who had anastomosis of the deep venous system and those who have had the original anastomosis repeated.

The purpose of this study was to ascertain whether the rate of salvage in patients who had anastomosis of the deep

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venous system was higher than in those in whom the original anastomosis was redone. We also aimed to identify variables associated with the outcome. We tested the null hypothesis, which was that in patients with venous compromise there would be no difference between the numbers of patients who had either method as a salvage technique.

Material and methods

Design, setting, and participants

This study was approved by the institutional review board of the Ninth People's Hospital, College of Stomatology, Shanghai Jiao Tong University School of Medicine. We designed and implemented a retrospective cohort study, which was derived from all patients who presented between February 2012 and February 2017 for the evaluation and management of tumours in the head and neck with free radial forearm flaps.

Patients included in the study sample had been diagnosed with venous compromise after re-exploration. They had also had a salvage procedure within 72 hours of the moment at which compromise was noted, because the timing of the salvage attempt can greatly influence the outcome.⁷ They were included if they had had a sole reconstruction of the RFFF for the defects after ablation. The exclusion criteria included: patients who had had re-exploration more than 72 hours after the compromise of the flap had been noted; those who had had double free flaps; those who had had vein grafts; those with venous complications but no compromise evident on re-exploration; and those who had had arterial thrombosis or other vascular problems of unknown aetiology; those in whom an attempted salvage for venous compromises did not go ahead for any reasons; and those with insufficient follow-up information.

The senior surgeon completed two anastomoses in which two donor veins and recipient veins of similar calibre were available, and the second venous anastomosis would not compromise the patency of the primary venous anastomosis. A sole deep or superficial system was selected, depending on the surgeon's preference or the patient's anatomical details. Because veins in the deep system are much smaller and thinner than the superficial system, most surgeons chose the superficial system as a single source of venous drainage for the RFFF for convenient microanastomosis and a relatively shorter operating time.

Primary variables and main outcomes

The patients' records were reviewed for information on the original venous outflow, causes of venous complications, salvage techniques, the number of venous anastomoses, and the outcome of salvage. The primary predictor variable was the technique of salvage, which included anastomosis of the deep venous system and repeat of the original anastomosis of the venous outflow. The primary outcome measure was the

success rate of the salvage. Potential confounders included original venous outflow, the causes of venous complications, and the number of venous anastomoses. Emergency re-exploration was necessary when postoperative monitoring suggested a vascular problem. Failure of the flap referred to partial or complete necrosis caused by venous compromise. Infection, dehiscence, or fistula were also considered as failure of the flap. Mechanical obstruction or extrinsic causes of complications included compression of the venous pedicle by the drainage tube, haematoma or oedema, and twisting or kinking of the vein. It was not clear what caused the venous thrombosis or whether inadequate outflow contributed to it. If the vascular intima were not devastated, and there was no mechanical cause found, we thought that thrombosis could have been caused by the inadequate outflow or the intrinsic causes of the venous complications.

Statistical analysis

Statistics were analysed with the aid of SPSS (version 16.0, SPSS, Inc, Chicago, IL). We used univariate analysis to assess the significance of the differences between each variable in relation to the salvage techniques and the salvage outcome. The chi squared test and Fisher's exact test (in which the expected frequency was small), were used to compare the significance of differences between the rates of salvage of the different techniques. Probabilities of less than 0.05 were accepted as significant. The Cochran–Mantel–Haenszel test was used to test the significance of the associations between the different techniques and salvage rates after we had controlled for the original venous outflow. The Cochran–Mantel–Haenszel test was used instead of logistic regression analysis for multiple-factor analysis because we found that only the original venous outflow influenced the outcome of salvage, and so we used a stratified design to control it.

Results

We collected and reviewed data from 587 patients who had had RFFF reconstruction after the ablation of tumours. Of these, 51 had compromise of the flap. A further three did not have any attempt at salvage because they were medically unstable or recipient vessels were unavailable, or both, and so second flaps had to be inset, (one local flap and two deltopectoral flaps). Six patients were considered ineligible based on the exclusion criteria, including one patient with double free flaps, three with vein grafts, and two who presented with no compromise on re-exploration. The final sample consisted of 42 patients who had had venous complications that required re-exploration (Table 1). The causes of venous compromise in the 42 patients are shown in supplemental data (please see online).

Study variables were equally distributed among the salvage techniques. Original outflow might be an indicator of

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