SKIN GRAFTING CASES BY NEGATIVE PRESSURE WOUND THERAPY FOR THE TREATMENT OF SKIN TUMORS AND INTRACTABLE CUTANEOUS ULCERS

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Abstract
The most common causes of skin graft loss are hematoma, infection, or shear. To promote close contact between the graft and the wound, negative pressure wound therapy (NPWT) has been recently used particularly when a skin graft must be placed over an uneven wound bed surface. Hence, through a chart review of medical records from January 2015 to December 2017, we evaluated the effectiveness of NPWT as a coadjuvant treatment for 44 cases of surgical wounds of various body sites. Accordingly, our study suggests that the use of NPWT is a promising tool in skin grafting for the treatment of skin tumors and intractable cutaneous ulcers on the curved body parts. Further studies must be done to clarify the ideal conditions of performing NPWT in parallel with skin grafting on the wounds in difficult recipient wound beds.

Key words : negative-pressure wound therapy, skin grafting, skin tumors, intractable cutaneous ulcers, burn

Introduction

Skin grafting is one of the fundamental surgical technique widely used in the reconstruction of large skin defects[1)]. Since grafted skin lacks an intact blood supply, revascularization, which occurs within 24-48 hours after grafting, influences the engraftment of a skin graft and is known as the key stage for the long-term success of grafting. The major causes of graft failure are shear forces of the interface, which disrupt the fragile new vessel connections, and the formation of seroma or hematoma between skin graft and wound bed. Accordingly, it is important that the graft is fixed without any shear forces at this stage. However, although a dressing that prevents these events has always been desirable, no method completely satisfies these objectives in the cases on the curved body parts.

Negative pressure wound therapy (NPWT) has been proven beneficial in the treatment of wounds in which a sealed wound dressing systems using a porous material provides an even distribution of pressure throughout the wound[2-4)]. This dressing is placed in direct contact with the wound attached to a vacuum device that creates a negative pressure environment in the wound inducing an effect to compress the graft. Applying continued vacuum helps to remove excess fluid from the wound and increase blood flow to the area and promote wound healing. While NPWT has been becoming a rapidly evolving method in the treatment of wounds, there are a few reports evaluating NPWT as a bolster dressing for skin

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grafts. Accordingly, in the present study for the treatment of skin tumors and intractable cutaneous ulcers, we investigated the effectiveness of NPWT for skin graft in difficult recipient wound beds on various body sites.

Patients and Methods

For successful skin grafting, contact between the graft and the wound bed is important. To promote close contact between the graft and the wound, we performed NPWT applied after skin grafting between January 2015 and December 2017. Included in this case series were patients with skin tumors, burns, intractable skin ulcers, and others (Table 1). The consent information and purposes of this study were accurately explained to the participants and they provided informed consent voluntarily, including the possible use of photos without identifying marks or facial features.

The procedure for skin graft bolstered by negative pressure wound therapy (NPWT) was applied according to the manufacturer's instructions (RENASYS® NPWT system, Smith & Nephew, Hull, UK). Briefly, after excision of the lesion including melanoma (Fig. 1a), a full thickness or split-thickness skin graft was laid onto the wound defect and was stapled in place (Fig. 1b). The skin graft was covered with a single layer polyurethane foam, which was cut to fit the contour of the wound, followed with a transparent adhesive dressing followed by applying the RENASYS Dressing Kits (Fig. 1c). Negative pressure was delivered at a continuous −80 to −100 mmHg and NPWT was kept on the wound by day 3-6 of postsurgery in most cases (Fig. 1d). The main outcome of skin graft was assessed using digital photographs at the moment of uncovering the NPWT closure by a clinician who is experienced with skin graft procedures. The rate of graft take is expressed as a percentage of the vital skin graft of surgically treated areas. Clinically the vital skin graft is immobile and has a healthy color ranging from red, brown, purple but not black or grey.

Table 1. Characteristics of patients who underwent NPWT: The cases with tumor include malignant melanoma, squamous cell carcinoma, basal cell carcinoma, malignant peripheral nerve sheath tumor, malignant fibrous histiocytoma, dermatofibrosarcoma protuberans, primary cutaneous follicle center lymphoma, Bowen's disease, dermatofibroma, angiomxyoma, and Clark's nevus. The cases with cutaneous fistula include hidradenitis suppurativa and ruptured epidermal cyst. The cases with intractable cutaneous ulcer include arterial or venous ulcer. The cases with others include hypertrophic scar and necrotizing fasciitis. (*asterix) Heel is included in "sole".

characteristics of patients		cases
gender	male	21
	female	23
age (years)	>60	29
	41-59	9
	<40	6
area of wounds	chest	3
	shoulder	1
	back	4
	arm	4
	hand	4
	buttocks	3
	thigh	4
	lower leg	6
	dorsum of foot	2
	sole*	9
	lumbar	3
	knee	1
mode of wound	tumors	32
	burn	2
	cutaneous fistula	3
	intractable cutaneous ulcer	5
	others	2

Results

Between January 2015 and December 2017, a total of 44 patients were identified for study inclusion. They included 21 males and 23 females with a range of 16 years to 95 years (a mean age of 61.3 years).

With respect to surgical site, 3 cases were involved in chest, 1 case in shoulder, 4 cases in back, 4 cases in arm, 4 cases in hand, 3 cases in buttocks, 4 cases in thigh, 6

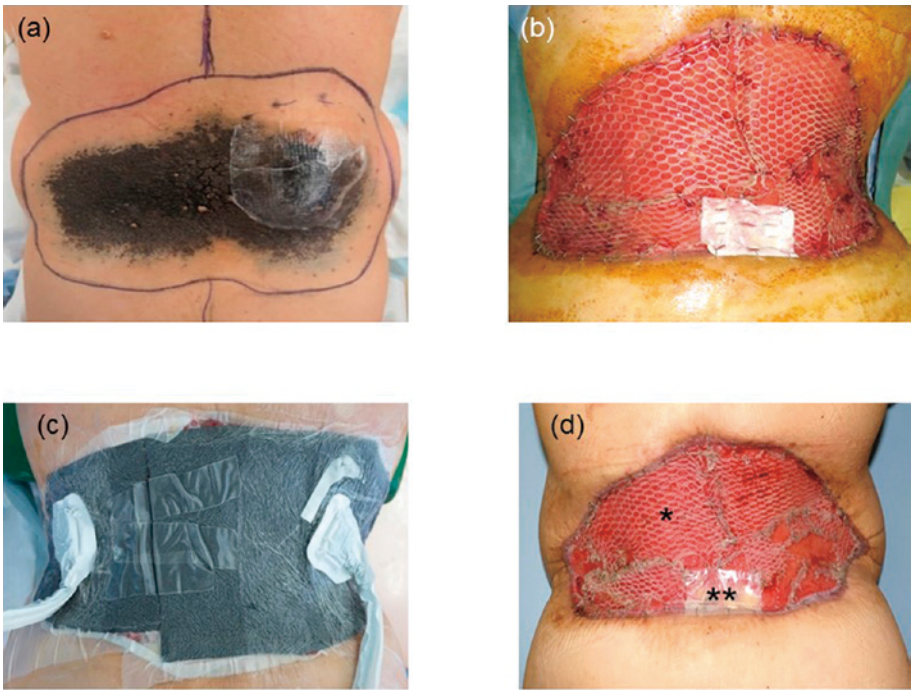

Fig. 1. (a) Melanoma in congenital melanocytic nevus. (b) Split-thickness skin grafting. (c) NPWT application. (d) 5 days after surgery. The asterisk shows skin graft and the double-asterisk shows an artificial dermis PELNAC.

cases in lower leg, 2 cases in dorsum of foot, 9 cases in sole, 3 cases in lumbar region, and 1 case in knee (Table 1). The wound size ranged from 0.72 cm^2 to 510 cm^2 with a median of 58.4 cm^2.

NPWT was applied for the following indications : cases with tumors (n=32), burn (n=2), cutaneous fistula (n=3), intractable cutaneous ulcer (n=5), and others (n=2) (Table 1). The sizes of wound were as follows : >100 cm^2 in 7 cases, 11-99 cm^2 in 25 cases, and <10 cm^2 in 12 cases. The type of skin graft was a split-thickness in 32 cases and a full-thickness in 12 cases.

After removal of the NPWT closure, most areas of graft were successfully engrafted. The rate of graft take was 70～100% in 30 cases, 50～70% in 12 cases, and 0～50% in 2 cases at the moment of uncovering the NPWT closure (Fig. 2). Unfortunately, there was an earlier discontinuation of application of NPWT in 1 patient due to erythema around the sponge due to excess pressure. The skin grafts survived without infection or hematoma in all cases. All of the patients were discharged from the hospital without additional intervention. In addition, as for the parameters such as age, wound size, skin graft thickness, type of tumors, and infection, there were no statistically significant differences between group with less than 70% graft take and group with more than 70% graft take (data not shown).

We report two representative model cases, which were improved with NPWT applied after skin grafting.

Case 1 : A-54-year-old female presented with ulcerated nodules on her middle finger and ring finger (Fig. 3a), which were diagnosed pathologically as squamous cell carcinoma in burn scar. The nodules were excised with a 6 mm margin (Fig. 3b, c), which was then followed by full-thickness skin grafting (Fig. 3d) using NPWT. The NPWT dressing was removed 3 days later and the graft survived completely at the site (Fig. 3e). The site was functioning well 3 months after surgery (Fig. 3f).

Case 2 : A-26-year-old male presented with multiple subcutaneous induration and fistulas on the buttocks

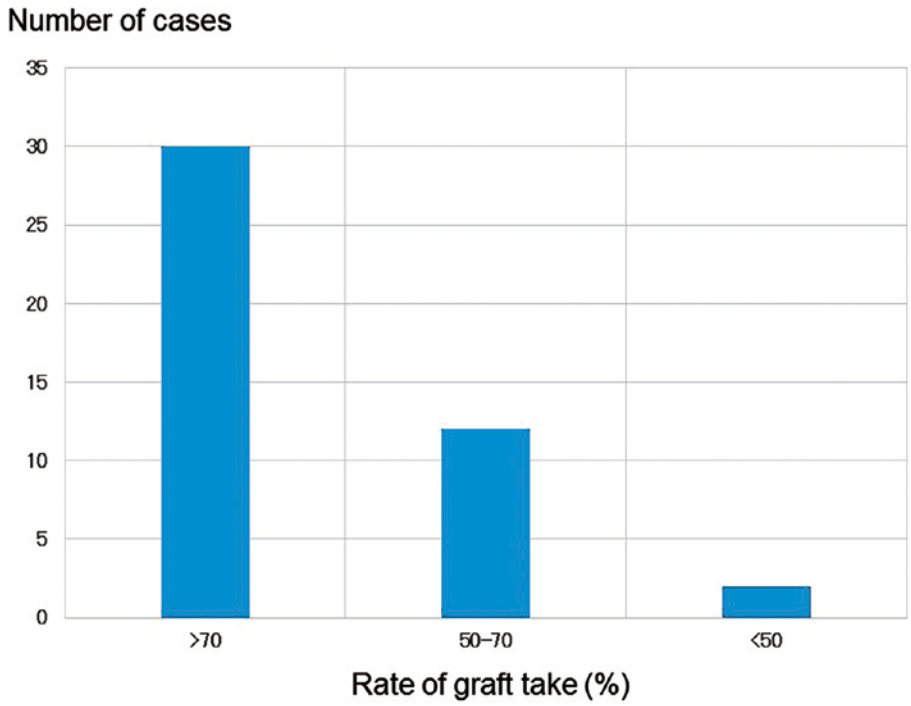

Fig. 2. Evaluation of graft take at the moment of uncovering the NPWT closure : The rate of graft take was classified into 70–100%, 50–70% and 0–50%, respectively.

(Fig. 4a), which discharged purulent material from an underlying abscess. After the diagnosis of chronic pyoderma, excision of the lesion was performed within the depth of superficial fascia (Fig. 4b), which was then followed by split-thickness skin grafting using NPWT (Fig. 4c). 2 months after NPWT, the skin graft was well-fixed without any hematoma or exudation (Fig. 4d).

Discussion

NPWT has many advantages for wound healing and graft survival[5]. First, NPWT maintains good apposition between the graft and the wound surface. Second, NPWT prevents the accumulation of hematoma or seroma in association with continuous removal of wound fluid. Third, NPWT reduces the number of bacterial colonies. Last, NPWT promotes vascularization and stimulates the formation of granulation tissues. Collectively, when NPWT is performed in parallel with skin grafting, NPWT is expected to help promote graft take and may reduce the risk of wound contamination in patients who are less compliant. This becomes particularly important for patients necessitating skin grafting in irregularly contoured regions.

In consideration of the above-mentioned benefits, in this study, for the treatment of skin tumors or intractable skin ulcers, we applied NPWT on the circumstances in which a skin graft must be placed on less-than-ideal conditions such as an extremely uneven wound bed surface on the contours of the body. As expected, NPWT showed satisfactory results due its close contact ability, although was significant graft loss in 2 cases in which skin grafts were placed on the heel. The patient was satisfied with increased mobility after surgery and we were satisfied with the ease of the surgical techniques and convenience of the postoperative management in comparison with the former routine treatment. All patients were discharged from care without requiring re-grafting, indicating that graft take was managed successfully without complications. While NPWT is likely

Fig. 3. (a) Cutaneous squamous cell carcinoma on middle and ring fingers. (b) Excision of the lesioned skin on middle finger. (c) Excision of the lesioned skin on ring finger. (d) Full-thickness skin grafting on the lesioned area. (e) 3 days after surgery. (f) 3 months after surgery.

to be a promising alternative for securing skin grafts to the wound bed, further studies will be required to elucidate the ideal conditions of performing NPWT, especially for surgery of skin tumors or intractable skin ulcers on the contours of the body.

Our study has the weakness of being a retrospective review and of observational nature. Our evaluation of the graft take lacked a control group to compare NPWT to traditional treatment and might include the risk of observer bias influencing exact estimation. Therefore, while our study suggests possible indication that the use of NPWT is a promising alternative in skin grafting on the curved body parts, the body of evidence available is insufficient to conclusively prove an additional clinical benefit of NPWT. Furthermore, according to the available evidence to date, the scientific evidence of NPWT to heal wounds remains uncertain[6,7]. Nevertheless, the absence of evidence does not deny that the use of NPWT is a promising alternative for the treatment of skin tumors or intractable skin ulcers on the curved body parts.

In the future, clinical trials with a rigid and objective index based on strict criteria for fixed term, follow- up period and reliable evaluation methods are warranted to clarify the exact benefits of NPWT in skin grafting. Namely, NPWT system should be compared to the Tie-over dressing technique using the following parameters :

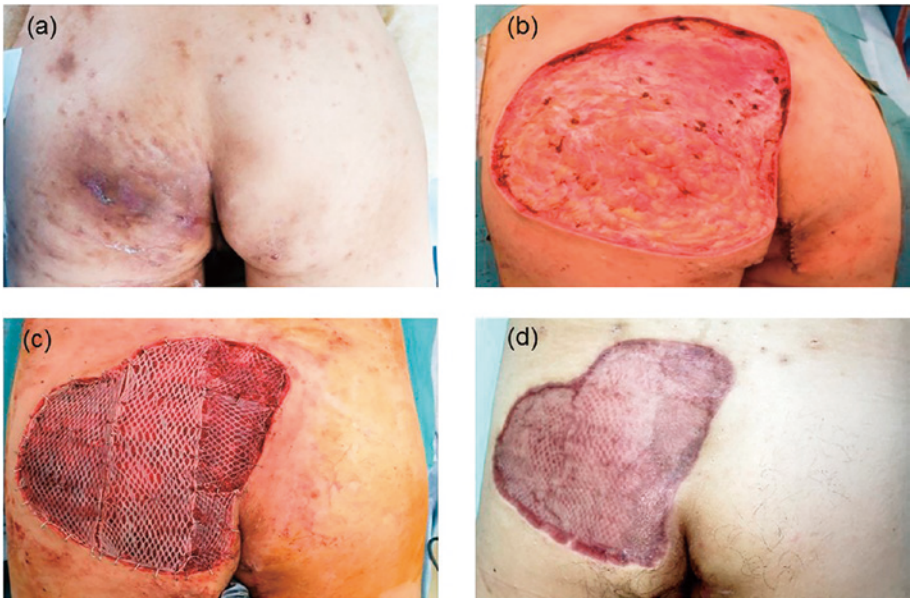

Fig. 4. (a) Chronic pyoderma on the left buttocks. (b) Excision of the lesioned skin. (c) Split-thickness skin grafting on the lesioned area. (d) 2 months after surgery.

(1) ease of the application (the length of time to apply dressing), (2) efficacy of the application (the percentages of graft take on 7th and 14th day post-surgery), (3) level of pain perceived by the patient (VAS pain scores at 1st, 7th and 14th day post-surgery), (4) complications (presence or absence of infection, skin maceration or breakdown), and (5) cost burden (the average co-payment being treated with tumor resection and skin grafts). With the given parameters in the evaluation of the two dressing techniques, it would be concluded that the NPWT system was more efficacious, with less discomfort and less costly, compared to Tie-over dressing in the integration of skin grafts.

Collectively, further improvements of NPWT technique, which include the development of both interface materials for wound fillers and next generation devices, is warranted to clarify the exact benefits of NPWT. In addition, it is our hope that the elucidation of optimal pressure level and days of NPWT application will help ascertain the full potential of NPWT, those will lead to better care for our patients.

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None reported.

Conflicts of Interest

None declared.

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