

Perioperative Anesthetic Management and Outcomes in Head and Neck Free Flap Reconstruction: A Prospective Observational Study from a Tertiary Cancer Care Center

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ABSTRACT:

Background: Major head and neck oncological resections with microvascular free-flap reconstruction impose substantial physiological stresses on patients and demand meticulous anaesthetic management. This study evaluates anaesthetic and perioperative outcomes, with a focus on fluid and transfusion management, in a tertiary cancer institute. **Methods:** Forty adult patients undergoing major head and neck cancer resection plus free-flap reconstruction were included for a period of 1 year. Data collected: demographic, comorbidities, flap type, operative duration, estimated blood loss (EBL), fluid and blood product administration, vasopressor usage, postoperative ICU stay, flap failure rate, and complications. Deep vein thrombosis (DVT) prophylaxis with DVT pump intra-operatively and enoxaparin 40 mg daily for 5 days post-operatively was applied. **Results:** The mean age was 51.83 ± 9.40 years; 21 males (52.5%), 19 females (47.5%). The most common flap was anterolateral thigh (ALT) in 18 (45%), followed by radial artery forearm flap (RAFF) in 13 (32.5%), free fibula flap (FFF) in 6 (15%), combined ALT+FFF in 2 (5%), and jejunal free flap in 1 (2.5%). Comorbidities included hypertension in 5 (12.5%), diabetes in 3 (7.5%), hypothyroidism in 2 (5%) and atrial fibrillation in 1 (2.5%). The mean operative duration was 11.56 ± 0.88 hours. Mean intraoperative blood loss was 1465 ± 199 mL and average fluid administered was 4.70 ± 0.43 L; 2 ± 0.50 units of packed red blood cells (PRBCs) and fresh frozen plasma (FFP) were used on average when indicated. No patients required vasoconstrictors. No symptomatic DVTs occurred. Flap failure occurred in 6 patients (12.5%); mean ICU stay was 5.2 ± 2 days. **Conclusion:** Despite substantial operative durations and blood loss, with vigilant anaesthetic management especially in fluid and transfusion strategies an 85% flap success rate was achieved. These data underscore the critical role of anaesthetic planning in microvascular head and neck reconstruction procedures.

Keywords: *Microvascular anastomosis, Head and neck cancer; free-flap reconstruction, Anaesthesia*

INTRODUCTION:

Head and neck cancers constitute a major global cancer burden, particularly in developing countries like India, where tobacco and alcohol use are prevalent risk factors. Surgical resection remains the mainstay treatment for locally advanced disease, often necessitating extensive tissue removal followed by reconstruction to restore anatomy and function. With advancements in microvascular surgery¹ and a better understanding of donor site anatomy², free flap reconstruction such as the radial artery forearm flap (RAFF), anterolateral thigh (ALT) flap, free fibular flap and jejunal free flap has revolutionized reconstructive surgery by enabling single-

stage restoration of form and function with excellent aesthetic and functional outcomes^{3,4}. Free flap reconstruction of the head and neck was introduced with the jejunal free flap by Seidenberg in 1959.⁵ Free tissue transplantation by microvascular anastomosis was performed by Goldwyn⁶ and Krizek⁷ in animal models in the 1960s. However, these procedures pose significant anesthetic challenges due to their prolonged duration, major fluid shifts, potential for massive blood loss, and the need for meticulous intraoperative monitoring to ensure flap viability. Airway management is often complex because of tumor location, restricted mouth opening, and postoperative airway edema, necessitating

Careful preoperative evaluation and planning. Maintenance of hemodynamic stability, optimal perfusion of the microvascular anastomosis, normothermia, and adequate analgesia are critical determinants of flap survival and patient recovery.

This study aims to evaluate the perioperative anesthetic management and its impact on intraoperative hemodynamic stability and postoperative outcomes in patients undergoing free flap reconstruction for head and neck oncosurgeries at a tertiary cancer care center. The objectives are to assess the intraoperative fluid management strategies used during free flap reconstruction, evaluate the role of intraoperative monitoring techniques in optimizing flap perfusion, analyze the incidence of intraoperative and postoperative

complications and compare postoperative outcomes in relation to intraoperative hemodynamic parameters and fluid therapy.

Patient Data:

A total of 40 patients who underwent microvascular free flap reconstruction for head and neck malignancies from June 2024 to June 2025 were included in the study. Among them, 21 (52.5%) were males and 19 (47.5%) were females. The mean age of the study population was 42.8 years, ranging from 28 to 84 years. The average body weight was 52.6 kg. According to the American Society of Anesthesiologists (ASA) physical status classification, patients were graded between ASA I and ASA III.

Diagnosis:

Table 1. Distribution of Cases According to Primary Site of Carcinoma

Primary Site of Carcinoma	Number of Cases (%)
Carcinoma of the buccal mucosa	14 (35%)
Carcinoma of the lower gingivobuccal sulcus	8 (20%)
Carcinoma of the lower alveolus	6 (15%)
Carcinoma of the lateral border of the tongue	7 (17.5%)
Carcinoma of the hypopharynx	5 (12.5%)

Flaps Used:

Table 2. Distribution of Cases According to Type of Free Flap Used

Type of Free Flap	Number of Cases (%)
Anterolateral thigh flap (ALT)	20 (50%)
Radial artery forearm flap (RAFF)	13 (32.5%)
Free fibular flap (FFF)	6 (15%)
Jejunal free flap	1 (2.5%)

Procedures Performed:

Table 3. Distribution of Cases According to Type of operations

Type of operations	Number of Cases (%)
Commando procedure	15 (37.5%)
Hemiglossectomy	10 (25%)
Mandibulectomy	8 (20%)
Other composite resections	7 (17.5%)

Preoperative Evaluation and Optimization:

All patients included in the study were subjected to a detailed history and clinical examination with special emphasis on airway assessment, nutritional status, comorbidities, and previous surgery, radiotherapy or chemotherapy. Preoperative investigations included complete blood count, renal and liver function tests, serum electrolytes, coagulation profile, electrocardiogram, and chest radiograph. Where indicated, echocardiography, pulmonary function testing, and arterial Doppler studies of the donor site were also obtained. Preoperative optimization consisted of anemia correction with a target hematocrit >30%, optimization of comorbidities such as diabetes or hypertension, electrolyte correction, nutritional supplementation, and pulmonary optimization in chronic smokers and COPD patients. Preoperative counseling was conducted regarding prolonged operating time, the necessity for postoperative ventilation, tracheostomy, and flap monitoring. Patients were kept nil per oral for 8 hours before induction. For premedication, all the patients were given tablet alprazolam 0.5 mg the night before surgery.

Intraoperative Management:

Standard ASA monitoring was instituted, including ECG, non-invasive blood pressure, pulse oximetry, end-tidal CO₂, temperature, and urine output. In high-risk cases, invasive arterial pressure monitoring and central venous catheterization were performed. Clinical monitoring of the patient was done with intraoperative urine output, blood loss, glucose and Arterial Blood Gas (ABG) assessment.

Airway Management:

Airway control was planned based on preoperative assessment:

In patients with normal airways, induction of anesthesia was performed with intravenous fentanyl 2 µg/kg, propofol 1.5–2 mg/kg, and muscle relaxation with vecuronium 0.1–0.4 mg/kg. Intubation was followed by the insertion of a nasal reinforced endotracheal tube. In case of anticipated difficult airways, awake fiberoptic intubation was done. In a few cases with extensive tumor involvement or airway compromise, elective tracheostomy was performed prior to induction. Correct placement of the tube was confirmed by capnography and 5-point chest auscultation.

Maintenance of Anaesthesia:

Anaesthesia was maintained on a mixture of oxygen and air/nitrous oxide, using sevoflurane (1 - 1.5 MAC) for inhalational maintenance along with intermittent boluses of fentanyl for analgesia and vecuronium infusion for muscle relaxation. Ventilation was adjusted to maintain

normocapnia. The operating room temperature was kept between 24–25°C, warmer blankets were used, and all intravenous fluids were preheated to 36–37°C.

Fluid and Hemodynamic Management:

Crystalloids and colloids were given as guided by hemodynamic parameters and urine output. Transfusion of blood products was considered if hemoglobin levels dropped below 8 g/dL or were clinically indicated by blood loss. Mean arterial pressure was maintained in the range of >65 mmHg with judicious use of vasopressors, preferably phenylephrine/ephedrine, if necessary.

Postoperative Care:

Extubation decisions were individualized, based on airway edema, extent of resection, and the need for postoperative ventilation. At the end of surgery, patients were admitted to the ICU for elective mechanical ventilation (if the patient is not extubated) and close flap monitoring.

Postoperative analgesia was provided using multimodal regimens that included intravenous paracetamol, and opioids as needed. Normothermia and hemodynamic stability were maintained, with a target hematocrit of approximately 30%, urine output >1 mL/kg/h, and oxygen saturation (SaO₂) >94%. The free flap was closely monitored during the first 24 hours for arterial spasm, venous congestion, or graft edema based on colour, capillary refill, temperature, and use of laser Doppler flowmetry. In cases where ischemic changes occurred, prompt surgical re-exploration was undertaken. Graft edema was reduced by elevating the recipient site. The plan for extubation or weaning of the tracheostomy tube was done when the airway oedema had subsided and the spontaneous respiratory effort of the patient improved. Early ambulation and enteral nutrition was started as tolerated.

RESULTS:

A total of 40 patients undergoing major head and neck oncological resections with microvascular free flap reconstruction were included in the study. The mean age of the study population was 51.83 ± 9.40 years, comprising 21 males (52.5%) and 19 females (47.5%). The most commonly performed flap was the anterolateral thigh flap (ALT) in 18 patients (45%), followed by the radial artery forearm flap (RAFF) in 13 patients (32.5%), free fibular flap (FFF) in 6 patients (15%), combined ALT with FFF in 2 patients (5%), and jejunal free flap in 1 patient (2.5%).

Among the study population, 5 patients (12.5%) had hypertension controlled on medication, 3 patients (7.5%) had diabetes mellitus controlled with insulin, 2 patients

(5%) had hypothyroidism on thyroxine replacement therapy, and 1 patient (2.5%) had atrial fibrillation controlled with metoprolol.

The mean duration of surgery was between 11.56 ± 0.88 hrs, with the longest case lasting 14 hours. The mean intraoperative blood loss was approximately 1465 ± 199.44 mL, and patients received an average of 4.70 ± 0.43 liters of intravenous fluids, including crystalloids and colloids. On average 2 ± 0.50 units of packed red blood cells (PRBCs) and fresh frozen plasma (FFP) were transfused as required in cases of significant blood loss or coagulopathy.

Vasoconstrictors (phenylephrine/ephedrine) were used in case of hypotension. Intraoperative deep vein thrombosis prophylaxis was maintained by using DVT pump and postoperatively by low molecular weight heparin (Enoxaparin sodium) at a dose of 40mg once daily for consecutive 5 days. No complications of deep vein thrombosis were seen in our study.

Flap failure occurred in 5 patients (12.5%), including 1 RAFF, 2 ALT, and 2 FFF. One intraoperative failure occurred, which led to abandonment of the free flap procedure. All failed flaps were subsequently re-explored and reconstructed using regional flaps, primarily pectoralis major myocutaneous (PMMC) or local flaps. The mean postoperative intensive care unit (ICU) stay was 5.2 ± 2 days.

The overall flap success rate was 85%, and despite the prolonged operative duration and significant intraoperative blood loss, all patients remained hemodynamically stable under vigilant anaesthetic management and multidisciplinary perioperative care.

DISCUSSION:

Major head and neck oncological resections with microvascular free-flap reconstruction are lengthy, complex procedures requiring seamless coordination between the surgical and anesthetic teams. In our series of 40 patients, the mean age was 51.8 ± 9.4 years, with a nearly equal sex distribution findings consistent with institutional reports that typically describe middle-aged cohorts with a slight male predominance depending on tumor site and regional epidemiology.⁸ Flap selection followed global trends: the anterolateral thigh (ALT) flap was most common (45%), followed by the radial artery forearm (RAFF, 32.5%) and free fibular flap (FFF, 15%). The ALT flap has become a preferred choice worldwide due to its versatile tissue volume, long pedicle, and low donor-site morbidity, while the RAFF and FFF are reserved for intraoral and mandibular composite defects.⁹ Airway management in oral cavity and oropharyngeal cancers poses significant challenges, often compounded by prior radiotherapy leading to fibrosis, trismus, and

restricted neck mobility. Tumor bulk or altered anatomy from prior surgeries can further complicate mask ventilation and tracheal intubation, necessitating expertise in advanced airway techniques.¹⁰ In our study, 15 patients had anticipated difficult airways; of these, seven underwent tracheostomy under local anesthesia, and the remainder were intubated successfully using fiberoptic bronchoscopy¹¹.

Securing reliable venous access can also be difficult in these patients due to prior chemotherapy or radiotherapy. Two of our patients required central venous catheterization as peripheral access was inadequate. Donor-site selection further limits available limbs for IV cannulation, emphasizing the need for preoperative planning.¹²

Intraoperatively, meticulous temperature and hemodynamic control were maintained to ensure optimal flap perfusion. Normothermia was crucial to preserve microcirculatory flow, as hypothermia can induce vasoconstriction, raise plasma viscosity, and impair tissue perfusion. In a study conducted by Moellhoff et al.¹³, patients who developed intraoperative hypothermia had significantly higher rates of total flap loss (6.6% vs. 3.0%) and arterial thrombosis (4.6% vs. 1.9%), along with longer hospital stays (16.8 vs. 15.1 days; $p < 0.05$) compared to normothermic patients. In our study, intraoperative fluid therapy followed established principles of perioperative fluid management in microvascular surgery. Insensible losses were replaced with crystalloids (Ringer's lactate or Plasmalyte), as suggested by Sigurdsson et al.¹⁴ in his study of Perioperative Fluid Management in Microvascular Surgery, 2003. Hypovolemia was managed with synthetic colloids (Hydroxyethyl starch) when $Hb > 10$ g/dL and $Hct > 35\%$, while packed red blood cells were transfused when $Hb < 10$ g/dL or $Hct 30-35\%$ to maintain oxygen delivery and flap perfusion. Fluid management was further guided by urine output (>0.5 mL/kg/hr), blood loss estimation, and serial ABG lactate levels. Hypotension after microvascular anastomosis was corrected with fluid boluses and vasopressors, if required (phenylephrine or noradrenaline) as suggested in a study by Akash N Naik et al.¹⁵. Peri-operative analgesia was maintained using intravenous paracetamol infusion as well as buprenorphine dermal patch (10 mcg) post-operatively. Opioids minimize hemodynamic responses to intubation and surgical stimuli intraoperatively as well as provide analgesia during the early postoperative period. Fentanyl is a suitable analgesic in microvascular surgery, providing hemodynamic stability and, possibly, protecting the myocardium against ischemic injury.¹⁶

The mean operative duration was 11.56 ± 0.88 hours (≈ 694 minutes), which was longer than the 551 minutes reported by Irawati et al. (2023)¹⁷.

They noted an 11% increase in postoperative

complication risk for each additional operative hour. The mean intraoperative blood loss of 1465 ± 199 mL was also higher than values in most recent reports, including Delong et al¹⁸., who documented blood loss of 611 ± 187 mL in uncomplicated cases and 665 ± 230 mL in those with postoperative complications. This increased blood loss and operative time may reflect the complexity of composite resections in head and neck cancer. The average volume of intravenous fluids given was 4.70 ± 0.43 L, while patients received an average of 2 ± 0.50 units of packed red blood cells (PRBCs) during surgery to maintain normovolemia and ensure flap viability.

All patients were monitored in the ICU for at least 48 hours. Postoperative care emphasized continuous flap monitoring, hemodynamic stability, and multimodal analgesia. Deep vein thrombosis prophylaxis with a DVT pump and enoxaparin (40 mg once daily for five days) was routinely administered, and no thrombotic

complications occurred. In current clinical practice, peri- and post-operative thromboprophylaxis (enoxaparin, heparin [UFH], or aspirin) has become the standard of care after major H&N surgery (C. J. Pannucci et al.¹⁹; Venkatesh et al²⁰.). Free flap failure after the anastomotic revision was not affected by postoperative antiplatelet therapy, postoperative prophylactic anticoagulation, intraoperative heparin bolus, tPA, and therapeutic anticoagulation as described by Jessica L Bishop et al²¹ in their study.

Our success rate was 87.5%, which was lower compared to 98.8% reported by Bui Duc T et al²². and 97% by Gavin J. le Nobel et al²³. This highlights the importance of vigilant intraoperative monitoring, prompt recognition of vascular compromise, and timely surgical intervention. The single intraoperative flap loss and few postoperative failures were successfully salvaged using regional flaps such as the pectoralis major myocutaneous (PMMC) flap.

Table 4: Factors Contributing to Free Flap Compromise

Category	Specific Causes
Arterial Compromise	Arterial thrombosis Arterial spasm
Venous Compromise	Venous thrombosis Venous spasm Venous outflow obstruction
Mechanical Factors	External compression (tight dressings) Flap edema Excessive use of crystalloids Extreme haemodilution
Ischemic and Local Factors	Prolonged ischemia • Histamine release (from anesthetic or antibiotic agents) Excessive tissue handling
Systemic Factors	Generalized vasoconstriction Hypovolemia Hypothermia
	Pain Respiratory alkalosis Hypotension • Cardiac depressant drugs (e.g. anesthetics, calcium channel blockers) Extensive sympathetic blockade (e.g. epidural) Profound vasodilatation Cardiac failure (ischemia, fluid overload)
Other	Prolonged flap ischemia

CONCLUSION:

Major head and neck oncological resections with free-flap reconstruction demand comprehensive anaesthetic planning. Our experience shows that even with extended

operative duration and substantial blood loss, outcomes can be acceptable through meticulous fluid/transfusion management and coordinated multidisciplinary care. Anaesthetic strategies aimed at minimizing blood loss,

transfusion exposure, and preserving flap perfusion are critical to operative success in this challenging population.

REFERENCES:

- O'Brien BMCC. Microvascular reconstructive surgery. Edinburgh, London, New York: Churchill Livingstone; 1977.
- Taylor GI, Razaboni RM. Michel Salmon's anatomical studies. Book 1. Arteries of the muscles of the extremities and the trunk. St Louis: Quality Medical Publishing; 1994.
- Kroll SS, Schusterman MA, Reece GP. Comparison of the rectus abdominis free flap with the pectoralis major myocutaneous flap for reconstructions in the head and neck. *Am J Surg* 1992;164:615-8.
- Kroll SS, Schusterman MA, Reece GP. Costs and complications in mandibular reconstruction. *Ann Plast Surg* 1992;29:341-7.
- Seidenberg B. Immediate reconstruction of the cervical esophagus by a revascularized isolated jejunal segment. *Ann Surg* 1959;149:162.
- iGoldwyn, R.M., Lamb, D. C. and White, D. L.(1963). An experimental study of large island flaps in dogs. *Plastic and Reconstructive Surgery*, 31,528.
- Krizek, T.J., Tani, T., Desprez, J. D. and Kiehn, C. (1963). Experimental transplantation of composite grafts by micro-surgical vascular anastomosis. *Plastic and Reconstructive Surgery*,36,538
- Bagal S, Budukh A, Thakur JS, Dora T, Qayyumi B, Khanna D, Fernandes D, Chakravarti P, Singh R, Patil S, Dikshit R, Chaturvedi P. Head and neck cancer burden in India: an analysis from published data of 37 population-based cancer registries. *ecancermedalscience*. 2024;18:1690. <https://10.3332/ecancer.2024.1690>.
- Lueg EA. The anterolateral thigh flap: radial forearm's "big brother" for extensive soft tissue head and neck defects. *Arch Otolaryngol Head Neck Surg*. 2004;130(7):813-818. doi:10.1001/archotol.130.7.813.
- Zheng G, Feng L, Lewis CM. A data review of airway management in patients with oral cavity or oropharyngeal cancer: a single-institution experience. *BMC Anesthesiol*. 2019;19(1):92.
- Nagarkar R, Kokane G, Wagh A, Kulkarni N, Roy S, Tandale R, Pawar S. Airway management techniques in head and neck cancer surgeries: a retrospective analysis. *Oral Maxillofac Surg*. 2019 Sep;23(3):311-315.
- LeVasseur N, Stober C, Daigle K, et al. Optimizing vascular access for patients receiving intravenous systemic therapy for early-stage breast cancer-a survey of oncology nurses and physicians. *Curr Oncol*. 2018;25(4):e298-e304. <https://10.3747/co.25.3903>
- Moellhoff N, Broer PN, Heidekrueger PI, Ninkovic M, Ehrl D. Impact of intraoperative hypothermia on microsurgical free flap reconstructions. *J Reconstr Microsurg*. 2020;36(9):663-670. doi:10.1055/s-0040-1715880.
- Sigurdsson GH. Perioperative Fluid Management in Microvascular Surgery. *J Reconstr Microsurg*. 2003;19(2):91–96. <https://10.1055/s-2003-38386>.
- Naik AN, Freeman T, Li MM, Marshall S, Tamaki A, Ozer E, Agrawal A, Kang SY, Old MO, Seim NB. The use of vasopressor agents in free tissue transfer for head and neck reconstruction: current trends and review of the literature. *J Reconstr Microsurg*. 2021;37(2):140-147. <https://10.1055/s-0040-1716783>.
- Sear JW. Recent advances and developments in the clinical use of i.v. opioids during the perioperative period. *Br J Anaesth* 1998;81:38–50
- Irawati N, et al. Effect of operative time on complications associated with major head and neck surgery. *J Surg Res*. 2023.
- Li D, Wang C, Wei W, Li B, Liu H, Cheng A, Niu Q, Han Z, Feng Z. Postoperative complications of free flap reconstruction in moderate-advanced head and neck squamous cell carcinoma: a prospective cohort study based on real-world data. *Front Oncol*. 2022 Jun 24;12:792462. <https://10.3389/fonc.2022.792462>.
- Pannucci, C. J., Dreszer, G., Wachtman, C. F., Bailey, S. H., Portschy, P. R., Hamill, J. B.,

- ... Wilkins, E. G. (2011). Postoperative enoxaparin prevents symptomatic venous thromboembolism in high-risk plastic surgery patients. *Plastic and Reconstructive Surgery*, 128(5), 1093–1103. <https://doi.org/10.1097/PRS.0b013e31822b6817>
20. Venkatesh, K. P., Ambani, S. W., Arakelians, A. R. L., Johnson, J. T., & Solari, M. G. (2020). Head and neck microsurgeon practice patterns and perceptions regarding venous thromboembolism prophylaxis. *Journal of Reconstructive Microsurgery*, 36(8), 549–555. <https://doi.org/10.1055/s-0040-1710553>
 21. Bishop JL, Vasudev M, Garcia N, Heslop G, Pham TT, Hicks MD, Chowdhury F, Grayson JW, Goddard JA, Tjoa T, Haidar Y, Thomas CM. Effect of perioperative antithrombotics on head and neck microvascular free flap survival after anastomotic revision. *OTO Open*. 2023 Feb 5. <https://doi.org/10.1002/ohn.295>
 22. Bui DT, Cordeiro PG, Hu QY, Disa JJ, Pusic A, Mehrara BJ. Free flap reexploration: indications, treatment, and outcomes in 1193 free flaps. *Plast Reconstr Surg*. 2007 Jun;119(7):2092–100. <https://doi.org/10.1097/01.prs.0000260598.24376.e1>
 23. le Nobel, G. J., Higgins, K. M. & Enepekides, D. J. Predictors of complications of free flap reconstruction in head and neck surgery: analysis of 304 free flap reconstruction procedures. *The Laryngoscope* 122(5), 1014–1019 (2012).