A Case of a Chemical Burn Wound Treated by Suction Blistered Epidermal Grafting

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The patient was a 34-year-old male who had the dorsum of his right foot burned with strong alkali. Subsequently, the wound changed to an ulcer 3 days after the accident, and it was resistant to conventional treatment. After seventeen days of a granulation tissue-forming period, we applied a suction blistered epidermal graft using an intrinsic heating system we had devised.

Suction blistered epidermal grafting is a less painful method with minimal scarring that is applicable to various skin diseases and researches. However, currently used techniques require patients to be immobile for some time and it makes physicians and patients feel uneasy and uncomfortable. The time needed for the suction blister formation is dependent on many factors. Among them, the temperature and the suction pressure are the important factors that can be modified easily. So, we devised a suction device having the capability to heat itself and used a suction machine with a pressure meter. We applied this to the above patient.

We present a case of a chemical burn wound treated with suction blistered epidermal grafting. (Ann Dermatol 10:(1) 48~52, 1998).

Key Words : Suction blister, Epidermal graft, Ulcer

Historically, in 1964, Kiistala and Mustakallio first described and improved a suction blistering technique with very little trauma[1]. Since then, some related studies have been performed. Among them, studies by Evans and Naylor showed that suction blisters are more easily made on warm skin[2]. In addition, Peachey, in 1970, showed the relationship between skin temperature and the speed of suction blister formation, and confirmed that with in vivo testing[3].

Suction blisters had been developed and used mainly as a method for the surgical treatment of vitiligo[4,5,6,7,8], and as a kind of research tool in various fields[9,10,11,12,13]. This is becoming the more popular surgical technique these days, because of the advantages over other methods. However, because of the disadvantages, most notoriously, a long immobilization time, the clinical application of this method has been limited to selected diseases. As a result, we tried to improve the method of producing suction blisters. So we devised an instrument with an intrinsic heating system that would aid in forming the suction blisters easily. The usefulness of this device was confirmed by suction blistered epidermal grafting in our patient. Chemical burn-induced skin ulcers are sometimes resistant to ordinary treatments, demanding skin grafts. We present a case of a chemical burn wound treated with suction blistered epidermal grafting.

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CASE REPORT

The patient was a 34-year-old male who had a deep round coin-sized ulcer on the dorsum of his right foot (Fig. 1). He had burnt his foot seven days previously with a strong alkali solution which turned out to be NaOH (Fig. 2). The wound changed to a necrotic ulcer three days after the ac-

Table 1. The result from heated suction blisters on normal volunteers (Room temperature 23℃, humidity 40 %)

Patient number		1	2	3
Sex/age		M/38	M/30	M/35
Skin type		V	Ⅲ	Ⅳ
Pressure(barr/mmHg)		0.4 / 228	0.5 / 285	0.6 / 342
1st vesicle	heating	21 min	12 min	9 min
	non-heating	42 min	30 min	22 min
Confluent single bullae	heating	32 min	18 min	32 min
	non-heating	68 min	36 min	58 min

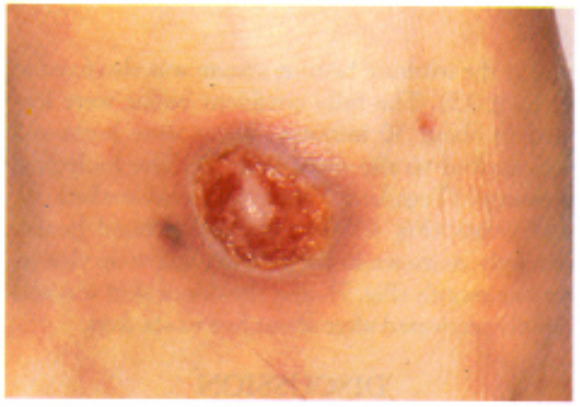

Fig. 1. A deep round coin-sized ulcer with slight dusky base.

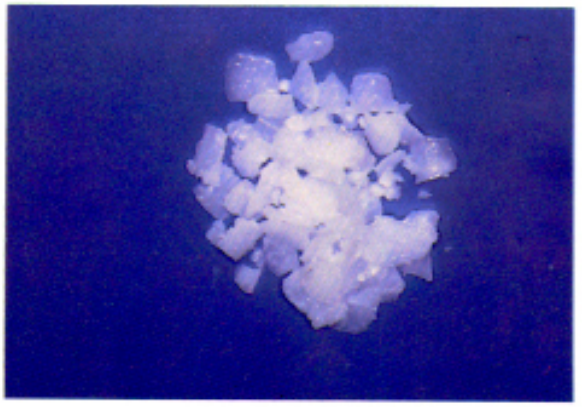

Fig. 2. White crystals of NaOH on blue background.

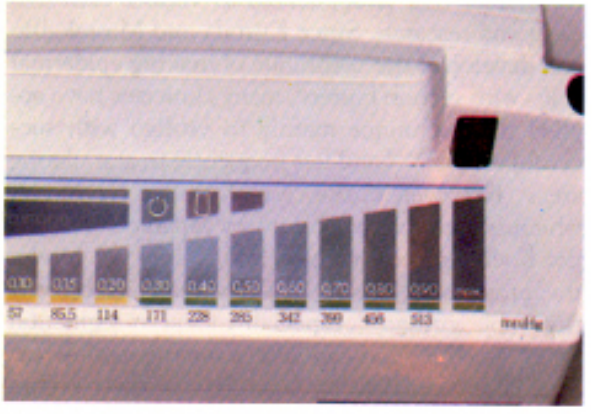

Fig. 3. A portable suction unit.

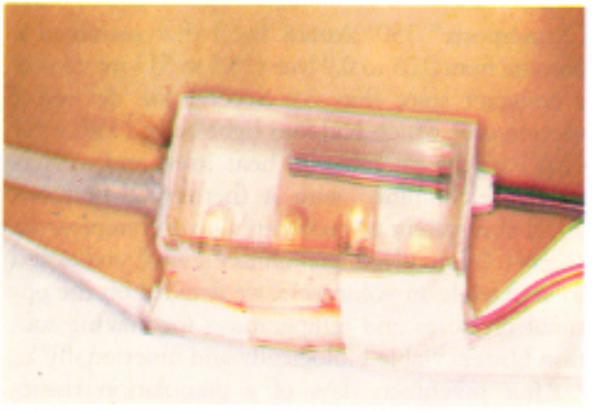

Fig. 4. The intrinsic heating system applied on the patient.

cident, and it was resistant to conventional treatment. As a result, he visited our department. He had no major medical illness and was a healthy factory worker. On routine laboratory examinations, there were no specific abnormalities.

During that time, we devised a method that could improve the efficiency in making suction blisters. First, we introduced a portable suction device

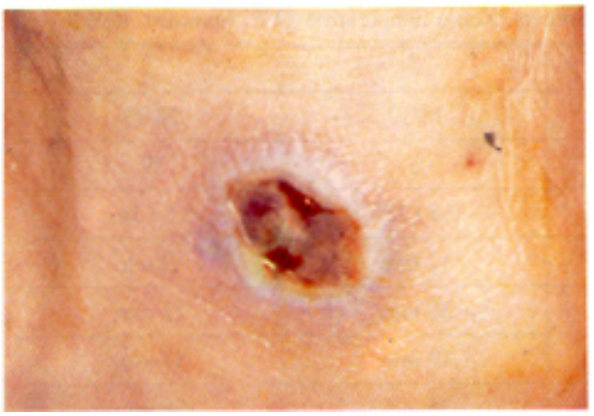

Fig. 5. The ulcer covered with harvested epidermis.

Fig. 6. The follow-up photograph of the ulcer after the dressings were removed.

Fig. 7. The wound completely healed.

(Atmorporte® 350, Atmos Inc.) that sustained a pressure from 0.05 to 0.9 barr (28.5 to 513 mmHg) at a constant state (Fig. 3). Second, we devised a suction unit which had four light bulbs (3W, total 12W) in the chamber to heat itself and a thermometer combined with a thermostat that enabled this system to maintain a given temperature (Fig. 4). Previously, in preliminary animal studies and in vivo trials on volunteers, we decided on the optimal pressures and temperatures for making suction blisters viable biologically and functionally[14].

After seventeen days of a granulation tissue-forming period by second intension, we applied a suction blistered epidermal graft using the device with intrinsic heating system we had devised. After antiseptic preparation of the lower abdominal wall, the intrinsic heating unit was applied to it. The suction pressure was maintained at 0.5 barr that is equivalent to 285 mmHg, and the temperature at the intrinsic heating system was also fixed at 41℃(±0.5). The fully confluent bullae were formed in about 30 minutes. These were harvested and applied to the ulcer (Fig. 5). The biological dressings (Tegaderm® were left undisturbed for seven days (Fig. 6). The patient's wound healed promptly, as shown in the patient's follow-up visit after one month (Fig. 7), and the donor skin was also rapidly recovered after about five to six days.

DISCUSSION

Suction blistered epidermal grafting is the less painful and minimally scarring method with very little trauma that is applicable to various skin diseases and research. Since Kiistala and Mustakallio had developed the technique of making epidermal grafts with suction blisters[1], many clinicians have applied this technique mainly to vitiligo with successful results[4,5,6,7,8] and less frequently to granulating areas[1]. However, in the case of vitiligo treatment, which is a sort of physical injury capable of making the Koebner phenomenon, and it does not hinder the progressive nature of the disease itself, only the stable vitiligo[5,15], especially, focal or segmental types[6] are the good candidates for this technique. The large skin defects, regardless of their origin, from burns[1], trauma, leg ulcers, necrosis following ischemia, infection of surgical wounds and so on, demand the time for granulation formation before any kinds of grafts are given. It is the right time for the graft when the wound base is filled with granulation tissue and all possibility of secondary infection is excluded. The epidermal grafts are su-

perior than other grafts e.g. split-thickness skin grafts, full-thickness skin grafts, etc. in view of donor morbidity. It leaves no scarring at the donor site[1]. Additionally, it is a relatively minor surgical procedure rarely requiring anesthesia. It could be the most important advantage for patients with high anesthetic risk.

However, currently used technique requires the patient to be immobile for a long time, and it makes physicians and patients feel uneasy and uncomfortable. So, many physicians adopted other methods such as punch biopsy grafts, minigrafts, autologous cultured composite skin substitutes, autologous cultured/noncoltured melanocyte grafts, minipigmentation, and combination of dermabrasion and epithelial sheet grafts[5,16,17,18] in treating vitiligo patients. However, the suction blistering technique remained to be improved.

The time needed for the suction blister formation is dependent on many factors such as sex, age, suction pressure, temperature, skin site or skin thickness[3,19] and possibly, skin types. Among them, the temperature[3] and the suction pressure[19,20] are the important factors that can be modified easily.

So, we devised a suction device having the capability to heat itself by the intrinsic heating system, and used a suction machine with a pressure meter that could sustain steady pressure. After confirming the advantages of heated suction blisters by animal studies performed on ginea pig skin, and in vivo tests on normal lower abdominal skin of healthy volunteers (table 1), we applied this to the above patient[14].

In conclusion, this suction blistered epidermal graft using the device we devised showed the effectiveness and convenience in treatment of skin defects requiring grafts.

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