Original Research Article

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Tumescent non-tumescent technique for split thickness skin graft harvesting

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ABSTRACT

Background: Split-thickness skin graft failures can be attributed to flaws in the recipient bed which has to be well prepared. Tissues with limited blood supply such as bone, tendons, cartilage or sites with necrotic tissue or infection do not accept skin grafts. Adrenaline is used to harvest skin grafts due to its vasoconstriction effect which limits blood loss. The aim of our study was to determine skin graft take after tumescent technique compared to a non-tumescent technique for harvesting.

Methods: Two treatment groups of patients who fulfilled the inclusion criteria were randomly assigned. Forty patients underwent split-thickness skin graft harvesting with tumescent technique and forty patients underwent non-tumescent split-thickness skin graft harvesting. The recipient site was opened in both groups on the fifth day after surgery and take rate assessed. The donor site was assessed on day ten and if not healed, followed up for three weeks.

Results: There was a statistically significant association between skin graft take rate and skin grafting technique (p=0.011). The mean graft take rate was 2.5% higher in the tumescent group compared to the non-tumescent group (96.3% compared to 94%). On day 10, there was no difference in percentage healing of donor sites between the tumescent and non-tumescent groups, p=0.562.

Conclusions: Tumescent technique significantly reduced intraoperative blood loss. It is safe, inexpensive and easy to use. The subdermal adrenaline/saline injection creates a smooth, dense surface which assists debridement and donor harvesting.

Keywords: Adrenaline, Healing rate of donor site, Plastic surgery fellow, Tumescent technique

INTRODUCTION

The tumescent technique has evolved over the past 20yrs mainly for the use in liposuction. Studies have been done to confirm that the tumescent technique reduces blood loss. Adrenaline is commonly used but its local and systemic effects vary from person to person. This study aims at determining whether the use of adrenaline before harvesting the graft has any effect on graft take rate. The success of a skin graft or its take depends on nutrient uptake and vascular ingrowth from the recipient bed.

Tumescent technique has been practiced for over twenty years especially in liposuction. A lot of studies have proved that it is useful in preventing blood loss.² This is important in this era of inadequate blood and blood products. However, adoption of the 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. All these still have significant blood loss compared to use of the 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 This occurs in four phases namely inflammatory response/plasmatic imbibition, inoculation, angiogenesis, and reinnervation. Proper skin graft dressing prevents graft mobility and seroma formation. Factors that affect take rate include seroma/hematoma formation, poorly vascularized wound bed, and contaminated bed, shearing of graft and technical aspects.4 Apart from these, comorbid conditions, some medicines like steroids, smoking, and malnutrition affect take. Split-thickness skin graft failures can be attributed to flaws in the recipient bed which has to be well prepared. Tissues with limited blood supply such as bone, tendons, cartilage or sites with necrotic tissue or infection do not accept skin grafts. Wounds must be free of pus and should have a healthy pink to a beefy red appearance with a ph of 7.4 or above. Streptococcus should be eliminated as it can 'eat up' the skin graft in twenty-four hours. Systemic diseases, nutritional disorders and vascular disorders should be corrected before grafting.⁵

METHODS

Totally 40 patients were included in the study. The study was conducted in the department of plastic surgery, Government Mohan Kumaramangalam Medical College Hospital, from 2016-2018. Two treatment groups of patients who fulfilled the inclusion criteria were randomly assigned. Forty patients underwent splitthickness skin graft harvesting with tumescent technique and forty patients underwent non-tumescent splitthickness skin graft harvesting. The recipient site was opened in both groups on the fifth day after surgery and take rate assessed. The donor site was assessed on day ten and if not healed, followed up for three weeks.

Inclusion criteria

- Patients aged 18-65 years with no comorbid conditions and who gave consent to participate in the study,
- Patients with clean wounds prepared for grafting,
- Patients with <30% TBSA from thermal burns.

Exclusion criteria

- Patients with comorbid conditions (HTN, diabetes, liver disease, renal failure, malignancies, vasculitis, HIV/AIDS, PEM).
- Patients with albumin levels <30g/dl,
- Hemoglobin level <10g/dl.
- Patients who refused or were unable to give consent.
- Patients with known allergy to adrenaline.

Procedure

Patients who fulfilled the inclusion criteria were recruited from the burns unit and surgical wards. For the purposes of this study, we recruited patients with TBSA below 30% with second-degree burns because they had less systemic complications. Clinical history, a physical examination is done for all patients. Patients gave consent for either procedure and were not allowed to choose. The solution formula for the tumescent procedure was made by 1-milligram adrenaline 1:1000 (manufactured by Laboratoire Renaudin LR, Itxassou, France) added to 999 mililitres of warm saline (37°C). This diluted the adrenaline to 1:1,000,000. The surgery site was infiltrated with the fluid formula by means of an 18G spinal needle attached to a 20 mililitre syringe until the tissue had a smooth, firm, even, slightly swollen appearance. The amount of solution used was recorded for each patient. Harvesting of STSG with electrical dermatome was done and meshing 2:1 for all areas except for hands, distal forearms, and face. Grafts were placed immediately after complete hemostasis and secured with staples. In the nontumescent group, the graft was harvested and the donor site was covered by serial application of abdominal packs soaked in adrenaline solution. The recipient site was analyzed on day 5 for taking rate and the donor site on day 10 for percentage healing.

Statistical analysis

The data collected was entered into the Statistical Package for Social Sciences (SPSS version 17.0) and cleaned for errors and an inconsistencies to ensure high-quality data. Descriptive univariate analysis of data on the socio-demographic characteristics (age, gender) was analyzed and presented using percentages, frequencies, tables, pie charts, and graphs. Then student t-test for comparison of a continuous variable. All tests were performed at a 5% significance level with 95% confidence.

RESULTS

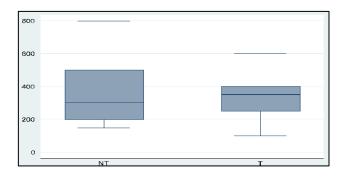


Figure 1: Burn surface area in the tumescent and non-tumescent groups.

Figure 1 shows that the mean burn surface area in tumescent group =343.8 (SD 130.1) with median burn surface area of 300 and range 100 to 600. In comparison, the mean burn surface area in the non-tumescent group was 360.5 (SD 169.3), median =350 range 150 to 800. There was no significant difference in BSA between groups (Mann-Whitney p=0.98).

There was a statistically significant association between skin graft take rate and skin grafting technique (p=0.011). The mean graft take rate was 2.5% higher in the tumescent group compared to the non-tumescent group (96.3% compared to 94%). On day 10, there was no

difference in percentage healing of donor sites between the tumescent and non-tumescent groups, p=0.562. Most patients in the study treatment groups had TBSA between 11 and 20% (55% versus 42.5% in tumescent and nontumescent groups, p=0.24), (Table 2).

Table 1: Characteristics of burn injuries in patients recruited in RCT.

	Technique	D voluo		
	Tumescent N (%)	Non-tumescent N (%)	P value	
Cause of burns				
Open flame	30 (75)	33 (82.5)	- 0.412	
Scald	10 (25)	7 (17.5)		
TBSA				
≤ 10%	9 (22.5)	16 (40)		
11-20%	22 (55)	17 (42.5)	0.24	
21-30%	9 (22.5)	7 (17.5)	_	

Table 2: Surgical outcomes on day 5 and 10 in burn patients.

	Technique			-
	Tumescent Mean (SD)	Non-tumescent Mean (SD)	The difference (95% CI)	P value
Skin graft take rate - day 5	96.3 (3.9)	94 (3.8)	2.3 (0.5 to 4.0)	0.011
Percentage healing of donor site - day 10	99.8 (1.6)	99.5 (2.2)	0.25 (-0.6 to 1.1)	0.562

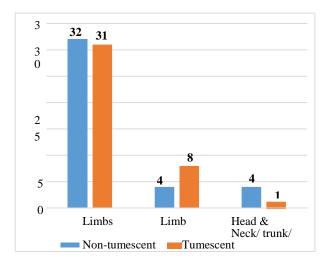


Figure 2: Skin grafting sites according to technique used during skin graft harvesting outcomes in treatment and control group.

The majority of burns in the recruited patients were caused by open flames: 75% in the tumescent group and 82.5% in the non-tumescent group (p=0.412). There was a statistically significant association between skin graft take rate and skin grafting technique (p=0.011). The mean graft take rate was 2.5% higher in the tumescent group compared to the non-tumescent group (96.3% compared to 94%), Table 3. On day 10, there was no

difference in percentage healing of donor a sites between the tumescent and non-tumescent groups, p=0.562.

Table 3: Final out-come at three weeks.

Time frame	Tumescent	Non - tumescent	P value
	N (%)	N (%)	
100% healing by 10 day	37 (92.5)	30 (75)	0.239
100% healing by 3 week	3 (7.5)	10 (25)	0.034

During follow up for assessing final outcome at three weeks all the patients had 100% healing. Patients in the tumescent group were significantly more likely to heal earlier with 7.5% healing between day 10 and week 3 compared to 25% of patients in the non-tumescent group who also healed during the same period (day 10 and final follow up, p=0.034).

DISCUSSION

Burn the rounds are usually managed with early tangential excision and grafting. This is plagued by the significant loss of blood with consequent transfusions albeit its complications. Tumescent technique is one of the ways of minimizing this iatrogenic blood loss. The

uptake of tumescent technique locally has been low in STSG surgery. This is probably because surgeons are not confident about the outcomes of the graft and the donor site. This study was designed to provide strong evidence towards this technique.⁶ The patients in each treatment group had comparable demographic and physical characteristics Open flame burns remain the commonest type of burn in our setting. House fires, gas and stove explosions were the major causes. This could be a point of public health intervention to prevent burns in our society. In both groups, limbs were the commonest part of the body burned and grafted due to their easy exposure. Other studies have confirmed this finding. Majority of the patients had BSA 11% to 20% but small areas of grafting were done at each sitting. In the tumescent group the areas ranged from 100 cm² to 600 cm² compared to 150cm² to 800cm². Despite this wide range between the two groups, their median surface area is not statistically different. 8 This means that the amount of tumescent solution used is not a factor of the outcome between the two groups. Early excision (below two weeks) and grafting is not practiced at all despite overwhelming evidence that it is associated with increased survival, lowers rate of burn sepsis, shorter hospitalization, reduced costs and less time away from work or school. In present study the duration from burn injury to graft surgery was 15 to 260 days. 9 This could be attributed to a large number of patients in the unit, inadequate facilities for surgery and lack of knowledge on its importance. However, the median between the two groups was equal at 75 days. Therefore, there is no statistical difference to influence outcome. 10 In present study, authors found that the skin graft take rate was 96.3% (3.9) in the tumescent group of patients and 94% (3.8) in the non-tumescent group of patients, p=0.011, 95% CI 2.3. This showed in fact that tumescent technique gave better skin graft take rates. In his study, he compared tumescent technique to a historical group of patients with non-tumescent technique. This affirmed that the viability of the harvested graft is not affected by the infusion of the tumescent solution. We don't know from this study why tumescent technique had a better outcome but authors postulate that there could be less hematoma/seroma formation on the grafted site. This requires further study. However, we wish to point out that the grafts were monitored relatively on day more studies need to be done to follow up the progress of the graft passed day 5. In both groups, the donor site had healed by day 10 (99.8% and 99.5% respectively). 11 Burn wounds are usually managed with early tangential excision and grafting. This is plagued by the significant loss of blood with consequent transfusions albeit its complications. Tumescent technique is one of the ways of minimizing this iatrogenic blood loss. The uptake of tumescent technique locally has been low in STSG surgery. This is probably because surgeons are not confident about the outcomes of the graft and the donor site. This study was designed to provide strong evidence of this technique. Majority of the patients had BSA 11% to 20% but small areas of grafting were done at each sitting. In the

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Institutional Ethics Committee

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