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HEAD AND NECK

Management of complications and compromised free flaps following major head and neck surgery

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Abstract Microvascular free flaps are preferred for most major head and neck reconstruction surgeries because of better functional outcomes, improved esthetics, and generally higher success rates. Numerous studies have investigated measures to prevent flap loss, but few have evaluated the optimal treatment for free flap complications. This study aimed to determine the complication rate after free flap reconstructions and discusses our management strategies. Medical records of 260 consecutive patients who underwent free flap reconstructions for head and neck defects between July 2006 and June 2010 were retrospectively reviewed for patient and surgical characteristics and postoperative complications. The results revealed that microvascular free flaps were extremely reliable, with a 3.5 % incidence of flap failure. There were 78 surgical site complications. The most common complication was neck wound infection, followed by dehiscence, vascular congestion, abscess, flap necrosis, hematoma, osteoradionecrosis, and brisk bleeding. Twenty patients with poor wound healing received hyperbaric oxygen therapy, which was ineffective in three patients who eventually experienced complete flap loss. Eleven patients with vascular congestion underwent medicinal leech therapy, which was effective. Among the 78 patients with complications, 44 required repeat surgery, which was performed for postoperative brisk bleeding in three. Eventually, ten patients experienced partial flap loss and nine experienced complete flap loss, with the latter requiring subsequent pectoralis major flap reconstruction. Microvascular free flap reconstruction represents an essential and reliable technique for head and neck defects and allows surgeons to perform radical resection with satisfactory functional results and acceptable complication rates.

Keywords Microvascular free flaps · Head and neck reconstruction · Dehiscence · Vascular congestion · Flap failure · Radical resection · Hyperbaric oxygen therapy

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Introduction

The head and neck region has a complex three-dimensional anatomy, and the reconstruction of defects in this region can be challenging. The goal of all head and neck reconstructions involves three fundamental components: wound healing, function, and esthetics [1]. To add to this challenge, many head and neck defects result from malignancies, and reconstruction is performed under the less favorable setting of previous or future radiation, which compromises both healing and functional outcomes.

Microvascular free tissue transfer techniques have become accepted techniques for head and neck reconstructions because of increased success rates for free flaps

(92–95 %) and superior esthetic and functional outcomes [2, 3]. Major ablative surgery in patients with head and neck malignancies can create significant defects in the orofacial region, which necessitate advanced reconstruction techniques. Reconstruction in this region is aimed at the restoration of function and facial contour. Vascularized free tissue transfer was an incredible addition to the extent of options available to plastic surgeons for treating head and neck defects. In addition to restoring structure and function, free flap reconstructions decrease the adverse effects of radical surgeries compared with other reconstruction techniques [4].

Several studies have investigated measures to prevent flap loss [5–7], but few have evaluated the best course of action following a free flap complication. This study aimed to determine the complication rate after free flap reconstruction and discusses our management strategies.

Methods

This retrospective study included 260 consecutive patients who underwent free flap reconstructions for head and neck defects at the Arthur G. James Cancer Center Hospital at The Ohio State University between June 1, 2006 and June 30, 2010. All patients who underwent free flap reconstructions were identified from The Ohio State University Medical Center database.

Patient and surgical characteristics and postoperative complications were identified and recorded. Clinicopathological data, including age at surgery, gender, intraoperative findings, smoking status, alcohol consumption status, nutritional status, previous therapy, tumor type, site of lesion, flap type, surgical duration, estimated blood loss, postoperative complications, and overall survival, were collected. Recorded comorbidities included diabetes mellitus; hypertension; history of stroke or myocardial infarction; pulmonary, renal, hepatic, or vascular abnormalities; and hypothyroidism.

Postoperative care was undertaken by the head and neck surgery team. Following surgery, nurses assessed the flaps for color, warmth, turgor, and capillary refill and monitored Doppler signals every hour for the first 48 h, while residents checked the same parameters every 4 h on the basis of Doppler signals and pinprick tests. After 48 h, the flaps were evaluated every 4 h by nurses and every 8 h by residents for an additional 2 days. Subsequently, the flaps were evaluated once per shift by nurses and twice daily by residents. All patients received daily aspirin.

Statistical analyses were performed using SPSS 19.0 software (SPSS Inc., IBM, Illinois, Chicago). Standard descriptive statistics were used to summarize the data. The paired-sample t test and χ^2 analyses were used to determine statistically significant differences between the patient groups, with $P < 0.05$ considered statistically significant.

Results

There were 172 male and 88 female patients with a median age of 59.2 years (range 22–87 years). The primary tumor sites included the oral cavity in 176 patients (67.7 %), the mid- or upper face and skull base in 47 (18.1 %), and the pharynx or esophagus in 37 (14.2 %; Table 1). With regard to donor site, the radial forearm flap predominated and accounted for 98 reconstructions (37.6 %), followed by the fibula flap for 73 (28 %), anterolateral thigh flap for 57 (21.9 %), iliac crest flap for eight (3.1 %), scapula flap for six (2.3 %), and other flaps for 18 (7.1 %; Table 2).

The overall success rate was 96.5 %. Postoperative complications requiring medical or surgical intervention occurred in 78 patients (30 %). The most common complication was neck wound infection ($n = 27$), followed by dehiscence ($n = 15$), vascular congestion ($n = 12$), abscess formation ($n = 7$), flap necrosis ($n = 6$), hematoma ($n = 5$), osteoradionecrosis ($n = 3$), and brisk bleeding ($n = 3$; Table 3). Twenty patients with poor wound healing and/or osteoradionecrosis received hyperbaric oxygen therapy (HBOT); however, it was ineffective in three patients who eventually experienced complete flap loss. Eleven patients with late vascular congestion underwent medical leech therapy, which resulted in partial improvement in all patients. Among the 78 patients with complications, 44 (56.4 %) required repeat surgery, which was performed for postoperative brisk bleeding in three (Table 4). Eventually 10 (3.8 %) patients experienced partial flap loss and nine (3.5 %) experienced complete flap loss; the latter subsequently underwent pectoralis major flap reconstruction.

Analysis of the study population revealed that flap loss (complete or partial) was associated with salvage surgery and previous chemoradiation. It was rare in patients without previous therapy (five of 152; 3.3 %) and much more prevalent in those who had undergone previous extirpative surgery alone (six of 41; 14.6 %) or previous radiation/chemoradiation with or without surgery (eight of 67; 11.9 %); the difference was statistically significant

Table 1 Primary site of tumor ($n = 260$)

Tumor site	n	%
Oral cavity	176	67.7
Mid-face or upper face and skull base	47	18.1
Pharynx or esophagus	37	14.2

Table 2 Donor sites for the free flaps used in this study ($n = 260$)

Donor site	*n*	%
Radial forearm	98	37.6
Fibula	73	28
Anterolateral thigh	57	21.9
Iliac crest	8	3.1
Scapula	6	2.3
Other	18	7.1

Table 3 Postoperative complications ($n = 78$)

Complications	*n*	%
Neck wound infection	27	34.6
Dehiscence	15	19.2
Vascular congestion	12	15.4
Abscess formation	7	9
Flap necrosis	6	7.7
Hematoma	5	6.5
Osteoradionecrosis	3	3.8
Brisk bleeding	3	3.8

Table 4 Number of patients requiring repeat surgery ($n = 44$)

Pathology	*n*	%
Vascular congestion	9	20.4
Flap necrosis	8	18.2
Dehiscence	8	18.2
Wound infection	6	13.6
Hematoma	5	11.4
Brisk bleeding	3	6.8
Other	5	11.4

($P = 0.006$). There was no difference in failure rates among the different types of free flaps.

Discussion

In the past three decades, limitations of pedicle flaps and the demand for new and better donor sites have led to a resurgence of free tissue transfer techniques. Pedicle flaps were not feasible for the reconstruction of defects requiring bulky or thin pliable tissue. In addition, their range was limited by the length of their pedicle. With further investigations, new donor sites for free flaps possessing longer vascular pedicles and comprising various tissues such as skin, muscle, and bone have emerged. Free flaps allow surgeons to select the optimal tissue from a large number of potential donor sites for the reconstruction of any kind of defect [8, 9]. In the present study, the major donor sites were the RF (37.6 %), fibula (28 %), and ALT (21.9 %). Since RF flap is a very reliable, versatile flap with an ideal soft tissue thickness for oral cavity defects, traditionally it has been used more frequently for the reconstruction of this region [6, 9]. Even though ALT flap has been replacing some of the RF flaps, it is not always the most ideal flap due to too much bulk in patients with higher body mass index.

Free flap reconstruction provides surgeons with the opportunity to perform radical resections while minimizing cosmetic and functional defects. Because free flap donor sites are often distant from the primary surgical site, a two-team approach can be used to decrease the surgical duration. The outstanding perfusion of free flaps significantly improves wound healing and protects against wound breakdown and osteoradionecrosis in patients requiring postoperative radiotherapy or chemotherapy [10, 11]. Because revascularized free tissue flaps preserve their independent blood supply, they are not subject to resorption, providing long-term stability and esthetics.

Free flaps are effective in accomplishing successful reconstruction of head and neck defects; however, recognition and management of complications early in their course are crucial to avoid devastating consequences [2, 3, 12]. In our patient series, the overall success rate for free flaps was 96.5 %, which is in line with those in recently published larger patient series [2, 3, 12]. Postoperative complications requiring medical or surgical intervention occurred in 78 patients (30 %), and we could avoid repeat surgery in 34 patients (43.6 %) who responded to conservative medical therapy. Nonsurgical options must be used in an effort to salvage these complicated flaps.

In microsurgery, it is crucial to identify possible complications as early as possible to preserve the viability of the flap [13]. The rate of surgical re-exploration to check microvascular anastomoses was 17 % (44 patients) in our series. Similar repeat surgery rates have been reported in the literature [14, 15]. The reasons for repeat surgery included vascular congestion in nine patients, flap necrosis in eight, dehiscence in eight, wound infection in six, hematoma in five, brisk bleeding in three, and other reasons in five. Free flaps complicated by wound infection, hematoma, and brisk bleeding could easily be salvaged by conservative strategies. However, most patients with severe vascular congestion, flap necrosis, and dehiscence experienced partial or complete flap loss.

The present study also revealed that arterial thrombosis behaves differently from venous thrombosis. The latter is most commonly the result of mechanical obstruction caused by twisting, kinking, stretching, or compression of veins; therefore, it is easier to manage, leading to a much higher salvage rate compared with arterial thrombosis.

Arterial thrombosis tends to occur early and is usually more serious [12, 16]. Furthermore, postoperative arterial thrombosis is mostly related with intraoperative arterial thrombosis caused by technical issues at the anastomosis site.

Several well-documented animal studies have reported the better survival of patients with composite grafts and free flaps who received postoperative HBOT [17–20]. Similarly, the superior survival of pedicle flaps, particularly failing flaps, has also been reported in patients who received postoperative HBOT [21, 22]. There is no published clinical trial for the effects of HBOT on free flaps in the clinical setting, although studies on experimental animals have shown superior flap survival. In the current study, 20 patients with poor wound healing and/or osteoradionecrosis received HBOT; however, three did not respond and eventually experienced complete flap loss. We could not determine the effectiveness of HBOT in this retrospective analysis because we did not have a specific protocol. Further prospective controlled studies are required to evaluate the efficacy of HBOT in patients with compromised free flaps.

In selected cases, late venous congestion can be managed by medical leech therapy. Pohlenz et al. [2] used leech therapy in 17 patients with radial forearm flap surgery, while Dabb et al. [23] and Koch et al. [24] described several successful cases of venous congested flaps salvaged by leeches. They accept leech therapy as a viable option when venous congestion is noticed over time. In our series, 11 patients with venous congestion underwent medical leech therapy, which resulted in partial improvement in all patients.

Analysis of our study population showed that increased flap loss (complete or partial) was associated with salvage surgery and/or previous chemoradiation, similar to the finding in previous studies [25, 26]. We have not found any difference in failure rates among the different types of free flaps.

Flap failure caused by vascular thrombosis is inevitable and frequently leads to devastating results. When vascular thrombosis is detected, prompt surgical re-exploration should be employed to salvage the free flap. Successful salvage of a free flap is dependent on rapid return to the operation theater and re-establishment of blood flow before onset of the no-reflow phenomenon within the microvasculature of the flap [12, 27]. It should be noted that the chance of surgical salvage is low after 36 h [2].

This study has some limitations. The first is its retrospective design and the lack of randomization. Because our management strategies were based on the patient's clinical situation, we could not compare the efficacies of different strategies. Second, this was a single-center study. Further multicenter studies are required to address the issues of optimal management of compromised free flaps.

Conclusions

This study suggests that microvascular free flap reconstruction represents an essential and reliable technique for head and neck defects on the basis of the high free flap success rates, adequate management of most complications, and good functional outcomes. Close monitoring and early identification of postoperative complications are imperative in preventing potential flap failures.

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional review board of The Ohio State University Office of Responsible Research Practices and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study, formal consent was not required.

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