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THE USE OF SPLIT SKIN GRAFTING IN DIABETIC FOOT ULCERS – A PROSPECTIVE OBSERVATIONAL STUDY

General Surgery

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ABSTRACT

Background: Diabetic foot ulcers (DFU) form a major burden in the surgical field. A majority of them are large ones which do not undergo spontaneous healing by conventional measures often compounded by slow healing, super added infections leading to increased hospital stay and loss of resources. Hence the aim of this study is to ascertain the role of split skin grafting (SSG) in hastening DFU treatment. **Materials And Methods:** Consecutive cases of 80 diabetic patients with DFU admitted to our general surgical department over a period of two years from August 2018 to September 2020 who met the criteria for autologous split skin grafting were included in the study. They were grafted and followed up over a minimum period of six months. **Results:** There was a greater than 90 percent uptake in 91.25% patients and between 90% to 50% uptake in 5% cases and less than 50 percent uptake in 3.75 % cases. Those 3.75% cases required re-grafting and they healed well. **Conclusion:** Split skin grafting is feasible after optimizing the diabetic ulcers which would result in faster epithelial covering of the wounds with shorter hospital stay and early rehabilitation to normal life. Hence SSG can be a promising method in treating DFU for better outcomes.

KEYWORDS

INTRODUCTION:

The global diabetes prevalence in 2019 is estimated to be 9.3% (463 million people), with an estimated increase to 10.2% (578 million) by 2030 and 10.9% (700 million) by 2045. There were 65·0 million (95% UI 58·7–71·1). Prevalent cases of diabetes in India in 2016 compared with 26·0 million (23·4–28·6) in 1990. One of the most common problems in the care of the diabetic patient is the diabetic foot ulcers (DFU), with studies reporting an average annual incidence of 2.2%. It is estimated that approximately 20% of hospital admissions among patients with DM are the result of DFU. The costs of treatment, increased disability, mortality and complications related to diabetes continues to be among the largest health care burdens.

Indeed, DFU can lead to infection, gangrene, sepsis, amputation, and even death if necessary care is not provided. Hence the necessity for adequate intervention in the early stages of diabetic foot ulcers. Standard therapy involves the use of dressings to protect the wound bed from trauma and to absorb exudates, offloading high pressure from the wound bed, example by prescribing protective footwear, and wound debridement to accelerate endogenous healing and facilitate the effectiveness of topically applied substances like betadine, colloidal silver, papaine urease or simple saline dressings to hold moisture. But these measures are inadequate in healing all diabetic ulcers when the patient's intrinsic wound-healing capacity is poor. While conventional care could be effective in healing the ulcers in some cases, many reports showed long healing time and a high rate of long-term recurrence with such management. In such patients, skin grafting is a second-line treatment option. However, the effectiveness of skin replacement therapies in treatment of diabetic ulcers is still unclear.

On burns patients, split-thickness skin grafts have acceptance rates of nearing 100%. There is minimal research available studying STSGs on diabetic patients. The majority of literature available on diabetic patients is retrospective reviews or case studies. Therefore the aim of this study is to treat DFU with proactive split skin grafting to cover the granulated raw area and follow them up prospectively.

MATERIALS AND METHODS:

A total of 80 diabetic foot ulcer patients attending the general surgical department whose ulcers were large enough that would not be feasible for conservative management by dressings alone were chosen by consensus.

Inclusion Criteria:

1. Age 30 years or more.
2. Diabetics with active foot ulcer.
3. Consenting to take part in the study.

Exclusion Criteria:

1. Below 30 years.
2. Refusing consent.
3. Poor general condition requiring acute medical care.
4. Extensive gangrene of lower limb likely to result in upfront amputation.

The enrolled patients were subjected to initial evaluation of general condition, systemic evaluation, local examination of foot by classifying the ulcers by Wagner's classification, documentation of the ulcer extent, location, any gangrene of tissues (both dry and wet), vascular status of the limb, neurological status of limb and laboratory parameters such as fasting and postprandial sugars with glycosylated hemoglobin levels, WBC count to rule out sepsis from the DFU and swab or tissue culture from the ulcer is taken for bacteriological profiling.

Once the initial assessment is done the patient is subjected to a systematic debridement to remove non-vitalized tissue. Patient is treated with appropriate antibiotics, anti-diabetic drugs and daily dressings until the wound has sufficient granulation tissue to take up skin graft. A mandatory negative culture is essential before grafting.
Under suitable anesthesia the split skin graft is taken from the thigh and used to cover the ulcer area and placed in position by sutures. The first look dressing is done on the fourth postoperative day to assess the primary uptake. There after the regular dressings once in three days are done till two weeks following which it is left open as the skin would have taken up completely. The patients are then followed up for once in four weeks till six months. Patients are encouraged to ambulate after completion of one-week post-procedure if the graft is placed on the dorsum of foot while for the grafts on plantar aspect off-loading footwear is given to avoid shearing forces on the grafted area. For raw areas over weight bearing areas can be managed initially with SSG as the procedure is simple and doesn't require prolonged immobilization, decreased hospital stay and cost effective. For patients who recurred with graft failures at weight bearing areas at a later date were considered for flap procedures.

RESULTS:

There was a total of 80 patients in this study. Of these 68% were males and 32% were females. 11% of the patients were below 40 years of

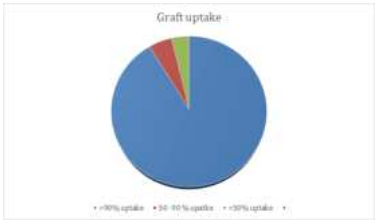
age, 23% between 40 -50 years, 32% of them were 50 – 60 years and the rest 34% were above 60 years. 22.5 percentage of patients with diabetes diagnosed for less than 5 years, 43.75% between 5 -10 years and 33.75 % greater than 10 years. Percentage of patients with HBA1C between 6-8 were 23.75%, between 8-10 were 47.5%, Above 10 were 28.75%.

About 21.25% of patients had symptoms for less than one month, 36.25 % between 1-2 months, 28.75 % between 2-4 months and 13.75% above 4 months.

The duration of hospital stay ranged from 6 days to 3 weeks with an average of 12 days. The number of weeks taken for complete wound healing ranged from 3.5 weeks to 9 weeks with an average of 5.6 weeks.

There was a greater than 90 percent graft uptake in 91.25% patients and between 90% to 50% uptake in 5% cases and less than 50 percent uptake in 3.75 % cases. Those 3.75% cases required re-grafting and they healed well.

Donor site infection overall was 2% and was not dependent on the size of the donor area. All infections were treated conservatively with antibiotics and dressings and they healed well. Figures 1 and 2 show the grafted sites on dorsum of foot.



DISCUSSION:

Lower limbs in diabetics are more prone for ulcerations due to a combination of sensory and motor neuropathy, arteriopathy of large arteries and a deficit in micro-circulation due to microvascular angiopathy. Uncontrolled diabetic status, the total duration of diabetes, preventive foot care taken by the patients all play a vital role in the development of diabetic foot ulcers. Lower limb diabetic wounds pose several challenges owing to the neuropathy, endothelial dysfunction and increased susceptibility to infection. Of them neuropathy is a major concern because the patient's limbs have hypoesthesia and are often unaware of the severity of their wound until the ulcer enlarges and infection spreads more proximally. Endothelial dysfunction disrupts the microvasculature in the body affecting many organs like eyes, kidneys and distal extremities. Also studies have shown the increased blood sugar levels retards the chemotaxic response to combat infection. These systemic challenges compounded by other patient-specific problems like smoking, poor nutrition, hyperlipidemia, renal and cardiac failure status and noncompliance, make the care of chronic wounds challenging. As a result, conservative management with regular dressing has been the most common practice. But the chances of infection are high with more than 50% of the DFUs become infected, with 20% to 30% of the involved limbs necessitating amputation. One should treat ulcers as early as possible and with aggressive intent to help in timely healing. This is especially important to prevent the main complication of ascending infection associated with chronic wound that commonly lead to amputation. Though a number of topical agents promoting the wound healing has been described it consumes time and resources. Hence another way to cover the wounds especially larger ones is a necessity, so comes the role of skin grafting to cover the wounds and reduce the possibility of infections. Once the causative source that impairs wound healing is eliminated, a graft is useful in faster healing and decreases the risk of further amputation or tissue loss.

The application of skin grafts for the patient with diabetes is dependent on various factors like other medical co morbidities, the status of circulation in the lower limbs, the presence of infection, categorization of the anatomical location of the wound like non-weight bearing areas like dorsum, medial and lateral sides of foot, instep, amputation stump versus weight bearing areas and donor site availability. The skin graft restores healthy intact skin which in turn become impervious to microorganisms and thereby prevent further infection. An autologous split skin graft has the advantage of a spontaneous healing at the donor site and the chances of uptake at recipient site is high. Skin grafting promises faster time to healing with a single treatment in comparison to other topical wound modalities. There are risks including donor site morbidity and failed take of the graft which can be minimized by proper preparation of the wound and SSG by expert's hands. Poor patient selection is the prime reason that can lead to graft failures. The other factors are intrinsic problems in diabetics which are neuropathy, microangiopathy and increased susceptibility to infection in diabetics in general. In patients with other co morbidities especially end-stage renal disease, donor site wound infection rates are increased.

Split-thickness skin grafts have poor results in ulcers with exposed bone, tendon and joints where the vascularity is poor and lack of granulation tissue leads to absence of imbibation and graft rejection. Also increased shear and pressure influence the outcome of graft uptake, hence SSGs are not preferred over weight bearing areas. Hence one should also evaluate the planned location for the graft and avoid direct weight-bearing areas where the immediate results of graft uptake might be good during immobilization, hospitalization and offloading of the pressure areas but when the patient returns to normal life then the skin grafts showed loss especially at the centre. Despite these risks, in carefully chosen patients SSG can be a useful and effective technique for the closure of diabetic wounds. In small wounds there may not be big difference between standard dressings and SSG but in larger wounds, STSG offers more durable coverage than the scar that results from secondary closure and allows for more rapid closure. When one obtains STSGs from a donor site, the grafts should contain both the epidermis and a partial layer of the dermis. The donor site then heals through re-epithelialization. With lower extremity ulcerations, one performs thorough debridement to remove debris, biofilm and create a clean and red granulation tissue. If there is exposed bone or tendon at the floor of the ulcer, negative pressure wound therapy (NPWT) aids the development of granulation tissue and covers these avascular structures. Sometimes it may take few weeks to form an appropriate bed and we should not graft without meeting the adequate standards. If there is any concern regarding residual infection after debridement, they should be treated appropriately by intravenous or topical antibiotics based on the culture and sensitivity before grafting.

HBA1C levels and SSG is a debatable topic with few studies showing that SSG take do not appear to be adversely affected by hemoglobin A1c (HbA1c) levels. Infection is one of the leading causes of graft failure, highlighting the importance of reducing biofilm and managing any underlying infection. Although there is not a direct correlation of HbA1c to STSG failure, co-morbidities such as peripheral vascular disease, congestive heart failure (CHF), edema and end-stage renal disease (ESRD) might play a role in poor uptake of grafts. Offloading is vital in grafts placed on the plantar aspect of the foot to prevent the recurrence of ulcerations. With STSG, offloading methods can also reduce shearing forces, serous fluid collection and hematoma formation beneath the graft and damage to grafts by pressure. Though the best option in large ulcers over weight bearing areas would be flaps, grafts can reduce the size of the raw areas and might help in patients who may not be fit to undergo procedures like flap.

The main advantage of split-thickness skin grafts is its versatile nature. One can employ STSG as a primary treatment method on the diabetic ulcers, as secondary treatment, an adjunct to a partially accepted/failed treatment or to help facilitate healing of the donor site of another plastic surgery intervention where it can be very effective and potentially more cost-effective. In a 2019 meta-analysis looking at the use of STSG for diabetic ulcerations by Yammin-et-al noted that 85.5 percent healed over a mean time of five weeks with a recurrence rate of 4.2 percent, infection rate of 4.4 percent and a re-grafting rate of 12.1 percent. The researchers also found that donor site morbidity was only 1.75 percent.

Such values are considered far better in comparison to following standard care. In fact, the reported outcomes following conservative care are to be considered time consuming and comparatively ineffective. In a study by Margolis-et-al reported a healing rate ranging between 24.2% and 47% during 12 weeks and a range of 30.9% to 68% by 20 weeks after standard care. Veves-et-al reported healing by 12 weeks in 38%, and Ince-et-al reported 59.8% and 71.0% healing by 12 and 20 weeks, respectively. In our study the wound infection rate at the recipient site was 2.8% which is comparable to other studies.

Mahmoud-et-al studied the difference in days to heal and days spent in

the hospital in 100 diabetic patients (fifty in each group) using STSG versus conservative wound care.

All the patients included in the study healed completely, however, the STSG group healed in an average of 28 days, versus 122 days in the conservative group. In a review of SSG in diabetic wounds by McCartan-et-al it was found when used as the primary closure on optimized diabetic foot ulcerations, split-thickness skin grafts are 78% successful at closing 90% of the wound by eight weeks. In our study with careful selection of patients with ulcer in non-weight bearing areas there was graft uptake in upwards of 90%. Hence SSG can be a feasible option for diabetic ulcers in non-weight bearing areas while ulcers in weight bearing areas require multimodality treatment like platelet rich plasma injections for small ulcers and flaps for larger ulcers.

CONCLUSION:

Most of the studies done on SSG in diabetic foot ulcers are either case studies or retrospective analysis. Our study is a prospective one which highlights that the usage of SSG after proper optimization of wounds is a viable option. Accordingly, further prospective studies with large number of enrolment would validate the same.

Figure 1: SSG on dorsum of foot at first dressing

Figure 2: SSG on dorsum of foot after complete healing

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