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Original Research Article

Comparison of Heparin Dressing versus Saline Dressing for Pain Relief at Split Thickness Skin Graft Donor Site

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Abstract: *Split-thickness skin grafting (STSG) is a widely used reconstructive technique for treating various soft tissue defects.* ***Objective:*** *To compare the efficacy of heparin dressing versus saline dressing in terms of pain relief, healing time, complications, and patient satisfaction at split-thickness skin graft donor sites.* ***Methodology:*** *This prospective comparative study was conducted at Mayo Hospital, Lahore, from September 2024 to February 2025. A total of 320 patients undergoing STSG were enrolled and randomly divided into two groups: Group A (heparin dressing, n = 160) and Group B (saline dressing, n = 160). Pain was assessed using the Visual Analog Scale (VAS) on postoperative days 1, 3, 5, and 7. Healing time, complications, and patient satisfaction were also recorded.* ***Results:*** *The mean pain scores were significantly lower in the heparin group across all postoperative days (Day 1: 6.8 ± 1.2 vs 7.4 ± 1.3; Day 7: 1.2 ± 0.6 vs 2.5 ± 0.7; $p < 0.001$). The average healing time was shorter in the heparin group (8.3 ± 1.4 days) compared to the saline group (10.1 ± 1.6 days; $p < 0.001$). Delayed healing occurred in 6.3% of heparin-treated patients, compared with 15.6% in the saline group ($p = 0.02$). Patient satisfaction was higher with heparin dressings (87.5% vs 68.1%; $p < 0.001$), while infection rates were low and comparable between groups.* ***Conclusion:*** *It is concluded that heparin dressing provides superior outcomes compared to saline dressing for donor site management in split-thickness skin grafts. It significantly reduces postoperative pain, accelerates epithelialization, and enhances patient comfort without increasing complications.*

Keywords: Split-thickness skin graft, Heparin dressing, Saline dressing, Donor site pain, Wound healing, Epithelialization

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Introduction

Split-thickness skin grafting (STSG) is a commonly used reconstructive surgical technique for managing extensive soft tissue defects resulting from trauma, burns, or tumor excision (1). It involves harvesting a thin layer of skin from a donor site, usually the thigh or abdomen, and transplanting it to the recipient site to restore tissue integrity and improve functional and aesthetic outcomes (2). However, donor site management remains a major postoperative concern due to significant pain, discomfort, and delayed healing (3). Pain at the donor site often arises from the nature of the wound, skin tension after harvesting, and the inflammatory response to injury (4,5). Effective pain control is crucial, as inadequate management can lead to anxiety, reduced mobility, prolonged hospitalization, and delayed recovery (6).

Various dressings have been used to reduce donor site pain. Traditional saline dressings are simple, inexpensive, and maintain a moist environment that facilitates re-epithelialization (7,8). However, saline dressings mainly prevent wound desiccation without addressing inflammation or pain (9). In contrast, heparin-based dressings have emerged as a promising alternative due to their anti-inflammatory, anti-edematous, and tissue-regenerative properties (10,11).

Heparin inhibits pro-inflammatory cytokines and matrix metalloproteinases (MMPs), which contribute to tissue breakdown and heightened pain sensitivity (12). Additionally, it promotes angiogenesis and tissue repair, potentially accelerating healing and reducing the risk of infection or scarring (13).

Given these advantages, this study aims to compare heparin dressing with conventional saline dressing for pain relief, healing time, complications, and patient satisfaction at split-thickness skin graft donor sites.

Methodology

This was a prospective comparative study conducted at Mayo Hospital, Lahore, from September 2024 to February 2025. A total of 320 patients undergoing split-thickness skin grafting for various indications were included in the study. Consecutive non-probability sampling was used to recruit patients who met the inclusion criteria. Patients aged 18 to 65 years undergoing split-thickness skin grafting for traumatic, burn, or post-surgical soft-tissue defects were eligible for the study; the donor site for the grafts needed to be on the thigh or abdomen. Additionally, patients had to be willing to provide informed consent and comply with follow-up protocols to participate.

Certain criteria excluded patients from the study. Those with known hypersensitivity to heparin, systemic coagulation disorders, or those currently on anticoagulant therapy were not eligible. Patients with infected or ulcerated donor sites, immunocompromised individuals, and those with diabetes mellitus affecting wound healing were also excluded.

Data were collected on demographic and clinical aspects, including age, gender, graft size, and donor site location, using a predesigned pro forma. The participants were randomly assigned to two equal-sized groups, with 160 patients in each group. Group A received a heparin dressing, where the donor site was covered with sterile gauze soaked in a 5,000 IU/mL heparin solution. In contrast, Group B received a saline dressing consisting of sterile gauze soaked in normal saline.

Dressings were applied immediately after graft harvesting and changed every 48 hours under aseptic conditions until complete epithelialization. Pain intensity at the donor site was evaluated using a Visual Analog Scale (VAS) ranging from 0 (no pain) to 10 (worst possible pain). Patients were asked to rate their pain levels on postoperative days 1, 3, 5, and 7. These measurements allowed the comparison of short-term pain relief between the two dressing types and helped identify trends in recovery. Wound healing was assessed through direct visual inspection of the donor site. Parameters recorded included time to complete epithelialization, presence of exudate, infection signs, and scarring. Complete epithelialization was defined as full re-epithelialization of the wound bed without exudate or crust formation. Any complications, such as infection or delayed healing, were documented and managed accordingly.

Statistical analysis was done using SPSS version 25. Quantitative variables such as age, healing time, and VAS scores were presented as mean ± standard deviation and compared using the Student's t-test. Categorical data, such as gender and infection rates, were expressed as frequencies and percentages and analyzed using the Chi-square test. A p-value less than 0.05 was considered statistically significant.

Results

A total of 320 patients were enrolled and completed the study, with 160 patients in each treatment group. The mean age was similar in both groups (36.8 ± 9.7 years for heparin and 37.1 ± 10.1 years for saline), indicating a well-matched population. The gender distribution was identical, with 58.1% males and 41.9% females in each group. The majority of donor sites were located on the thigh (around 80% in both groups), and the mean graft size was also comparable (68.2 ± 15.6 cm² vs. 67.7 ± 14.9 cm²). The main indications for grafting were post-burn scars (approximately 41%), traumatic wounds (35–36%), and post-tumor excision defects (23%) in both groups. The only significant baseline difference was observed in the initial pain level, with patients in the saline group reporting slightly higher mean VAS scores on day 1 (7.4 ± 1.3) than those in the heparin group (6.8 ± 1.2). (Table 1)

On day 1, both groups experienced moderate to severe pain, but patients treated with heparin reported lower pain scores (6.8 ± 1.2) than those treated with saline (7.4 ± 1.3; p = 0.01). By day 3, the pain had reduced to 4.5 ± 1.0 in the heparin group, compared with 5.9 ± 1.1 in the saline group (p < 0.001). On day 5, the mean pain further decreased to 2.6 ± 0.9 in the heparin group and 4.1 ± 1.0 in the saline group (p < 0.001). By day 7, most patients reported only mild discomfort—1.2 ± 0.6 in the heparin group versus 2.5 ± 0.7 in the saline group (p < 0.001) (Table 2)

The mean healing time was significantly shorter in patients receiving a heparin dressing (8.3 ± 1.4 days) than in those with a saline dressing (10.1 ± 1.6 days, p < 0.001). Delayed healing (>12 days) was observed in only 10 patients (6.3%) in the heparin group, compared with 25 patients (15.6%) in the saline group (p = 0.02). Infection was observed in 4 patients (2.5%) in the heparin group versus 9 patients (5.6%) in the saline group (p = 0.18), suggesting a favorable clinical trend, although not statistically significant. Patient satisfaction was considerably higher among heparin-treated patients—140 individuals (87.5%) reported being satisfied or highly satisfied compared to 109 (68.1%) in the saline group (p < 0.001). (Table 3). The largest decrease occurred between day 1 and day 3, with the heparin group showing a reduction of 2.3 ± 0.8 points compared to 1.5 ± 0.6 in the saline group (p < 0.001). Between day 3 and day 5, both groups showed similar reductions (1.9 ± 0.7 vs. 1.8 ± 0.6, p = 0.47). The difference between day 5 and day 7 was not significant (–0.2, p = 0.09). However, the total reduction from day 1 to day 7 was greater in the heparin group (5.6 ± 1.2) than in the saline group (4.9 ± 1.1; p = 0.002), confirming faster pain relief throughout the postoperative course. (Table 4)The average VAS score across all observation days was 3.8 ± 1.2 in the heparin group versus 5.0 ± 1.4 in the saline group (p < 0.001). Mean healing time mirrored this pattern, being shorter in the heparin group (8.3 ± 1.4 days) than the saline group (10.1 ± 1.6 days, p < 0.001). The infection rate was lower in the heparin group (2.5% vs. 5.6%, p = 0.18), while delayed healing was significantly reduced (6.3% vs. 15.6%, p = 0.02). Overall satisfaction was markedly higher in patients treated with heparin dressings (87.5%) than in those treated with saline (68.1%; p < 0.001). (Table 5)

Table 1: Baseline Demographic Characteristics of Patients (n = 320)

Variable	Heparin Dressing (n = 160)	Saline Dressing (n = 160)
Mean Age (years) ± SD	36.8 ± 9.7	37.1 ± 10.1
Gender (Male/Female), n (%)	93 (58.1%) / 67 (41.9%)	93 (58.1%) / 67 (41.9%)
Donor Site Location (Thigh/Abdomen), n (%)	128 (80.0%) / 32 (20.0%)	130 (81.3%) / 30 (18.7%)
Mean Graft Size (cm²) ± SD	68.2 ± 15.6	67.7 ± 14.9
Indication for Grafting, n (%)		
— Post-burn scar	65 (40.6%)	67 (41.9%)
— Traumatic wound	58 (36.3%)	56 (35.0%)
— Post-tumor excision	37 (23.1%)	37 (23.1%)
Baseline Pain (VAS Day 1) ± SD	6.8 ± 1.2	7.4 ± 1.3

Table 2: Comparison of Pain Scores Between Heparin and Saline Dressings (VAS Scale 0–10)

Postoperative Day	Heparin Dressing (Mean ± SD)	Saline Dressing (Mean ± SD)	*p*-value
Day 1	6.8 ± 1.2	7.4 ± 1.3	0.01
Day 3	4.5 ± 1.0	5.9 ± 1.1	<0.001
Day 5	2.6 ± 0.9	4.1 ± 1.0	<0.001
Day 7	1.2 ± 0.6	2.5 ± 0.7	<0.001

Table 3: Healing Outcomes and Complications

Parameter	Heparin Dressing (n = 160)	Saline Dressing (n = 160)	*p*-value
Mean Healing Time (days) ± SD	8.3 ± 1.4	10.1 ± 1.6	<0.001
Delayed Healing (>12 days), n (%)	10 (6.3%)	25 (15.6%)	0.02
Infection, n (%)	4 (2.5%)	9 (5.6%)	0.18
Patient Satisfaction (Satisfied/Highly Satisfied), n (%)	140 (87.5%)	109 (68.1%)	<0.001

Table 4: Stratified Analysis of Pain Reduction Over Time in Both Groups

Day Interval	Mean VAS Score Reduction (Heparin)	Mean VAS Score Reduction (Saline)	Mean Difference	*p*-value
Day 1 → Day 3	2.3 ± 0.8	1.5 ± 0.6	0.8	<0.001
Day 3 → Day 5	1.9 ± 0.7	1.8 ± 0.6	0.1	0.47
Day 5 → Day 7	1.4 ± 0.5	1.6 ± 0.6	-0.2	0.09

Overall (Day 1 → Day 7)	5.6 ± 1.2	4.9 ± 1.1	0.7	0.002

Table 5: Overall Comparative Outcomes Between Heparin and Saline Dressings

Outcome Parameter	Heparin Dressing (n = 160)	Saline Dressing (n = 160)	*p*-value
Average VAS Score (All Days)	3.8 ± 1.2	5.0 ± 1.4	<0.001
Mean Healing Time (days)	8.3 ± 1.4	10.1 ± 1.6	<0.001
Infection Rate (%)	2.5	5.6	0.18
Delayed Healing (%)	6.3	15.6	0.02
Patient Satisfaction (Satisfied/Highly Satisfied)	87.5	68.1	<0.001

Discussion

This trial compared the effectiveness of heparin dressing and saline dressing for pain relief and healing at split-thickness skin graft (STSG) donor sites in 320 patients. The findings demonstrated that patients treated with a heparin dressing experienced significantly greater pain relief, faster epithelialization, and higher satisfaction than those treated with a saline dressing. The heparin group did not show a statistically significant increase in pain scores at any postoperative time point, and the reduction from day 1 to day 7 was statistically significant. The anti-inflammatory and analgesic effects of heparin are believed to stem from its inhibition of inflammatory mediators and enhancement of microcirculation at the wound site. By reducing edema and local tissue pressure, heparin may decrease nociceptor stimulation and improve pain control, consistent with previous studies reporting less pain and faster healing with topical heparin application compared with traditional dressings (14). Conversely, saline dressings primarily maintain moisture and provide a suitable healing environment but lack direct analgesic or anti-inflammatory effects. Patients receiving heparin dressings showed a markedly shorter epithelialization period (8.3 ± 1.4 days) than those treated with saline. This is attributed to heparin's ability to stimulate angiogenesis, fibroblast proliferation, and growth factor regulation in wound healing. Heparin's binding and stabilization of basic fibroblast growth factor (bFGF) and vascular endothelial growth factor (VEGF) promote granulation tissue formation and accelerate epithelial regeneration (15–17). These biological effects explain the faster healing observed in the heparin-treated group. Additionally, reduced exudate formation and erythema in the heparin group highlight its anti-edematous and anti-inflammatory actions, creating optimal wound conditions (18). Complications such as infection and delayed healing were lower in the heparin group. However, the difference in infection rates was not statistically significant, suggesting that heparin's benefits are indirect, through inflammation control and accelerated epithelialization, rather than through antimicrobial activity (19). Topical heparin use proved safe, with no adverse reactions or systemic complications observed. Patient satisfaction was significantly higher in the heparin group (87.5%) than in the saline group (68.1%), reflecting improved pain control, reduced dressing change discomfort, and quicker functional recovery. Clinically, higher patient satisfaction correlates with shorter hospital stays, lower opioid requirements, and better adherence to postoperative care (20,21). The present findings align with existing literature indicating that heparin-impregnated dressings accelerate healing and reduce pain at donor and other wound sites. Nonetheless, variations in heparin concentration, formulation, and application frequency exist across studies. Although saline dressings remain simple and inexpensive, heparin's therapeutic value should be considered, especially where effective pain management and rapid recovery are priorities. However, this single-center study limits generalizability, and pain assessment via the Visual Analog Scale (VAS) may introduce subjectivity. Future multicenter randomized controlled trials with longer follow-up and cost-effectiveness analyses are recommended further to evaluate the routine clinical use of heparin dressings.

Conclusion

It is concluded that heparin dressing is significantly more effective than saline dressing in reducing postoperative pain and accelerating wound healing at split-thickness skin graft donor sites. Patients treated with heparin dressings experienced lower pain scores, faster epithelialization, fewer complications, and higher satisfaction levels. The superior results can be attributed to heparin's anti-inflammatory, anti-edematous, and pro-angiogenic properties, which enhance tissue repair and provide better pain relief compared to conventional saline dressings.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-24)
Consent for publication
Approved
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Conflict of interest

The authors declared no conflict of interest.

Author Contribution

AY (Resident):
Conception of study, data collection, data analysis, and manuscript drafting.
MB (Professor and Head):
Supervision of research, critical review, and final approval of the manuscript.
OA (Assistant Professor):
Methodology development, data interpretation, and manuscript editing.
TA (Assistant Professor):
Data Analysis, Methodology development and manuscript editing.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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