Research Article

Frequency of Venous Complication in Free Flaps After Head and Neck Cancer Reconstruction

Zuhera Khan,[1] Munazza Saleem,[2] Fahmina Buriro,[3] Mazhar nizam,[4] Syed Aqil Shah,[5] Asim Durrani,[6] Ahmad Rahim Bux[7]

[1]Indus Medical College Hospital, Tando Muhammad Khan[2]Athabasca University, Faculty of Health Disciplines, Calgary, Alberta, Canada. [3-6]Department of Plastic Surgery, Patel Hospital, Karachi, [7]Department of Pathology, Aga Khan Hospital Karachi

Abstract |

Background: With the advancement in clinical techniques, free flap surgery for head and neck defects has gained popularity as a refined microvascular surgical technique that comes with numerous challenges. The objective of this study is to define the frequency of venous complications in free flaps employed for head and neck cancer surgeries in a tertiary care hospital to establish guidelines for the early management of failing flaps and to look for a similar pattern of venous complications in free flaps of the head and neck.

Methodology: This prospective study was conducted in the plastic surgery department of Patel Hospital Karachi from January 16th, 2017, to July 16th, 2017. It included all patients with head and neck malignancies who had free flap reconstruction and were examined for venous problems within five days of surgery, regardless of gender.

Result: Venous issues were found in 6 out of 70 free flaps (8.6%) in head and neck cancer reconstruction, resulting in a 95.4% flap success rate. Even when external factors were not considered, venous thrombosis was the most common cause of venous complications.

Conclusion: The study concluded that venous complications are the most common reason for free flap failure, followed by arterial causes, neck hematoma, recipient or donor artery issues, and infections.

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Corresponding Author | Dr. Zuhera khan, FCPS (Plast) Assistant professor Plastic surgery Indus Medical College Tando Muhammad khan, 03113282371, **Email:** drzuherakhan@gmail.com

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Introduction

Head and neck tumors, specifically oral cancer incidence, are a major health care burden in Asia. According to the World Health Organization (WHO), the incidence of oral and lip cancers in Pakistan in 2012 was 8.6%.[2] Head and neck tumors are the second most common cancer in Pakistan, second only to lung and breast cancers in males and females, respectively. It refers to cases registered with the Shaukat Khanum cancer registry only; the accurate number would be even more than this figure because of under reporting.[1-3] Anwar and colleagues also documented high incidence rates in their report (10.9%).[4] This can be attributed to the high intake of gutka, pan, chewable tobacco, betel nut and smoking, with smoking more common in males and betel nut in females.[5]

Among oral cancers most were seen in the buccal cavity (54%) and the tongue (24%). The majority have extensive oral cancers at presentation, causing complex facial defects. A microvascular-free flap is the most reliable option to reconstruct such complex defects in the head and neck regions, as there are limited local options for reconstruction. The most used free flaps are the radial forearm free flap, the anterolateral thigh flap, the fibula

osseous and osseo-cutaneous flap, the latissimus dorsi flap, etc. Free flaps are the safe alternative, even though they, like all procedures, are not without risks. Complications include vascular complications, neck hematoma, infection, and flap failure. The most common complications are vascular, as supported by Wu et al. in their study, which showed a 9.9% flap re-exploration rate most commonly due to venous insufficiency, followed by arterial bleeding and hematoma.[6-9]

Venous thrombosis is more than twice as common as arterial thrombosis and tends to develop later.[8-11] Shen et al. identified venous problems (59.9%) as the most common etiology of flap failure, followed by arterial problems (27.9%), hematoma (10.2%), infection, and recipient vessel problems.[12] Late flap failures (i.e., > 48 hours) were most often due to infection or mechanical stress around the anastomosis. The risk of venous compromise manifests itself in the first 24 to 72 hours and rarely after this period, but complications have been seen even after five days. Even though not consistently documented, prior irradiation at the recipient site has been identified by some authors as a contributing factor.[13] If the flaps are examined frequently, especially every hour in the first 48 hours, venous problems are observable clinically. A venous compromise is most certainly present if the flap swells, turns blue, and gushes out dark blood quickly after being poked with a needle.

Considering the significance and prevalence of this issue, as well as the dearth of data on local populations, the authors were propelled to conduct this study. This study was carried out to offer local data on free flap complications and explain the vascular complication patterns, which will aid in the early management of free flaps.

Methodology

This study is a descriptive case series of head and neck cancer patients operated on by the Plastic Surgery Department at Patel Hospital Karachi from January 16th, 2017, to July 16th, 2017, after approval of the synopsis for the FCPS-II thesis. The sample size was calculated to be seventy (70) by the open resource WHO (World Health Organization) calculator version by KC Lun and Peter Chiem, National University of Singapore. The proportion of overall venous complications was taken as 9.9%,[6] with a seven percent margin of error and a 95% confidence interval. It was a prospective study, and data was collected as a non-probability consecutive sampling technique. All patients operated on for head and neck cancers who met the criteria were included in this study.

All the study participants were patients of either gender with head and neck cancers between the ages of eighteen (18) to sixty (60) years, with T-1 to T-4 stages requiring reconstruction with free flaps. After informed consent, all the patients were interviewed and examined in detail by the primary authors to ensure they met the inclusion criteria. Patients were excluded from the study if there was salvage-free flap surgery, arterial insufficiency, or stage four disease with systemic metastasis found in them.

The data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 21. The frequency and percentages of venous complications, gender, and radiation, co-morbidities such as hypertension and diabetes mellitus, smoking, free flap choices, number of venous anastomoses, disease stage, and clinical symptoms were also recorded. A mean standard deviation (SD) was recalculated for the age of the patients, duration of hospitalization, and length of intensive care unit (ICU) stay. Effect variables such as age, gender, length of hospital stay, co-morbid (Hypertension and Diabetes Mellitus), length of ICU, options of free flaps, number of anastomoses, and disease stage were controlled through stratification to see the influence on venous complications. A chi-square test was used, with a p-value of 0.05 considered significant.

Result

The average age of the patients was 46 ± 9.9 years (min: 22 years; max: 60 years). There were fifty-three (75.7%) men and seventeen (24.3%) women. Both hypertension (HTN) and diabetes mellitus (DM) were present as comorbidities in individuals with head and neck cancer. None of the patients in this research had been exposed to radiation in the previous six weeks.

Most patients had moderately differentiated squamous cell carcinoma (SSC), followed by well-differentiated SCC. Almost all cases were stage IVA, with features of locally advanced disease. 28 (40%) had Radial forearm flap, 28 (40%) had anterolateral thigh (ALT) flaps, while fibula flaps accounted for 20% (n = 14). The venous complication was seen in 8.6% (n = 6) of the flaps (fig1), while the flap success rate was 95.71 percent. In 18.6% (n = 13) of the cases, a single venous anastomosis was employed, and in 81.4 percent (n = 57) of the cases, a dual anastomosis was used.

Smoking was found to have a statistically significant influence on venous complications in free flaps after head and neck reconstruction (p = 0.026). On analyzing the relationship between venous problems and the length of ICU and hospital stays, it was discovered that patients with flap failure have significantly prolonged ICU stays (p=0.033). The stratification of other confounding variables like gender, age, comorbidities like DM, HTN, radiation, and hospital stay was found to be statistically insignificant. The number of venous anastomoses, as well as the option of the free flap, are compared in terms of venous complications. With a p-value greater than 0.05, the results were deemed to be statistically insignificant. (Table 1).

Two of the six flaps with vascular complications were the free fibula, two ALTF, and two radial forearms. This distribution implies that the choice of the flap has no significant relationship with failure. The flap could not be saved in the fourth patient due to delayed vascular impairment caused by a clinically obvious wound infection (Fig 2). The development of supraventricular tachycardia in the early postoperative period, which was cardioverted with verapamil and later shifted to bisoprolol, was another aspect that could have contributed to the flap failure in this case.

Table 2 shows the clinical details of all the patients in whom there was flap failure.

Table 1: *Comparison of Venous Complications with Different Parameters of the Study Subject*

Variable of the study		Venous complication		P-Value
		YES (n=6)	NO (n=64)	
Gender Distribution	Male	4(5.7%)	49(70%)	0.292
	Female	2(2.9%)	15(21.4%)	
Smoking	Yes	3(4.3%)	9(12.9%)	0.026*
	No	3(4.3%)	55(78.6%)	
Hypertension	Yes	3(4.3%)	14(20%)	0.124
	No	3(4.3%)	50(71.4%)	
Diabetes Mellitus	Yes	1(1.4%)	4(5.7%)	0.897
	No	5(7%)	60(85.7%)	
	No	6(8.6%)	64(91.4%)	
Number of venous anastomoses	Single vein	1(1.4%)	12(17.1%)	0.900
	Dual vein	5(7.1%)	52(74.3%)	
Option of free flap	RFF°	2(2.9%)	26(37.1%)	0.694
	ALTF*	2(2.9%)	26(37.1%)	
	free fibula	2(2.9%)	12(17.1%)	

*Anterolateral thigh flap ° Radial forearm flap

Discussion

In this study, seventy (70) cases of free tissue transfer to the head and neck region were reviewed and the overall success rate was found to be 95.71% (67/70). The study had six cases of postoperative venous complications, accounting for 8.6 percent of all cases. Only three flaps were salvaged out of six, indicating a fifty percent success rate of re-exploration for vascular problems. During the trial, only one patient developed arterial insufficiency of the flap, which was ruled out. The most common cause of free flap failure was discovered to be venous.[6-11]

Table 2: *Description of Cases with Venous Complication*

Number of cases	Type of flap	Site	Comorbs	Reexplore	Cause of venous complication	Onset of venous complication	Flap outcome
Case 1	Free fibula flap	Left lower alveolus/Mandible	None	Yes	Venous thrombosis	Day 1	salvaged
Case 2	Free fibula flap	Left cheek /Mandible	None	Yes	Expanding Neck hematoma	Day 1	salvaged
Case 3	Free ALTF*	Left cheek	None	No	Not known [Outer flap lining had venous congestion and managed conservatively]	Day 1	Viable; partial flap compromise only
Case 4	Free RFF°	Right buccal mucosa and right commissure	HTN	Yes	Infection. Supraventricular tachycardia	Day 4	Failed
Case 5	Free ALTF*	Left Orbito Maxillary	DM, HTN, hep B	Yes (twice)	Venous thrombosis	Day 2	Failed
Case 6	Free RFF°	Left cheek	HTN	Yes	Venous thrombosis	Day 1	Failed

*Anterolateral thigh flap ° Radial forearm flap

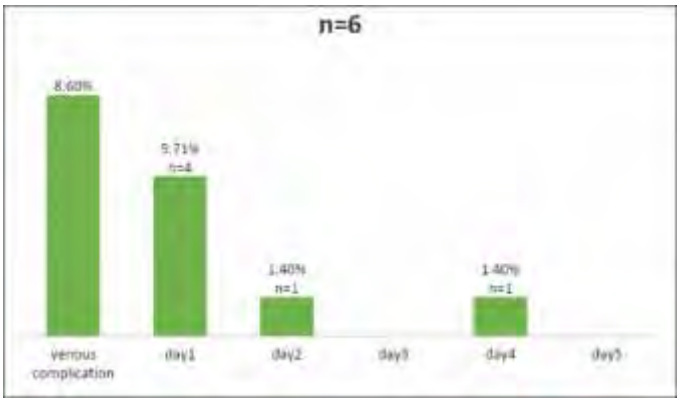

Figure 1- *Frequency of Venous Complications and Day of Development of Venous Problems*

Figure 2: *Case 4 Radial forearm flap having signs of venous compromise, evident by congestion, swelling, and signs of wound infection by cheek swelling and erythema, neck covered with dressing in the picture.*

All these findings are comparable with Wu et al.'s research, which showed a 9.9% flap re-exploration rate most commonly due to venous thrombo-sis, followed by arterial bleeding and hematomas.[6,12,14-16]

The risk of venous compromise is higher in the first 24 to 72 hours and is rare after that, however, it can happen up to the fifth day. In the first 24 hours, four out of six patients showed clinical symptoms of venous impairment. Infection or mechanical stress surrounding the anastomosis were the most common causes of late flap failures (greater than 48 hours), as evident in case # 4. As discussed in a recent multi-institutional review (n = 1764), flaps showed vascular thrombosis (9%), mostly venous compromise, during the first 8 hours after surgery (Day 0), with a greater flap salvage rate (64%) if explored early.[14,17] Early recognition of signs of compromise indicates that flaps can be saved to improve outcomes, thereby lowering mortality, morbidity, and expenses. Venous issues can be identified clinically if the flap is examined often, especially every hour in the first 72 hours. The flap should be returned to the operating room (OR), which needs to be carried back to the operating room excluding external variable. If it swells, becomes blue, and gushes out a small amount of dark blood when the needle is pricked. It is most likely a venous compromise. It is possible that some of the flaps that had venous problems on Day 1 but couldn't be saved despite early intervention had venous compromise early on the table that was not recognized, perhaps as a result of surgeons' fatigue due to prolonged operative time and hesitance in exploring the flap. Delaying the exploration until changes are apparently evident in the flap is found to be the root cause of flap failures supported by Wei and Lin's work.[16-19]

Radiation is known to have deletorious effects on wound healing. Although none of the patients had radiation within the last 6 weeks, there was one patient (patient no 5 in table 2) who had been treated with excision and radiation two years ago. That patient had a venous complication of the flap which couldn't be repaired despite prompt intervention. Later, unfortunately, that patient died a month after the first surgery due to hospital-acquired pneumonia.

At Patel Hospital, we usually perform two venous anastomoses, which is another variable in flap survival and exploration rate, although our results were unreliable. There is an ongoing debate about whether one or two venous anastomoses should be done to avoid venous complications. Although many researchers now believe that double venous anastomoses are safe, the evidence is still ambiguous.[8,9,12,15,18,20,21]

Sometimes, the tiniest suggestion of vascular compromise occasionally leads to unwarranted surgeries that endanger patients' lives and add to their financial burden.[22-24] Many authorities now report other advanced measures for flap monitoring to avoid unnecessary revisions based on the clinical judgment of the observer. Advanced options to determine complications include assessment of vascular patency by handheld or implantable Doppler, tissue pH, laser Doppler, pulse oximetry, use of visible light spectroscopy to measure tissue oxygenation in free flaps and lately, the use of Fluoresceine or Indocyanine Green (ICG), etc. whereas, clinical assessment is sensitive and superior to all.[25] In contrast, clinical assessment by the residents of plastic surgery, trained ICU staff or experienced microvascular surgeons

are sensitive and superior to all, with a success rate ranging from 85 to 95%.[25] Although the clinical judgement does not put an additional burden on the patient, it is not feasible in buried free flaps of the head and neck region. For these cases, these advanced methods are the best alternative tools.[25]

Conclusion

A microvascular-free flap reconstruction is a reliable option for head and neck reconstruction after cancer defects. The most devastating complication of losing a flap can be easily controlled by through preoperative planning, reducing patients' modifiable risk, meticulous technique and diligent postoperative monitoring by dedicated members of the microvascular team. There are multiple modifiable risk factors that, if taken care of, can prevant flap failure becasue, even in teh setting of a successful free flap, a second flap may still be required to deal with late complications, such as post-radiation trismus, osteoradionecrosis (ORN), etc. By reducing failures, we can move to the next level by bringing "Aesthetics to Reconstruction".

Conflict of Interest *None*

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