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Tumescent versus non-tumescent technique in skin graft healing: a cross-sectional study

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ABSTRACT

Background: Skin grafting, especially burn surgery, is associated with great blood loss. Tumescent technique is the subdermal injection of fluid containing a vasoconstrictor prior to burn wound surgery to reduce blood loss. Adrenaline is used to harvest skin grafts due to its vasoconstriction effect which limits blood loss. Although adrenaline is widely used, its local and systemic effects vary from patient to patient. The object of the present study was to observe the efficacy of tumescent technique, using adrenaline, versus non-tumescent technique in the healing of split thickness skin graft donor day 10.
Methods: Two treatment groups of patients, tumescent (group A, n = 45) and non-tumescent technique (group B, n = 45), who fulfilled the inclusion criteria were randomly assigned. Tumescent technique involved administration of 1 mg (1:1000) adrenaline in 500 mL of saline. No prior administration of agent was performed in non-tumescent technique. Split-thickness skin grafting was carried out followed by regular inspection of the donor site. Healing rate was recorded at the postoperative day 10 by performing wound tracing technique and evaluated by performing unpaired t-test. P <0.05 was considered as statistically significant.
Results: The mean age of patients was 29.98±12.6 years in group A and 45.36±10.23 years in group B. Age distribution was concentrated between 18 and 38 years. On postoperative day 10, complete epithelialization was observed in 15.56 % and 6.66% of patients in group A and B, respectively. Compared to the patients in group B, patients who underwent tumescent technique (group A) had higher healing rate (>80%, p=0.0134). Evidence of infection in the donor site was absent in both the groups.
Conclusions: Tumescent technique by using adrenaline is more effective than non-tumescent technique in the healing of donor site and can be implemented preoperatively in split-thickness skin grafting.

Keywords: Adrenaline, Non-Tumescent, Skin grafting, Tumescent

INTRODUCTION

Adoption of tumescent technique in STSG has been low due to inadequate information on the viability of the graft especially after using adrenaline. Many surgeons still use electrocautery, tourniquet and topical adrenaline gauze.[1,2] All these still have significant blood loss compared to use of tumescent technique. Information on local and systemic effects of adrenaline vary in literature with some authors saying the effects are minimal and transient while others believe that it adversely affects the harvested graft and healing of donor site.[3-6]

However, very few information is available regarding the studies comparing the healing rate of donor site upon application of adrenaline solution for STSG and the non-tumescence technique in which the graft is harvested

without the administration of any agent causing tumescence. Therefore, the current study was conducted to compare the healing rate between patients undergoing STSG by tumescent technique with adrenaline in saline solution and non-tumescence technique.

METHODS

This prospective, randomized, double-blind, cross-sectional study was conducted from 1st January to 31st December 2016 at KLE's Dr Prabhakar Kore Hospital and Medical Research Centre, Belgaum.

The study included 90 patients requiring skin graft surgery and each patient served as his or her control. Patients between the age of 18 and 78 years, admitted in KLE's Dr Prabhakar Kore Hospital and Medical Research Centre, Belgaum and requiring the skin graft surgery were included in the study.

Thigh donor area was also among the criteria of inclusion. The study was conducted in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving human subjects. Approval for the study was provided by the Ethical and Research Committee of Jawaharlal Nehru Medical College, Belgaum.

Written consent was obtained from all the patients before the start of the study. Patients who refused to give consent, had history of blood or coagulation disorder, or comorbid conditions such as diabetes mellitus, hypertension, ischemic heart disease and other cardiac disorders, renal failure, and immune-compromised disorders were excluded from the study.

Demographic characteristics, including, age and sex were recorded. The patients were divided equally into two groups (group A and B, n = 45 each) by following opaque envelop method.[6] Group A was referred as the tumescent group and group B as the non-tumescent group.

In the group A, the donor site was prepared preparation on the day of surgery and before intervention by subdermal infiltration with a modified tumescent solution as subcutaneous preharvest injection of 1 mg (1:1000) adrenaline added to 500 mL of saline.

In the group B, the donor site was marked, and the graft was harvested without the application of any agent. STSG was carried out for all the patients according to the standard procedure followed by the institution (Figures 1 and 2A and 2B).

Following the grafting procedure, the donor site of patients in both the groups were monitored and inspected on 10th day postoperatively for percentage healing (Figure 3). Percentage of wound healing by epithelialization was calculated by wound tracing method using transparent sheet, which involved the use of sterile transparent sheet placed over the donor site wound.

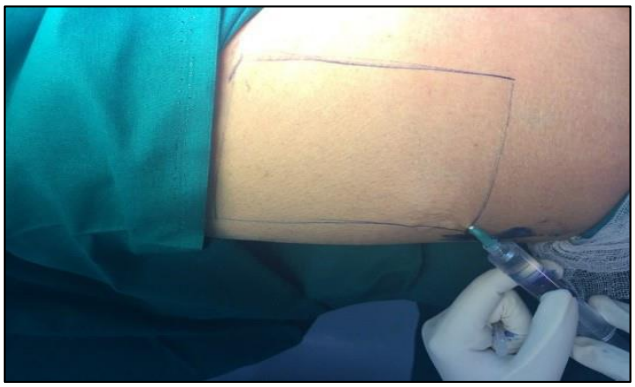

Figure 1: Administration of modified tumescent solution at the donor site.

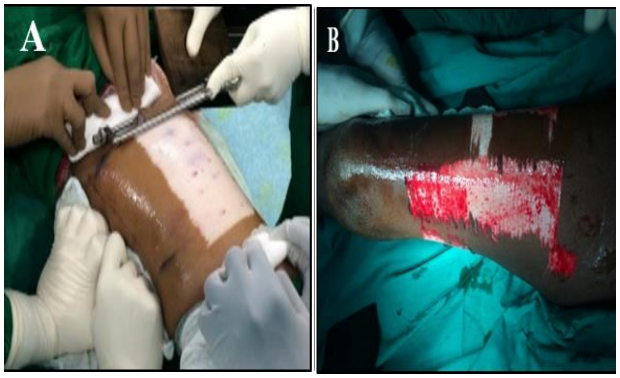

Figure 2: (A). Harvesting graft: Tumescent technique, (B). Harvesting graft: Non-tumescent technique.

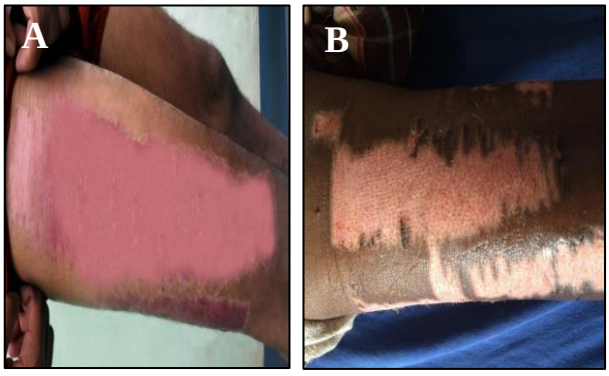

Figure 3: (A) Donor graft harvesting site on 10th post-operative day in group A. (B) Donor graft harvesting site on 10th post-operative day in group B

The healed epithelialized area was marked by marker and then the sheet was placed over calibrated paper to count the area of percentage of healing in both the groups.[7] Evaluation and comparison of the donor site healing in group A and B were done by performing unpaired t-test. $P < 0.05$ was considered as statistically significant.

RESULTS

Out of 90 patients, 71.11% were men and 28.89% women. Group-wise distribution of sex, age and diagnosis of the patients is shown in Table 1. The mean age of the study population in group A and B was 29.98±12.6, 45.36 ± 10.23 years, respectively.

The age distribution of the study population was concentrated in the age-group of 18-38 years.

Table 1: Distribution of demographic variables and diagnosis of the patients.

Variables	Group A, n (%)	Group B, n (%)
Sex		
Male	30(66.66)	34(75.55)
Female	15(33.34)	11(24.45)
Age (years)		
18-38	33(73.33)	10(22.22)
39-58	11(24.44)	27(60)
59-78	1(2.33)	8(17.78)
Diagnosis		
Chronic ulcer	6(13.33)	20(44.45)
Post burn contracture	17(37.77)	0(0)
Cellulitis	0(0)	10(22.22)
Traumatic ulcer	0(0)	15(33.33)
Burn injury	22(48.90)	0(0)

No clinical evidence of donor site infection was observed in any of the groups. Difference was observed in both the groups with respect to the exudate secretion, skin maceration, or hemorrhage from the donor site.

Complete epithelialization of the donor area using tumescent and non-tumescent techniques was observed in 15.56% and 6.66% of patients, respectively.

Table 2 represents the group-wise distribution of healing percentage achieved using tumescent and non-tumescent techniques. The percentage of healing with the use of tumescent technique was statistically significant and higher when compared to the non-tumescent technique indicating higher healing rate (P = 0.0134).

Table 2: Group-wise distribution of healing percentage among patients.

Healing percentage	Group A, n (%)	Group B, n (%)
≤ 50	1(2.22)	4(8.89)
51-80	10(22.22)	22(48.89)
81-99	27(60)	16(35.56)
100	7(15.56)	3(6.66)

DISCUSSION

The advent of tumescent anaesthesia in cutaneous surgery has given rise to bloodless and painless surgery, in addition to reduced postoperative swelling and bruising. Administration of subcutaneous injection provides an improved plane for harvesting the graft and facilitates the faster removal of necrotic tissue with minimal bleeding. The anaesthetic agents used in the surgery are also known to be antibacterial in nature, which helps in preventing infection at the selected site.[5] In the present study, the tumescent technique was successful in reducing postoperative complications and has resulted in faster healing as compared to non-tumescent technique.

Incidence of burns, cellulitis, and traumatic ulcers is more in men as compared to the women, as observed in the several studies.[2,4,8,9,10] Sex distribution in the present study was in accordance with these studies. The age distribution assessed in these studies was from 7 to 41 years. This contrasts with the present study which compares the techniques within 18 to 78 years. In addition, there are limited number of studies pertaining to application of tumescent technique in cases of ulcer and cellulitis to study the age and sex distribution among patients.

Blood circulation in the site of wound or infection is reduced with the administration of vasoconstrictors such as adrenaline. The studies evaluating tumescent technique with administration of adrenaline have largely concentrated on the number of days taken for complete epithelialization or healing of donor.[2,5]

In contrast, the present study focussed on the number of patients achieving complete epithelialization by postoperative day 10, which is another novel aspect covered in the subject. In the present study, the number of donor areas that achieved complete epithelialization on the postoperative day 10 by tumescent technique was seen in 15.56% of patients. Whereas in group B, complete epithelialization was observed only in 6.66% of patients. The difference in healing percentage between the groups was statistically significant (P= 0.0134). This indicates that the implementation of tumescence anaesthesia in cutaneous surgery will not only aid in minimal bleeding and ease of graft harvesting but will also help in faster healing with no further complications.[11] Apart from the small sample size, the study also limits itself by distributing the patients uniformly in both the groups according to type of diagnosis. This could be due to the type of randomization technique used in the study. From the study, it can be ascertained that implementation of tumescence technique could aid in faster healing and easier graft harvesting in surgeries involving patients with burn, ulcer, and cellulitis. However, future studies could consider larger sample size and better randomization technique for effective comparison between the techniques.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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