Postoperative Care and Monitoring of the Reconstructed Head and Neck Patient

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ABSTRACT

Reconstruction of head and neck patients using free tissue transfer is perhaps the most challenging of areas in the human body. Although complications are inevitable in a percentage of patients, it is good postoperative care and monitoring that determines the success or failure of the reconstruction and also permits early salvage of a failing free flap. Teamwork and cooperation among members of the reconstructive team are critical. Here we review the significance of clinical care and monitoring of reconstructed head and neck patients in the intraoperative and postoperative periods. We also review different techniques and strategies for flap monitoring and anticoagulation used for free tissue transfers.

KEYWORDS: Free flap, implantable Doppler, monitoring, thrombosis

Free tissue transfer allows unparalleled aesthetic and functional outcomes in head and neck reconstruction. However, the advantages of free flaps are tempered by risk of postoperative complications such as microvascular thrombosis. In the head and neck, this is particularly important because a single misstep, such as a constricting tracheostomy tie, can easily lead to early thrombosis and subsequent flap failure. Success of free tissue transfer therefore relies on both good surgical technique and vigilant postoperative care and monitoring.

After free tissue transfer, the flap is initially perfused solely through the anastomosed microvascular circulation. Endothelialization occurs across the anastomotic line and is essentially complete by 2 weeks.^{1,2} Reperfusion of the flap also occurs from the periphery and from the wound bed through vasculogenesis and angiogenesis. Therefore, it is during the initial postoperative period that the risk of flap failure is the highest,

when the flap is solely perfused by an incompletely endothelialized microvascular circulation.

Anywhere from 5 to 25% of free flaps necessitate reexploration due to circulatory compromise. However, quoted figures of flap failure in the head and neck are relatively low in major centers, testifying to the importance of vigilant postoperative monitoring. In a large series of 1235 head and neck free flaps by Wei et al,³ the flap failure rate was 3.4%. Another large series of 1310 free flaps in the head and neck by Yu et al⁴ reported a flap compromise rate of 3.7%, with flap failure rate of 2%. Their salvage rate was 44.9%.

Studies have reported that the majority of microvascular thrombi occur within the first two⁵ or three⁶ postoperative days. In general, venous compromise was more common than arterial compromise, with reported figures ranging from 54 to 63%⁴⁻⁶ of thrombosed vessels. Venous thrombosis is also more common during the first 3 to 5 days postoperatively.^{4,6} Arterial compromise,

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conversely, is less common, and also tends to occur after 1 week.⁶

Hence, postoperative monitoring of the reconstructed head and neck patient is most critical during the first 24 hours and in general up to 3 to 5 days after surgery. The recommended duration of flap monitoring varies according to locale. However, most series recommend at minimum hourly monitoring for the first 24 to 48 hours.^{6,7} Monitoring serves to facilitate salvage of the failing free flap. The success of microvascular salvage follows an inverse relation to the time between onset of flap ischemia and clinical recognition,⁸ and the secondary critical ischemia time is the critical period after postoperative flap compromise in which it is still possible to restore flap circulation.⁹

Unrecognized venous thrombosis or compromise from extrinsic compression can progress rapidly to arterial thrombosis and ultimate flap failure. In jejunal flaps, which are particularly susceptible to ischemia, mucosal ulcerations were evident after 3 hours of ischemia, with full-thickness necrosis by 6 hours.¹⁰ If circulation to a failing flap is not reestablished within 8 to 12 hours, salvage may become impossible due to development of the no-reflow phenomenon,¹¹ where restoration of blood flow results in initial hyperemia followed by a gradual decline in perfusion. Reperfusion injury mediated by oxygen free radicals, the complement system, and neutrophils also leads to cellular death and necrosis.¹² Therefore, early postoperative intervention is most often targeted at the failing venous anastomosis to prevent resultant arterial compromise and subsequent flap failure.

PREOPERATIVE PATIENT OPTIMIZATION

Optimization of the head and neck patient undergoing free tissue transfer begins in the preoperative period. Patients with coronary artery disease and diabetes mellitus are at higher risk of complications from both anesthesia and surgery. Consultation with a cardiologist or endocrinologist is appropriate to ensure appropriate perioperative medical management, such as administration of β -blockers and strict control of blood sugar through insulin therapy, respectively. Out of several risk factors in head and neck reconstruction such as hypertension, smoking, alcohol use, and hypercholesterolemia, only diabetes mellitus was found to be significantly associated with an increased incidence of postoperative complications.^{13,14} Interestingly, age (more than 65 years) was not found to affect outcome in free tissue transfer.¹⁵ Correspondingly, this should not be a contraindication for free flap reconstruction, as many patients with head and neck cancer would fall in this age group. Unrecognized hypercoagulability has also been reported as a cause of free flap failure.¹⁶ In patients with a family history of blood dyscrasias or past history of thromboembolism, it would be important to perform appropriate hematologic screen-

ing and initiate thromboembolic prophylaxis in consultation with a hematologist.

INTRAOPERATIVE OPTIMIZATION AND PATIENT CARE

As the head and neck presents an extremely confined space with a multitude of vital structures, technical considerations are key to success or failure of free tissue transfer. In planning of the microvascular anastomosis, it is essential to avoid any potential sites of kinking and compression. Tension at the site of the anastomosis is to be avoided at all costs. Redundancy of vessels is better tolerated but should be avoided. Where unavoidable, the placement of anchoring sutures in the surrounding tissues around the anastomosis to prevent torsion or compression of the anastomosis from movement of the head and neck may prevent potential vascular compromise. Some authors have reported observing and controlling the anastomosis for at least 45 minutes prior to definite wound closure to detect immediate and early vascular occlusion.¹⁷

Other simple measures, such as placing a sign on the patient's bed stating "no trach ties," may prevent an accident leading to flap failure. Design and inset of a monitoring paddle or external intestinal segment may be appropriate in many instances of head and neck reconstruction, as buried flaps for pharyngeal or tongue base reconstruction, for instance, cannot be monitored adequately postoperatively on the basis of clinical observation. Late flap failure has been reported to be more common in buried flaps, due to lack of reliable monitoring.⁴

Reconstruction of head and neck defects with pedicled regional flaps, although technically less demanding, still requires close intraoperative vigilance to avoid untoward events. Division of intervening skin bridges and liberal use of skin grafts should be performed to avoid vascular compromise of pedicled flaps. Tension at the wound margin during closure should be avoided as this may cause compression of the flap tissue and, particularly in irradiated patients, may lead to wound dehiscence.

POSTOPERATIVE CARE AND MONITORING

Immediate postoperative care of the reconstructed head and neck patient is best performed in a dedicated microsurgical unit or intensive care unit (ICU). Nursing staff on a normal floor may be unfamiliar with special measures for postoperative flap monitoring. In our practice, we would observe patients in the ICU for at least 24 to 48 hours. Keeping patients "nothing by mouth" and on strict bedrest for the first 24 hours are also routine measures designed to prevent potential complications and in the event that the patient has to return to surgery

for reexploration. The use of routine tracheostomy after head and neck reconstruction is common, with 69% of units reporting this in a national survey in the United Kingdom.¹⁸ Therefore, tracheostomy ties should be avoided, particularly after head and neck reconstruction with both free tissue transfer procedures with recipient vessels in the neck and after regional pedicled flaps from the trunk.

Hourly or half-hourly flap checks in the initial 24 to 48 hours by the nursing or house staff are perhaps the most important measure to assess free flap viability. Keeping the patient well hydrated and preventing anemia are also important steps to prevent microvascular thrombosis. In our unit, we will monitor a complete blood count and chemistry daily in the immediate postoperative period and ensure that the hematocrit is kept between 25 and 30% (30% for patients with a history of heart disease).

Diligent postoperative monitoring is not limited to free tissue transfer techniques alone. Workhorse pedicled flaps commonly used in the head and neck such as the pectoralis major and deltopectoral flap should also be clinically assessed after their transfer to the head and neck. Venous congestion and necrosis in the skin paddle of a pectoralis major myocutaneous flap that is used for reconstruction of a facial defect is as devastating as the loss of a free radial forearm flap used for a tongue defect. A congested flap may require medicinal leech therapy or systemic heparin until venous outflow can be established from the recipient bed. Alternatively, pin pricking the flap may be required until venous outflow is established or adjunctive treatment with hyperbaric oxygen for flaps lacking sufficient blood flow.

Any intervention that may result in flap salvage may not be possible unless clinical postoperative monitoring of the flap is undertaken. Orders may be written for the nursing staff to call the house officer if the flap color begins to change from pink to blue or becomes pale in color. A photograph may be taken of the flap reconstruction at the time of inset and posted on the head of the patient's bed so that the nursing staff is aware of how the flap should appear and notify the house officer if there is a change. Although muscle flaps with or without skin grafts may be more difficult to discern, clinical changes in appearance when compared with a photo will provide a better opportunity for nursing staff to monitor the reconstruction. Residents or physician assistants should also round on these patients in the afternoon so that interventions may be made on these patients in cases of compromise. If flap compromise is evident, a cause should be sought and the appropriate intervention made, whether this means a return to the operating theater for simple evacuation of hematoma or having to place the flap back in its original position as a delay.

Anticoagulation in Head and Neck Reconstruction

Use of anticoagulation is commonplace after free tissue transfer in the head and neck. However, there is no consensus regarding the most appropriate anticoagulation regimen or even the most appropriate dosage. All agents carry risks of undesirable bleeding and hematoma, with some agents more prone to complications than others. The most common agents in use are aspirin, heparin, and dextran. The regimen used for anticoagulation has not been shown to affect overall flap survival; however, use of dextran has been associated with increased systemic complications.

In a prospective randomized study of 100 consecutive free flaps in the head and neck,¹⁹ it was found that there was no difference in flap survival between patients receiving aspirin 325 mg/day for 120 hours and low-molecular-weight dextran 20 cc/hour for 48 or 120 hours. However, patients receiving dextran for 120 and 48 hours had respectively a 7.2 and 3.9 times greater relative risk of developing systemic complications than that of patients only on aspirin. Other studies have reported that use of dextran does not affect success in free tissue transfer.^{20,21} Whereas early studies showed that a single preoperative bolus of dextran was effective in improving patency rates in the immediate postoperative period,^{22,23} the weight of evidence appears to be shifting against routine use of dextran in microsurgery.

Aspirin has been shown in several studies to be effective in decreasing the incidence of macrovascular graft occlusion,^{24,25} with preoperative use 10 hours before surgery also shown to result in increased vessel patency and decreased platelet aggregation.²⁶ Use of subcutaneous or low-molecular-weight heparin has been shown to be similarly efficacious, demonstrated to have a statistically significant effect on prevention of postoperative flap thrombosis in a large prospective free tissue transfer study.²⁷ No difference in flap survival and incidence of complications was found between use of aspirin and low-molecular-weight heparin.²⁸ Significantly, use of low-molecular-weight heparin alone²⁹ or aspirin together with subcutaneous heparin³⁰ has not been shown to increase the incidence of hematoma or postoperative bleeding. Moreover, use of intraoperative heparin has not been shown to be useful, with a study on 505 flaps not showing any difference in incidence of microvascular thrombosis and complications between treated and control patients.³¹ Hence, our recommendation would be to use aspirin and subcutaneous heparin alone or in combination for postoperative anticoagulation after free tissue transfer.

Techniques for Postoperative Monitoring

A wide variety of techniques, both clinical and instrumental, exist for postoperative monitoring of free flaps.

The simplest is clinical observation, where the flap is assessed for color, swelling, temperature, and capillary refill. In the head and neck, this is mostly confined to an intraoral skin paddle or a monitor skin paddle or exteriorized bowel segment in the case of buried free flaps. A healthy flap will be pink and well perfused, minimally swollen in the postoperative period and warm to the touch. Capillary refill is commonly 2 to 3 seconds in duration and is assessed by applying and releasing pressure on a skin paddle with a fingertip and observing the initial pallor from direct pressure followed by return of a pink color from reperfusion. Signs of a congested (venous compromised) flap include a bluish color, increased swelling and warmth, and shortened capillary refill (<2 seconds). In the case of ischemia (arterial compromised flap), the flap will be pale in color, cold, and will have a delayed capillary refill (>3 seconds). The utility of postoperative monitoring by resident physicians versus nursing staff has been an issue of debate. A recent study showed that monitoring by trained nursing staff did not have a detrimental effect on outcome of free tissue transfer.³²

The "pinprick test" is another test used to monitor flaps with a skin paddle. The flap is punctured with a 25- to 30-gauge needle, with immediate flow of bright red blood being an indicator of flap viability. A congested flap, conversely, may result, instead, in flow of dark venous blood. This test is particularly useful in monitoring intraoral skin paddles, where it may be more difficult to assess color, warmth, and capillary refill clinically. Of note is that the pinprick should be performed in an area well away from the vascular pedicle to avoid inadvertent injury of the pedicle.

In cases of small bowel transfer for pharyngoesophageal reconstruction, a sentinel loop is often left outside the neck to facilitate clinical observation. In contrast with a skin paddle, a healthy bowel loop will exhibit a pink color with minimal swelling and also be warm to the touch. Peristalsis may also be evident on the sentinel loop. A bluish color, increased swelling, and loss of peristalsis are indicators of flap compromise. The exteriorized bowel can be ligated and removed in an outpatient setting when no longer required (Fig. 1).

An interesting alternative to these techniques has been described for monitoring buried flaps. Observation of continuous pulsation in the distal radial vessel stump of a buried free radial forearm flap has been described for monitoring reconstructed pharyngoesophageal defects,³³ with the monitoring stump ligated and resected 2 weeks postoperatively. Similarly, monitoring of the distal stump of the descending branch of the lateral circumflex femoral artery (left on the skin) through observation of direct pulsation for buried anterolateral thigh flaps has been reported.³⁴

The hand-held Doppler is another instrument commonly used in postoperative flap monitoring. Import-

Figure 1 Sentinel loop for monitoring after free jejunal flap for esophageal reconstruction in a 28-year-old Asian patient. A healthy bowel loop will exhibit pink coloration with minimal swelling and peristalsis.

tantly, the area of arterial and venous signals in the pedicle should be clearly marked in the immediate postoperative period, as confusion can arise from signals arising from other vessels in the head and neck. A clear distinction can typically be made between the arterial signal, which is pulsatile in nature, and the venous signal, which has a more confluent nature. Compression of the artery will lead to loss of signal within the flap, whereas compression of the flap will lead to augmentation of the venous signal due to increased venous return. This is the most commonly used method of free flap monitoring (Fig. 2).

The implantable Doppler probe has been used with success in head and neck reconstruction. In a consecutive series of 351 patients who underwent postoperative head and neck flap monitoring with the implantable Cook-Swartz Implantable Doppler Flow Probe (Cook Medical, Bloomington, IN), there was a reported sensitivity of 65.8% and a specificity of 98.2% for detection of flap compromise. For detection of direct vascular compromise, the sensitivity increased to 100%.³⁵ Optimal detection of flap compromise occurs if the probe is placed on the vein rather than on the artery, leading to early detection of venous obstruction instead of late arterial thrombosis (Fig. 3).

Continuous monitoring of tissue-oxygen partial pressure (ptiO₂) has been reported using the implantable Licox probe (Integral Life Sciences, Plainsboro, NJ) (Fig. 4).³⁶ In all failing flaps, a decrease in ptiO₂ of 10 mm Hg within one-half hour, or a ptiO₂ drop below 10 mm Hg was observed. The drop in ptiO₂ occurred rapidly in arterial compromise and more slowly in venous insufficiency. A disadvantage of this technique is that only one area of the flap can be monitored, which may be an inadequate reflection of oxygenation in other parts of the flap.

Figure 2 (A) Doppler probe used for free flap arterial and venous monitoring. (B) Doppler box.

Another technique of flap monitoring in the head and neck using laser Doppler flowmetry in combination with spectrophotometry has been reported.³⁷ In a small series of 61 patients, vascular complications were detected with no false-positive or false-negative results prior to clinical assessment. Laser Doppler relies on reflection of helium-neon laser light by red blood cells. Frequency shift between transmitted and reflected light is proportional to velocity of capillary blood flow. In this technique, absolute values cannot be relied upon, as values are different for every tissue and patient. The

Figure 3 An implantable Doppler probe around a flap vein. This is particularly useful for monitoring buried flaps.

Figure 4 Licox tissue oximeter.

trend of values is more important in predicting vascular compromise.

In a small study involving radial forearm flaps for intraoral reconstruction, positron emission tomography (PET) using radiolabeled water has been used to assess blood flow in head and neck free flaps postoperatively.³⁸ Muscle from the contralateral limb was used as a control. A low flap-to-control muscle blood flow ratio appeared to correlate with circulatory incongruity and poorer flap success. PET results were shown to correlate well with tissue oxygenation measurements.³⁹ Microdialysis is another technique reported for flap monitoring.⁴⁰

In our practice, we most commonly use a combination of clinical observation, hand-held Doppler for monitoring, and the implantable Doppler. The implantable Doppler is also very useful in monitoring buried flaps. As techniques continue to develop, it is certain that more modalities will become available for postoperative monitoring in head and neck reconstruction.

CONCLUSION

Vigilant postoperative monitoring in the head and neck patient can mean the difference between success and failure in free tissue transfer. Although complications inevitably occur in a percentage of patients, early detection and intervention can result in flap salvage. Coordination and communication among members of the microsurgical team is essential to ensure optimal outcome in the reconstructed head and neck patient.

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