Pressure with Precision: Optimizing Vasopressor Use in Free Flap Surgery

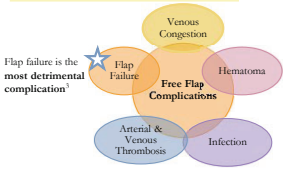
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Background Information

What is a free flap?

- Free flaps, a microsurgical technique introduced in the 1970s, **repair tissue defects** from trauma, cancer, infection, and congenital anomalies.[1]
- The procedure **transplants a patient's autologous vascularized tissue to distant sites**, commonly the head, neck, breast, and jaw.[2]
- Involves **meticulous dissection and anastomosis of blood vessels**[2]

Complications of free flap surgery



Flap failure is the **most detrimental complication**[3]



- **Risk factors:** peripheral vascular disease, hyperlipidemia, coronary artery disease, cigarette use and diabetes[4]
- **Flap failure impact:** diminished quality of life, prolonged hospitalization, and patient morbidity[4]

Current Practice

Role of Anesthesia
AANA Standard Nine: "Maintain patient's hemodynamic status"[5]

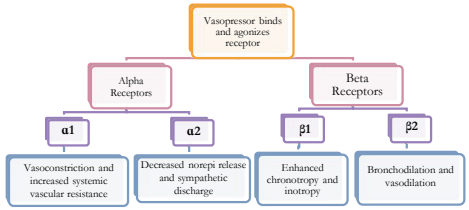
Lack of Standardized Care
The goal: maintain optimal perfusion and avoid vasopressor-related complications

Attitudes
70% of microvascular surgeons fear vasopressor use[3]

Goal-Directed Hemodynamic Therapy (GDHT)- Gold Standard

- Literature suggests that **GDHT is the most effective approach to managing patients undergoing free flap surgery**[6, 28-32]
- Involves **closely monitoring and responding to hemodynamic parameters**, including blood pressure (BP), cardiac output (CO), stroke volume (SV) to maintain adequate tissue perfusion by using devices such as an arterial line with FloTrac/Vigileo and EV 1000
- Minimizes the risk of under or over-perfusing the flap
- An **algorithm-driven approach** to treating hemodynamics using fluids or vasopressors

Pharmacology of Vasopressors[7]



Research Question

- **P** In adult patients undergoing free flap surgery,
- **I** does intraoperative vasopressor administration,
- **C** compared to no administration of vasopressors
- **O** increase the incidence of free flap failure
- **T** during the first 48 hours postoperatively?

Initial Literature Review & Expanded Search

Texas Medical Center Library Health Sciences Research Portal

Databases electronically accessed: PubMed, EMBASE, Cochrane Library, and MEDLINE

Search Terms	MESH Terms	Filters	Search Tools & Techniques
Initial Search ➢ "vasopressor" ➢ "free flap" ➢ "graft/flap failure" **Expanded Search** ➢ "goal-directed hemodynamic management" ➢ "free flap surgery" ➢ "flap failure"	**Initial Search** ➢ "vasopressor" ➢ "free flaps" **Expanded Search** ➢ "early goal-directed therapy" ➢ "free tissue flaps"	➢ Published in the last 15 years ➢ English language ➢ Full text availability	➢ Boolean operators "AND" "OR" ➢ Snowballing method

Initial Search= **18 Articles**
Expanded Search= **6 Articles**
Total Articles= 24 Articles

Study Designs

Inclusion	Exclusion
Age > 18[10-12]	Obesity[15,16]
Complete perioperative data set[11,13,14]	Incomplete anesthesia record[11,13,17,18]
The specific type of free flap being investigated (varied across studies)	Contraindication to vasopressors[15]
	Refusal of consent[15]

Types of Free Flaps
Deep inferior epigastric perforator
Head & Neck
Other: Anterolateral thigh, transverse rectus abdominis myocutaneous, radial forearm

Vasopressors
Phenylephrine
Ephedrine
Norepinephrine
Others: Dobutamine & Dopamine

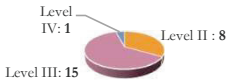
Physiologic Parameters Studied
CI, CO, SVR, SV, SVV

Patient Population Studied
Healthy Adult Patients
Adult Patients with **Comorbidities** (i.e., cancer or vascular disease)

Mode of Administration
Infusion [19-21], Bolus [8b, 18,16,22]

Grading the Evidence

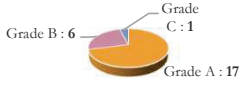
Level of Evidence[8]



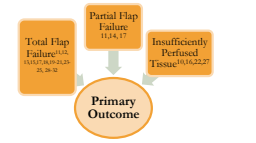
- Level I: Meta-analyses
- Level II: Experimental
- Level III: Quasi-experimental
- Level IV: Non-experimental
- Level V: Clinical expertise

Strength of the Evidence[9]

- **A** Substantial net benefit; Strongly recommended
- **B** Moderate net benefit; Recommended
- **C** Small net benefit; Recommend selectively
- **D** No net benefit; Recommend against
- **I** Insufficient evidence; Evidence lacking or conflicted



Primary & Secondary Outcomes



Primary Outcome Assessment Measures
Quantitative Perfusion Analysis[26]
Laser Doppler Velocimetry [8,11,21-23,25,26]
Clinician Assessment [11,21,23,25,26]

Secondary Outcomes
- Length of Hospital Stay[15,16]
- Medical Complications[12,13,17,23]
- Surgical Revision[12,15,16]
- Arterial or venous thrombosis[11,13,14,17,21,24]

Results:
- All studies except one **supported the use of vasopressors**
- No statistically significant relationship between vasopressor use and flap failure ($p > .05$)[10-14,17,19-21,25]
- One study reported a **significantly lower flap failure rate in the vasopressor group** ($p = .017$)[21]
- Only **one study reported an adverse outcome associated with vasopressor use**.
- Vasopressor use in patients with vascular comorbidities significantly increased the risk of flap necrosis ($p = .046$)[10]

Results:
- GDHT resulted in **statistically significant** ($p < 0.05$) improvements in flap survival rates, shorter hospital stays, and reduced flap necrosis, flap death, and ICU admissions.[6,30,31]
- Increased incidence of medical complications in the non-vasopressor receiving group[12]
- **Surgical revision was equally as likely** in the study and control groups [15]

The Ideal Vasopressor

- The **optimal vasopressor** for managing hypotension during microsurgical procedures **remains debated**.
- GDHT algorithms guide clinicians in making informed vasopressor and fluid management decisions (i.e., dobutamine for low cardiac index, phenylephrine for low systemic vascular resistance, and fluid boluses for stroke volume variation greater than 13%)[6, 28-32]

Ephedrine reduces flap complication rates[24]
Norepinephrine increases skin blood flow[22,26]
Phenylephrine had no impact on flap complication rates[24]

Recommendations for Practice

Population
-Healthy adult patients (**ASA I or II**)
-Cancer patients (head, neck, breast)

Drug, Dose, & Delivery
-Infusion or bolus
-Careful determination by the anesthesia provider

Risk-benefit analysis
-Cautious vasopressor in patients with vascular comorbidities (i.e., diabetes, peripheral arterial disease)

GDHT
-Utilize semi-invasive monitoring (arterial line with FloTrac/Vigileo or EV1000) for all flap patients to enable timely detection and management of hemodynamic instability.

QR Code with recommendations

Limitations

- **Variability:** sample size, healthy vs. comorbid patients
- **Heterogeneity:** Type of free flaps & vasopressor
- **Missing information**: Primary outcome measurement

Future Research

Consistent vasopressor dosing regimen → More RCTs → Consistent measurement of flap failure

Conclusion

- Goal-directed hemodynamic therapy is essential for **optimizing perfusion and improving outcomes in free flap surgery**. Vasopressors play a critical role, allowing precise control of blood pressure and perfusion. Their **timely and targeted use helps prevent under-perfusion** of free flaps by maintaining adequate perfusion pressure, highlighting their importance in **preserving flap viability**.

References

1. Ye et al., 2024; 2. American Society of Plastic Surgeons, 2018; 3. Goh et al., 2019; 4. Lim et al., 2023; 5. American Association of Nurse Anesthesiology, 2019; 6. Tapia et al., 2021; 7. Overgaard & Džavík, 2008; 8. Oxford Centre for Evidence-Based Medicine, 2011; 9. U.S. Preventive Services Task Force, 2018; 10. Dastagir et al., 2024; 11. Heine-Geldern et al., 2018; 12. Le et al., 2024; 13. Nelson et al., 2017; 14. Zhu et al., 2023; 15. Anker et al., 2018; 16. Anker et al., 2020; 17. Kelly et al., 2014; 18. Munro et al., 2022; 19. Chan et al., 2013; 20. Chen et al., 2010; 21. Fang et al., 2018; 22. Eley et al., 2012; 23. Monroe et al., 2011; 24. Szabo et al., 2017; 25. Taylor et al., 2021; 26. Rajan et al., 2019; 27. Rattinnen et al., 2016; 28. Almutairi et al., 2020; 29. Gupta et al., 2021; 30. Hand et al., 2016; 31. Kim et al., 2018; 32. Polanco et al., 2021