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Identification of independent risk factors for flap failure: A retrospective analysis of 1530 free flaps for breast, head and neck and extremity reconstruction☆

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Summary Reconstructive microsurgery is a powerful method of treating various complex defects. However, flap loss remains a possibility, leading to additional surgery, hospitalisation and costs. Consequently, it is important to know which factors lead to an increased risk of flap failure, so that measures can be undertaken to reduce this risk. Therefore, we analysed our results over a 20-year period to identify risk factors for flap failure after breast, head and neck and extremity reconstruction.

The medical files of all patients treated between 1992 and 2012 were reviewed. Patient characteristics, surgical data and post-operative complications were scored, and independent risk factors for flap loss were identified.

Reconstruction with a total of 1530 free flaps was performed in 1247 patients. Partial and total flap loss occurred in 5.5% and 4.4% of all free flaps, respectively. In all flaps, signs of compromised flap circulation were a risk factor for flap failure. More specifically, the risk factors for flap failure in breast reconstruction were previous radiotherapy, venous anastomosis revision, gluteal artery perforator (GAP) flap choice and post-operative bleeding. In head and neck reconstruction, pulmonary co-morbidity and anastomosis to the lingual vein or superficial temporal artery were risk factors, whereas a radial forearm flap reduced the risk. In extremity reconstruction, diabetes, prolonged anaesthesia time and post-operative wound infection were risk factors.

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Independent pre-, intra- and post-operative risk factors for flap failure after microvascular breast, head and neck and extremity reconstruction were identified. These results may be used to improve patient counselling and to adjust treatment algorithms to further reduce the chance of flap failure.

Introduction

Reconstructive microsurgery is a powerful tool for treating various complex defects; however, it is predominantly used to reconstruct postmastectomy, head and neck and post-traumatic extremity defects. Even in experienced hands, partial or total flap failure remains a true possibility, which affects both patient and surgeon severely, leading to additional surgery, hospitalisation, increased costs and emotional stress. Thus, it seems important to know which factors lead to an increased risk of flap failure, so that measures can be undertaken to reduce this risk and to improve patient counselling.

A number of variables have been demonstrated to be associated with flap loss after free tissue transfer. The reported preoperative risk factors are age, gender, tobacco use, diabetes, hypertension, body mass index (BMI), prior radiotherapy and recipient-site surgery. Intraoperative risk factors are limited surgical experience, use of vascular grafts and free flap choice. Little is known about post-operative risk factors, but all re-explorations with or without revision of an anastomosis are associated with higher flap loss rates.[1–17]

Previous reports analysing risk factors for flap failure have their methodological limitations, such as small sample size (<150)[1–6,8–11,13–17,18] and univariate analyses without correction for possible confounders.[1,9,10,12,14,16,18] Furthermore, the majority of these series only studied preoperative variables[1–3,5–10,12–17]; however, intra-operative as well as post-operative variables (complications) may also have an important effect on flap survival.[7,11]

The primary objective of the current study was to assess independent pre-, intra- and post-operative risk factors for partial and total flap failure after the most common types of microvascular reconstruction. The second objective was to determine the occurrence of major complications leading to reoperations following these microvascular reconstructions.

Patients and methods

All consecutive patients who received a free flap for breast, head and neck and extremity reconstruction between 1 January 1993 and 31 December 2012 were included. Cases were identified based on their operation codes, which have been digitally recorded since 1993. Patient characteristics, surgical data, post-operative complications and reoperations were collected from the medical files. The preoperative characteristics were sex, age, BMI, tobacco use, co-morbidities, medication, free flap indication and location, prior recipient-site surgery and previous chemotherapy and radiotherapy. The intraoperative characteristics included flap type(s), number of free flaps, total anaesthesia time, ischaemia time, recipient vessels, type of anastomosis, number of venous anastomoses, use of vein grafts and intraoperative revision of an anastomosis. The venous coupler device was introduced in the last year of this series, and it was used by only one microsurgeon for autologous breast reconstructions. Thus, the number of uses of this device was too low to include it as a variable in the analyses. The post-operative characteristics included use of unfractionated heparin and post-operative complications leading to reoperation, such as haematoma, infection, signs of compromised flap circulation and partial and total flap loss.

Statistical analysis

Univariate analyses were performed using chi-squared and Fisher's exact tests for categorical variables and Student's *t*-tests for continuous variables. All free flaps performed in each patient were analysed independently. All pre-, intra- and post-operative variables were analysed for a possible correlation with partial or total flap failure. Variables with $p < 0.10$ at univariate analyses were included in the multivariate regression analyses, using a backward model. Two-sided *p*-values <0.05 were considered statistically significant. Statistical analyses were performed using SPSS (SPSS for Windows Version 21.0; SPSS Inc., Chicago, IL, USA).

Results

Patient characteristics

A total of 1247 patients (566 male and 681 female) received 1530 free flaps for the reconstruction of postmastectomy, head and neck or post-traumatic extremity defects. Although this implies only an average of 77 flaps per year, 52% ($n = 795$) of the flaps were used during the last 5 years of this series, due to an increase in oncologic microvascular breast and head and neck reconstructions (Figure 1). The mean age at the time of operation was 50.4 years (range, 4–89 years). The mean body mass index (BMI) was 25.6 kg/m^2. The potential preoperative risk factors for flap failure were smoking (25.8%), diabetes (5.7%), hypertension (15.8%), cardiovascular co-morbidity (8.7%), pulmonary co-