RESEARCH ARTICLE

The role of systemic unfractionated heparin in free flap surgery outcomes: A retrospective study from a tertiary care hospital in Karachi, Pakistan

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Abstract

Objective: To assess the short-term impact of postoperative low-dose heparin on arterial insufficiency and venous congestion in free flap surgeries.

Method: The retrospective study was conducted at the Liaquat National Hospital, Karachi, and comprised data from January 2021 to July 2023 of patients of either gender aged 16-65 years who underwent primary reconstruction using free flap surgery and having no history of anticoagulation drugs. The patients were divided into two groups. Group A received postoperative low-dose unfractionated heparin (2500IU, three times daily for 5 days), while Group B did not receive any heparin postoperatively, except for a 5000IU intraoperative dose. Patient demographics, flap monitoring and complications, such as arterial insufficiency and venous congestion, were recorded. Data was analysed using SPSS v25.

Results: Of the 184 patients with mean age of 36.5±12.56 years (Range 18-66 years), 92(50%) were in each of the two groups. Both the groups had 56(60.9%) male and 36(39.1%) female patients. Arterial insufficiency was observed in 20(21.7%) patients in Group A and 27(29.3%) in Group B. Venous congestion occurred in 27(29.3%) patients in both the groups (p=1.000). Combined arterial insufficiency and venous congestion rates were 47(51.1%) in Group A and 54(58.7%) in Group B (p=0.300). Diabetes and hypertension were significant predictors of arterial insufficiency (p<0.05).

Conclusion: Postoperative low-dose heparin administration did not significantly reduce the risk of arterial insufficiency or venous congestion in free flap surgery. Comorbidities, like diabetes and hypertension, were associated with higher complication rates.

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Introduction

Currently, free flap surgery is most commonly performed for wound coverage compared to other local or distant options, and it is regarded as a reliable reconstruction technique for the coverage of large defects.[1,2] However, the complication rate is 1-4% among patients undergoing free flap surgery, with patients suffering flap failure due to microvascular thrombosis, anastomotic failure, mechanical obstruction, tension and compression.[3-6] Therefore, there is room for improvement. Arterial thrombosis usually forms in the first 24 hours, and venous congestion usually develops on the second postoperative day, especially in free flap surgery.[7,8]

Systemic unfractionated heparin or other anticoagulants are commonly used for prevention of flap thrombosis in free flap surgery.[9,10] Several methods of prevention of thrombosis have been recommended by surgeons, including antiplatelet, anticoagulant, and blood viscosity reduction methods.[11-15] However, these anti-thrombotics cannot prevent the risk of total flap loss or thrombosis, and they can potentially increase the risk of haematoma.[16] Thrombosis mostly occurs in free flap reconstruction during the first five postoperative days.[7]

The current study was planned to assess the impact of postoperative low-dose heparin on arterial insufficiency and venous congestion within five days after free flap surgeries.

Materials and Methods

The retrospective study was conducted from March to September 2024 at the Plastic Surgery Department of Liaquat National Hospital, Karachi, and comprised data from January 2021 to July 2023. Data was retrieved after approval from institutional ethics review board approval, which also waived the requirement for informed consent. Written or verbal consent was obtained only for follow-up clinical examination when required. Follow-up data was extracted from Outpatient Department (OPD) records with follow-up ranging 1-6 months. The sample size was calculated using the World Health Organisation (WHO) calculator[17] with 80% power, 95% confidence level and assumed 10% difference[18] in flap complication rates. A

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non-probability consecutive sampling was used and the sample comprised all patients of either gender aged 16-65 years who underwent primary reconstruction using free flap surgery and had no history of anticoagulation drugs. Cases of flap congestion due to infection (visible pus discharge) were excluded, and so were those with immediate intraoperative arterial insufficiency, secondary reconstruction with free flaps, a history of previous free flap re-exploration, and patients who had already received radiation on the anastomotic area. Patients aged >65 years were excluded due to higher baseline thrombotic risk and multiple confounders requiring reconstruction after carcinoma excision or in trauma.

In terms of perioperative management, the patients were divided into 2 groups. Group A patients received injection of heparin postoperatively, while Group B patients did not receive heparin. The decision for or against heparin totally depended on the primary surgeon's discretion. Both the groups received intraoperative dose of 5,000IU of heparin intravenously, as per the standard institutional policy. Group A patients additionally received 2,500IU of intravenous (IV) unfractionated heparin three time a day for five days, while Group B patients did not receive any heparin after the initial intraoperative dose.

Demographic and clinical data, including age, gender and comorbidities, such as diabetes mellitus (DM), hypertension (HTN), cardiovascular accident (CVA), cerebrovascular disease and smoking status, was recorded by the principal investigator. Flap monitoring was done by trained residents immediately after the operation, followed by 1h, 4h postoperatively, and then at regular intervals for the subsequent five postoperative days. Signs of vascular compromise were recorded. Venous congestion was labelled if it had at least any two of the following four clinical signs: warm temperature (no change or slightly warmer compared to surrounding skin), visible purple colour change of the flap, slow capillary return (>2 seconds) or rapid dark-coloured blood on pin prick. Arterial thrombosis was labelled if it had at least any two of the following four clinical signs: pale or white colour, capillary refill >2 seconds, prune-like turgor, scant bleeding on pin prick, and cool temperature (compared to the surrounding normal skin on finger palpation). Re-exploration was done in the light of clinical signs. Frequent clinical assessment remains the gold standard for free flap monitoring, with adjunctive technologies serving a supportive role rather than a substitute for experienced clinical evaluation.[18]

Complications and their correlation with arterial insufficiency and venous congestion were noted.

Data was analysed using SPSS v25 Chi-square or Fisher's exact test was used for categorical variables. P<0.05 was considered significant.

Results

Of the 184 patients with mean age of 36.5±12.56 years (Range 18-66 years), 92(50%) were in each of the two groups. Both the groups had 56(60.9%) male and 36(39.1%) female patients. In group A, 38(41.3%) patients had DM, 37(40.5%) had HTN 10(10.9%) had a CVA history and 28(30.4%) were smokers. The corresponding values in Group B were 45(48.9%), 36(39.1%), 0(0%) and 19(20.7%) (Table 1).

Table-1: Demographics characteristics of the patients (n-184).

Variable	Group A (Heparin) n=92 [n (%)]	Group B (No Heparin) n=92 [n (%)]
Gender		
Male	56 (60.9)	56 (60.9)
Female	36 (39.1)	36 (39.1)
Comorbidities		
Diabetes mellitus	38(41.3)	45(48.9)
Hypertension	37(40.5)	36(39.1)
Smoking	28(30.4)	19(20.7)
Cardiovascular accident	10(10.9)	0

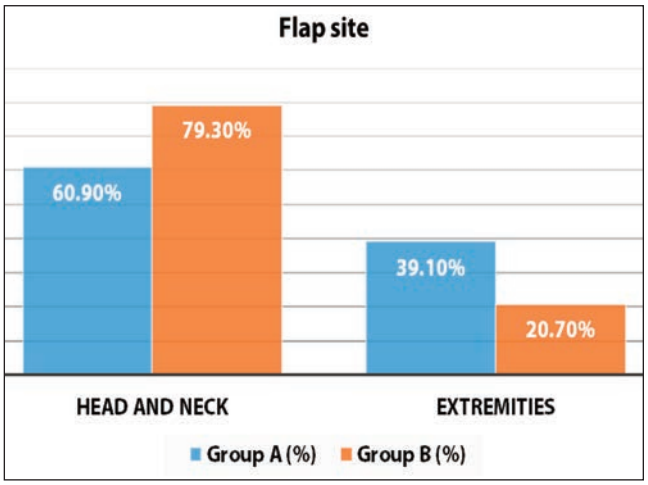

Figure-1: Distribution of flap site in the study groups.

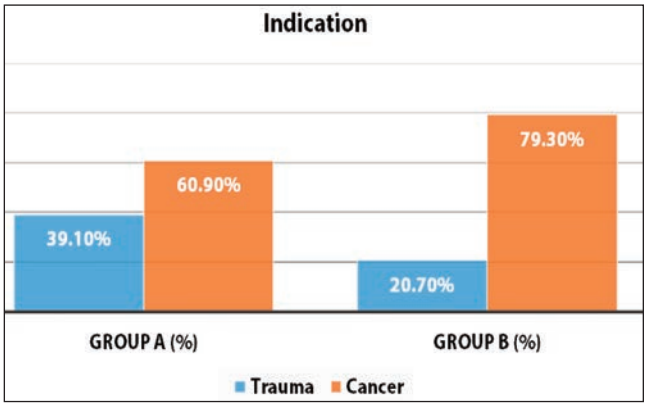

Figure-2: Intergroup comparison of indication.

Table-2: Intergroup comparison of flap type.

Flap Type	Group A [n (%)]	Group B [n (%)]
ALTF	55(59.8)	46(50)
FFF	9(9.8)	19(20.7)
FREE DCIA	10(10.9)	9(9.8)
RFFF	18(19.6)	18(19.6)

ALTF: Anterolateral thigh flap, FFF: Free fibula flap, DCIA: Deep circumflex iliac artery, RFFF: Radial forearm free flap.

Table-3: Correlation with arterial insufficiency and venous congestion.

	Group A n (%)	Group B n (%)	*p*-value
Arterial Insufficiency	20(21.7)	27(29.3)	0.237
Venous Congestion	27(29.3)	27(29.3)	1.000
Arterial insufficiency and venous congestion	47(51.1)	54(58.7)	0.300

Table-4: Correlation of arterial insufficiency with comorbidities.

Comorbidities	Arterial Insufficiency	No Arterial Insufficiency	*p*-value
Diabetes Mellitus	29	54	0.001
Hypertension	10	63	0.002
Smoking	19	28	0.424

There were 56(60.9%) and 73(79.3%) flaps done on head and neck region in both the groups (Figure 1). Most head and neck flaps included malignancy as indication in both the groups (Figure 2). The most commonly performed flap was anterolateral thigh flap (ALTF) in Group A 55(59.8%) and Group B 46(50%) (Table 2).

Arterial insufficiency was observed in 20(21.7%) patients in Group A and 27(29.3%) in Group B. Venous congestion occurred in 27(29.3%) patients in both the groups (p=1.000). Combined arterial insufficiency and venous congestion rates were 47(51.1%) in Group A and 54(58.7%) in Group B (p=0.300) (Table 3).

DM and HTN were significant predictors of arterial insufficiency (p<0.05) (Table 4).

Discussion

Some studies have suggested that the chances of survival increase with anti-coagulation, and several surgeons use the option.[16] Although there have been many studies favouring the use of anticoagulation for the prevention of thrombosis in free flap surgery,[19-24] little clinical evidence has been presented. The current study exclusively evaluated free flap reconstruction, and did not include pedicle flap. More than 90% of microsurgeons use antithrombotics in free flap surgeries.[11] However, it is controversial to say the least as to which one is the ideal anticoagulation agent or regimen. The ideal anticoagulation agent would have certain characteristics which include effective antithrombotic activity to prevent thrombosis in microvascular anastomosis, no to minimal side effects, minimal rates of complications related to postoperative or intraoperative bleeding, and, lastly, it should be easy to administer. Low-molecular-weight heparin, unfractionated heparin and aspirin are best examples of anticoagulation agents that are readily available and commonly used in free flap surgeries. The mechanism of action of heparin include binding of antithrombin III to thrombin, and inactivating factors like Xa. After this inactivation, fibrinogen cannot be converted to fibrin and lead to decreased formation of intravascular blood clot or thrombin.[25]

The current study analysed the correlation between low-dose heparin to flap arterial insufficiency or venous congestion. There was no significant difference in arterial ischaemia/venous congestion between the groups. This showed that arterial insufficiency and venous congestion do not depend on a single factor, like the administration of postoperative heparin, but are likely multifactorial depending on comorbidities, kinking, twisting and tension on pedicle.[26] Studies have also suggested there is no significant data showing that heparin increases haematoma risks.[7]

Earlier studies mostly included flaps done on head and neck, and only in cancer patients which itself is a risk factor for arterial thrombosis.[2,9,12,13] The current study included flaps on extremities as well, and not cancer patients were not the sole focus of the study. A study[27] showed success with aspirin, but the rate of haematoma formation was not addressed. No cases of haematoma, necrosis, or infection were observed in either group during the study period.

The current study has several limitations. The allocation to heparin or non-heparin groups was solely based on the surgeon's preference which may have introduced potential selection bias and limiting the internal validity of the data. Differences in patient comorbidities and case complexity may have confounded outcomes. Postoperative heparin dosing followed institutional practice, which does not include laboratory monitoring. The absence of postoperative haematomas in both groups suggests that the low-dose heparin protocol did not significantly increase the risk of bleeding complications. Also, there were more DM patients in the non-heparin group than the heparin group. Finally, multivariate analysis was not done. Large-scale, multicentre studies are recommended to develop standardised protocols.

Conclusion

Routine postoperative low-dose unfractionated heparin did not significantly reduce arterial insufficiency or venous

congestion in free flap surgery. The findings support a more selective, patient-specific anticoagulation strategy rather than routine use.

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Conflict of Interest: None.

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Author Contribution:

OAQ: Concept, design, data collection, analysis, interpretation, drafting, revision, final approval and agreement to be accountable for all aspects of the work.

SB & SG: Data analysis, interpretation and final approval.

AW, TM & MA: Data collection, analysis, interpretation and drafting.