Free flap failures: What to do next?

Nadia S Afridi MD, JL Paletz MD, SF Morris MD

Division of Plastic Surgery, Department of Surgery, Dalhousie University, Halifax, Nova Scotia

NS Afridi, JL Paletz, SF Morris. Free flap failures: What to do next? Can J Plast Surg 2000;8(1):30-32.

Over the past two decades, microvascular free tissue transfer has become a common procedure, usually with predictable results. The overall success rate of free flap surgery has gradually improved, and most recent reviews document an overall success rate between 90% and 95%. The goal of this study was to determine the outcome of those patients who underwent unsuccessful free microvascular tissue transfer. An extensive chart review was carried out on all those patients who underwent free microvascular tissue transfer at the Queen Elizabeth II Health Sciences Centre from 1988 to 1999. One hundred and forty-eight patients underwent free tissue transfer. A total of 164 free flaps were carried out, with an overall success rate of 92%. Free flap failure was defined as complete necrosis of the flap. There were 13 documented flap failures with complete necrosis of the flap requiring debridement. Seven patients underwent repeat free microvascular tissue transfer. These procedures were carried out by the same surgeon or surgical team 12 to 52 days after the first surgery. These secondary microvascular procedures were all successful. Of the remaining patients, five had either debridement and split-thickness skin grafting or regional flap coverage. One patient went on to lower limb amputation. This study reaffirms the success rates of free microvascular tissue transfer. In addition, the success rates of repeat free flaps were evaluated. It appears that patients undergoing repeat microvascular tissue transfers have no innate propensity for flap failure.

Key Words: *Free flap; Microsurgery; Outcome*

Échec des lambeaux libres : Quoi faire ensuite ?

RÉSUMÉ : Depuis les vingt dernières années, le transfert de tissu libre microvascularisé est une intervention courante, dont les résultats sont habituellement prévisibles. Le taux global de réussite de la chirurgie consistant à transférer des lambeaux libres s'est graduellement amélioré et les revues les plus récentes documentent un taux de réussite global compris entre 90 % et 95 %. Le but de la présente étude était de déterminer l'évolution clinique des patients chez qui un transfert de tissu libre microvascularisé a échoué. On a procédé à un examen approfondi des dossiers des patients ayant subi ce type de chirurgie au *Queen Elisabeth II Health Sciences Centre* de 1998 à 1999. Cent quarante-huit patients ont subi un transfert de tissu libre. Un total de 164 lambeaux libres ont été transférés, avec un taux global de réussite de 92 %. L'échec du lambeau libre était défini comme nécrose complète du lambeau. On a comptabilisé 13 échecs du lambeau révélant une nécrose complète et exigeant un débridement. Sept patients ont subi une deuxième chirurgie de transfert de tissu libre microvascularisé. Ces reprises ont été pratiquées par le même chirurgien ou la même équipe chirurgicale de 12 à 52 jours après la première intervention et ont toutes réussi. Du reste des patients, cinq ont subi soit un débridage et une greffe de peau de demi-épaisseur, soit une couverture régionale avec le lambeau. Un patient a subi une amputation du membre inférieur. La présente étude confirme les taux de succès du transfert de tissu libre microvascularisé. De plus, les taux de réussite d'un deuxième transfert de lambeau libre microvascularisé ont été évalués. Il semble que les patients qui subissent une deuxième intervention ne soient pas intrinsèquement exposés à un échec chirurgical.

Over the past twenty-five years, microsurgery has passed through its infancy and teenage years into maturity. Once a last ditch salvage measure, it is now used as the gold standard in a variety of difficult reconstructive situations.

The incidence of free microvascular tissue transfer failure varies between 5% to 10% (1-7). Earlier studies (8) reported somewhat higher failure rates, but in a recent review, the International Microsurgery Research Group surgeons who frequently performed microvascular surgery had an improved failure rate of 4.1% (9). The overall success rate varies from institution to institution, and appears to be related to a number of factors including spectrum of reconstructive prac-

Correspondence and reprints: Dr SF Morris, Room 4443, NHI, 1796 Summer Street, Halifax, Nova Scotia B3H 3A7. Telephone 902-473-7054, fax 902-473-8773, e-mail sfmorris@is.dal.ca

tice, experience of the surgeon, patient selection and timing of free tissue transfer (10). Fearon et al (11) reviewed a series of repeat microvascular free flaps, but the success rate of repeat free tissue transfer has not been adequately documented in the literature.

The purpose of this study was to evaluate the success rate in free microvascular tissue transfer at the Queen Elizabeth II Health Sciences Centre in Halifax, Nova Scotia, with a particular emphasis on the outcomes of failed free flaps.

PATIENTS AND METHODS

To identify those patients who had undergone free tissue transfer January 1988 to May 1999, inclusive, a previously established microvascular surgery prospective registry was used. In addition, patients were identified via operating room records. A review of the hospital and office charts was carried out to identify name, sex, date of birth, surgeon, date of surgery, type of flap, donor region, recipient region, indications for surgery, length of hospitalization and success rate.

Failed free flaps were identified as those flaps undergoing complete necrosis and requiring debridement. All buried osseous flaps were identified as failures if there was no uptake on postoperative bone scans and the bone went on to nonunion or delayed union.

Charts of patients found to have had an unsuccessful free microvascular tissue transfer underwent more extensive review. In particular, preoperative risk factors such as diabetes, peripheral vascular disease, obesity, smoking and other co-morbidities were recorded. The operative record was reviewed to identify intraoperative complications including thrombosis and/or revisions of the microvascular anastomoses. Each failed free flap case was reviewed extensively, and the responsible surgeon was asked to identify contributing causes for the failure. Postoperative microvascular revisions and monitoring difficulties were also assessed and recorded. In patients who had unsuccessful free flaps, the choice and rationale for secondary procedures were reviewed. In particular, the success rate of each of the secondary surgeries was assessed.

RESULTS

A total of 164 free microvascular tissue transfers were performed on 148 patients between 1988 and 1999. The minimum follow-up was three months. Of these patients, 105 were men and 43 were women. Patient ages varied from 12 years to 80 years, with a mean age of 45 years. The overall number of free flap failures was 13, 7.9% of free flaps.

The indications for free microvascular tissue transfer were traumatic injury in 49% (n=81), tumour ablation in 41% (n=67), infection in 8% (n=13) and other indications such as congenital causes in 2% of the cases (n=3). The regions reconstructed were lower limb in 50% (n=82), head and neck in 39% (n=64), upper limb in 8% (n=13) and the torso in 3% (n=5). The types of flaps used for reconstruction included muscle and musculocutaneous in 45% (n=74), osseous and osseocutaneous in 32% (n=53), skin and fasciocutaneous in 21% (n=34) and enteric in 2% (n=3).

For reconstruction of traumatic deformities, the failure rate was 6% (n=6), while tumour reconstruction had a 7% (n=7) failure rate. No failures occurred in free flaps performed for other indications. Microvascular reconstruction of the head and neck region had the highest failure rate (11%). The flap loss rate was 7% in lower limb reconstruction, but no failures were noted in reconstruction of the torso and upper limb. Failure rates according to the type of flap used also demonstrated significant diversity. Muscle and musculocutaneous flaps had a 4% failure rate, whereas skin and fasciocutaneous flaps failed 9% of the time and bone-based flaps were unsuccessful in 13% of cases.

The cause of failure of the flaps was not always clearly related to a single factor. Among the 13 free flap failures, five were related to anastomoses within the zone of injury. All were lower limb reconstructions for traumatic crush type injuries. Five flaps used for head and neck reconstruction post-tumour ablation failed. All of the patients had extensive recurrent tumours, and four of these patients had preoperative radiotherapy. Two other flap failures were related to technical difficulties with the microvascular anastomoses, and one buried fibula flap was lost due to overwhelming sepsis.

The outcome of all patients after unsuccessful free microvascular tissue transfer was assessed. A majority of patients (53%, n=7) underwent repeat free tissue transfer for secondary reconstruction. Thirty-one per cent of patients (n=4) had regional musculocutaneous flap closure. One patient had debridement and split-thickness skin grafting, and another underwent lower limb amputation. Successful wound closure was achieved in all cases with the single additional procedure. All secondary free flaps were successful. All of these repeat flaps were performed by the same surgeon or surgical team within 12 to 52 days postoperatively.

DISCUSSION

This study demonstrates the success rate of free microvascular tissue transfer at the Queen Elizabeth II Health Sciences Centre from 1988 to 1999 to be consistent with the literature. This patient population was varied in its demographics, and several surgeons were included in this study. Many of the cases were salvage procedures following several previous unsuccessful nonmicrovascular reconstructions. The overall success rate reflects in part the 'learning curve' of the surgeons involved in the care of these patients.

Success in free microvascular tissue transfer can be attributed to flawless preoperative planning and patient selection, intraoperative technical execution, and knowledgeable postoperative care (9). Patient evaluation and ultimate selection are crucial, and always includes individualization of therapy including the choice of free flap and specific timing of the procedure. In the perioperative period, the surgeon must perform the anastomoses with precision. Kinking of the vessels or back wall stitches must be prevented at this stage of the procedure. In addition, the zone of injury must be successfully avoided in performing the anastomoses even if vein grafting is required. Postoperative monitoring and patient positioning are often crucial, and can easily be overlooked. An-

astomoses performed in the zone of injury in the lower limb were the main contributing cause of flap failure in five patients. Greater degrees of traumatic injury in the lower limb have been documented to have higher free flap failure rates (12). It has been hypothesized that this is related to intimal shearing and, therefore, a propensity for thrombosis within the endothelial damaged vessel. The recognition of the 'zone of injury' in the subacute and chronic stages after lower limb trauma is difficult and potentially problematic.

All patients who had unsuccessful head and neck free flap reconstructions had prior tumour ablative surgery. Four of the five patients had also had preoperative radiotherapy, and intraoperative records indicated significant friability of the vessels when the microvascular anastomoses were attempted. Although, Kroll et al (13) and Bengston et al (14) did not demonstrate a statistically significant effect of radiotherapy on free flap success rates, Khouri et al (9) noted that an irradiated recipient site is a predictor of free flap failure, with the odds of failure increased by 4.2 ($P=0.01$). Other studies have also demonstrated poorer success rates in irradiated patients (15). The combination of a recurrent head and neck tumour requiring an osteocutaneous microvascular reconstruction in the face of a previously irradiated bed must be viewed with caution because these factors seem to be related to a much higher failure rate.

The most interesting finding to arise from this study is the success rate of the repeat microvascular tissue transfers carried out on seven of the 13 failed free flap patients. These were all successful with no associated complications. Oliva et al (16) reported an 89% success rate with repeat free tissue transfer. This is supported by similar results documented by Fearon et al (11), in which they document six of seven successful repeat free flaps. There are some notable differences between the latter study and our own, as in Fearon's case, the secondary free flaps were treated after failure at another institution. In our study, the same surgeon or surgical team performed both microvascular tissue transfers. The second free flap was completed within 12 to 52 days after surgery, and the patients' clinical conditions were unchanged or in fact worsened by the previous surgery. In light of this information, it would be unwise for a microvascular surgeon to rule out secondary free flap reconstruction after an initial failure because such patients appear to have no innate propensity for failure. The decision to reconstruct after failure of a free flap

should be made on an individual basis, but this study clearly shows that successful resolution of difficult clinical situations can be obtained with a secondary free flap.

ACKNOWLEDGEMENTS: The authors thank Dr Kevin Bush, Dr Leif Sigurdson and Dr Ken Wilson for kindly allowing inclusion of their patients in this study.

REFERENCES

1. Campbell P, McLean NR, Black MJ. Free microvascular tissue transfer in Newcastle upon Tyne. *J R Coll Surg Edinb* 1992;37:180-2.
 2. Glicksman A, Ferder M, Casale P, et al. 1457 years of microsurgical experience. *Plastic Reconstr Surg* 1997;100:355-63.
 3. Harashina T. Analysis of 200 free flaps. *Br J Plast Surg* 1988;41:33-6.
 4. Oliva A, Lineaweaver WC, Buncke HJ, et al. Salvage of wounds following failed tissue transplantation. *J Reconstr Microsurg* 1993;9:257-63.
 5. Percival NJ, Sykes PJ, Earley MJ. Free flap surgery: the Welsh Regional Unit experience. *Br J Plast Surg* 1989;42:435-40.
 6. Salemark L. International survey of current microvascular practices in free tissue transfer and replantation surgery. *Microsurgery* 1991;12:308-11.
 7. Suominen S, Asko-Seljavaara S. Free flap failures. *Microsurgery* 1995;16:396-9.
 8. Carlson GW, Coleman JJ. Microvascular free tissue transfer. *Arch Surg* 1989;124:438-40.
 9. Khouri RK, Cooley BC, Kunselman AR, et al. A prospective study of microvascular free flap surgery and outcome. *Plastic Reconstr Surg* 1998;102:711-21.
 10. Khouri RK. Avoiding free flap failure. *Clin Plast Surg* 1992;19:773-81.
 11. Fearon JA, Cuadros CL, May JW. Flap failure after microvascular free tissue transfer: The fate of a second attempt. *Plastic Reconstr Surg* 1990;86:746-51.
 12. Khouri RK, Shaw WW. Reconstruction of the lower extremity with microvascular free flaps: a 10 year experience with 304 consecutive cases. *J Trauma* 1989;29:1086-94.
 13. Kroll SS, Robb GL, Reece GP, et al. Does prior irradiation increase the risk of total or partial free flap loss? *J Reconstr Microsurg* 1998;14:263-8.
 14. Bengston BP, Schusterman MA, Baldwin BJ, et al. Influence of prior radiotherapy on the development of postoperative complications and success of free tissue transfers in head and neck cancer reconstruction. *Am J Surg* 1993;166:326-30.
 15. Aitasalo K, Relander M, Virolainen E. Microvascular free tissue transfers after preoperative irradiation in head and neck reconstructions. *Acta Otolaryngol Suppl (Stock)* 1997;529:247-50.
 16. Oliva A, Lineaweaver WC, Buncke HJ, et al. Salvage of wounds following failed tissue transplantation. *J Reconstr Microsurg* 1993;9:257-63.
-