Clinical Observation on Burn Skin Regenerative Repair

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【Abstract】Objective: To summarize the clinical evolution process of regeneration and repair of various deep burns.  
Methods: Through statistics of registration data of 12,500 cases of inpatients and outpatients treated in 1987 to 2002 by our hospital, combined with phased summarization of data, we elaborate the basic situation of patients and the healing process of wounds treated with moist exposed burn ointment (MEBO).  
Results: The maximal burn surface area was 99.8% of TBSA, the oldest patients was 88 years old, and the youngest was only two days old; superficial wounds of deep II-degree burns healed in two weeks after injury, without any scars; deep-type wounds of deep II-degree burns healed in three weeks, and the scar forming rate was 15%; superficial III-degree wounds should be treated with skin tension releasing, ploughing and weeding therapy, and the scar forming rate was 25%; Deep III-degree burns should be surgically closed, and the chief therapeutic drug of all wounds was MEBO.  
Conclusion: Using MEBO to treat deep burns plus the aid of ploughing and weeding therapy or surgical skills could facilitate the regeneration and repairing of wounds and reduce scar forming rate.

【Key Words】Burn wounds; Moist exposed burn ointment (MEBO); regeneration and repair of skin, curative effect

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The regeneration and healing of burnt skin has two patterns, especially deep burns, one is physiological healing and the other is non-physiological healing (pathological healing). The so-called physiological healing means the burn histiocytes regenerate to normal morphosis and function, and heal without scars. Non-physiological healing means the morphosis and function of burn histiocytes fail to regain normal healing, and heal with scars. In the light of the requirements of skin regenerative medicine, that burn wounds reach physiological healing is the purpose of burn care, and the moist exposed burn ointment (MEBO) and physiological moist environment developed by Xu Rongxiang is the basis for realizing regeneration of skin. Our hospital has obtained rich clinical experiences since the application of this therapy in 1987. Below is the summary:

1. Clinical data

1.1 General data

Our hospital used moist exposed burn ointment (MEBO) to treat 64,521 burn patients in the last 16 years, among them, 12,500 cases were inpatients and 52,021 cases were outpatients. These data takes inpatients as statistical resources, the maximal burn surface area was 99.8%, the oldest patient was 88 years old, and the youngest...
patient was only two days old. The injuries were caused by flame, hot liquid, electricity, chemicals, combustion and explosion. The burns extended all over the body, and the most frequent areas burned were faces, both hands, chest, abdomen, four extremities and perineum. The depth of burns covered various depths of the three-degree classification method, but the emphasis of this article was the therapeutic analysis of deep burns.

1.2 Methods and results

All patients were treated with moist exposed burn ointment, and late hospitalizing patients or patients receiving conventional therapy before were subject to treatment with MEBO immediately. Wound healing time and patients’ prognosis were the major observation indexes. Superficial II-degree wounds generally healed in seven days, and the longest healing time was not more than nine days, and their healing had no scars. Superficial wounds of deep II-degree burns mostly healed in 14 days after injury, and the longest was not more than 18 days, and their healing had no scars. Deep wounds of deep II-degree burns generally healed in 20 days after injury, and the longest was not more than 24 days, a few wounds healed with punctuated or little sluglike scars (accounting for about 15%), but most of them had no impact on function. Superficial III-degree burns mostly healed in 30~40 days, and the scar forming rate after healing was 25%, most scars were cord-like, mild dysfunction was seen in 10%, and moderate dysfunction in 5%. The wounds of deep III-degree burns generally needed the operations for therapy, the scar forming rate after healing was 40% and 20% of healing had impact on function.

In the statistical result of 1,025 cases of extensive burn care, we found they accounted for 8.20% of the overall inpatients. The largest burn surface area was 98%, the largest burn surface area of III-degree burns was 76%. 839 cases were cured, 150 cases presented moderate response, and 36 cases died, more than half of the cases that presented moderate response and died abandoned therapy or discharged themselves, an obvious increase compared with the statistics of domestic and foreign extensive burn healing rate. No toxic side effect was found among all cases during their administration, which demonstrated MEBO was safe in application in extensive burn patients.

Through observing the analgesic effect of 840 cases with burns wounds of different degree after administration in the early period, we found 520 case reached the full analgesic effect after 5 minutes of administration, and 339 cases achieved basic analgesic effect, 20 cases obtained the effect of reducing pain, and 1 case still suffered from pain. The pain in dressing change of wounds was far lighter than that in conventional therapy. In comparison treatment of both lower extremities of 10 cases of patients, we used moist exposed therapy with MEBO for one part, one parts was treated with antibiotic occlusive dressing and one part was treated with silver sulfadiazine (SD-Ag) therapy. When treated with MEBO, patients had no algesia, also presented no fear; while treated with occlusive dressing, patients feared the dressing, and the heart rate of three patients came to 120times/min when changing dressing, and the pain lasted up to 30~60 minutes when changing dressing; for dry therapy, the frequency of dressing change was 6~8 times each day, and the time for
dressing changing was 5′~15′, thus discontinuous pains occurred frequently.

The observation of wound infection degree from the angle of burn skin regenerative medicine, mainly took the following as judgment indexes: the surrounding of wounds occurred swelling and thermal pain, there was empyema under crust, and number of cases with discontinuation of the wound petechia and growth and repair. Totally 1,482 cases were observed, and their burn surface area was 30%~50%, only 14 cases has the aforesaid circumstances, an incidence rate of 0.95%, according to statistics of conventional therapy, its wound infection rate was about 40%. The infection rate of this group was obviously lower than that of conventional therapy.

2. Clinical observation of repair of wounds

Burn skin regenerative medicine takes the level of damaged skin tissue from the exterior to the interior to decide the depth of burn, which can be divided into the cuticular layer burn of the outmost layer (superficial burns are I-degree and deep burns are superficial II-degree), the dermal layer injury under the epidermis (superficial burns are those of deep II-degree, and deep burns are those of deep II-degree), and subcutaneous superficial injury (commonly called III-degree injury) and muscle and skeletal injury (deep III-degree injury), i.e., the rules of three degrees and six divisions established by Xu Rongxiang. But pathological results cannot be used to decide the depth of burn in clinical practice, the combination of macroscopic observation and physical inspection is adopted to decide the depth of various burn wounds, and its indexes include color and thickness of dead skin festering, blister size and cleanness of blister liquid, wound temperature, algesia, elasticity, difference of swelling degree etc. Wounds treatment must ensure wounds have such core technologies of burn skin regenerative medicine as a three-dimensional moist environment, smooth drainage, persistent drug supply and clearance without injury etc.

2.1 Epidermis burns

Superficial layer burns of epidermis (I-degree) can be embrocated with MEBO immediately after injury in default of swelling and exudation, once every four hours, and the burn wounds will heal in 2~3 days automatically, though pain is obvious, it will not cause systematic pathological change, thus superficial layers burns are usually not included in total burn surface area. Deep burns of epidermis (superficial II-degree) have exudates and swelling during therapy, blister tapping can be made for early debridement, and protective dead skin shall be applied with MEBO immediately, and this generally falls off after three days. Pain in wounds in early period of therapy is very obvious, and the application of MEBO can alleviate pain immediately. This type of wounds has no parabiotic tissue (blood stasis region), thus will not appear liquid (white emulsion will appear on wounds), debridement is unnecessary, adding drugs to 1mm thickness every four hours is acceptable, epidermic tissues will completely regenerate and repair after about 6~8 days, and color and form will be normal.
2.2 Dermal-injury (deep II-degree) burns

Their clinical treatment and outcome are comparatively complex, and disputes over its clinical treatment are great, dermal-injury burns can reach full regeneration and repair if they are treated according to the theory and methods of burn skin regenerative medicine, without any scar and dysfunction. There often will be scar formation and dysfunction if they are treated with conventional burn therapy.

The treatment of superficial layer burn of dermis (superficial burns of deep II-degree burns) requires protecting parabiotic tissues and making wounds superficial, embrocating MEBO immediately after injury and keep the wounds at 28°C~32°C, blisters shall be tapped to retain the blister skin, the dressing shall be changed once every four hours, and the dressing thickness shall be 1mm, skin fester will fall off after 3~5 days of administration, the wounds present pale red, i.e., the wounds has be made superficial to the healing result of superficial II-degree burns. The wounds liquefaction of this type of burns (white emulsion) is a special pharmacological action of MEBO, and shall be distinguished from so-called suppurative infection of wounds. The latter has swelling, thermal pain and dysfunction around its wounds, and exudates a mixture formed by dead epithelium, inflammatory exudates and bacteria whose toxicity is reduced due to MEBO after they leave the external layer of MEBO and cannot stay on the wounds for a long time, generally not more than one hour, otherwise there will be dipping (excessively moist) infection of wounds, thus prompt debridement without injury must be continued.

The deep layer injury of dermis impairs the deep layer of dermis and appendages of skin of subcutaneous tissues and forms a microcirculation stasis region, there is no blister or a few blisters on wounds with macroscopic observation, which show wax yellow or wax white, and show red or thick brown spots while passing through the dead layer. Because most nerve endings are damaged or dead, pain in wounds is not evident and skin temperature is low. The characteristics of this type of injury is that stasis tissues form an inflammatory infiltrating region after several hours of injury, and conventional therapy holds the inflammatory infiltrating region is the cause of secondary infection, and usually uses SD- Ag plus hot air drying therapy to make it dry and form a crust rapidly to reduce the inflammatory reaction, but finally wounds will deepen. But treatment with MEBT/MEBO will control or reduce the inflammatory region reaction after several hours of injury.

If extensive ploughing and weeding is conducted with ploughing and weeding knife before the early administration of MEBO, MEBO will permeate to the stasis tissues under the dead layer as soon as possible to make blood vessels smooth again and recover their physiological function, then the active ingredients of MEBO will make the inflammatory reactants neutralize repeatedly and excrete. Meanwhile MEBO makes parabiotic tissues regenerate, which effectively reduces and postpones the occurrence of systemic inflammatory response syndrome. The appearance of exudates after 24 hours demonstrates that deep microcirculation has recovered, the failure of appearance of exudates from wounds after 48~72 hours can be taken as the indicator of full-thickness derma injury and that parabiotic tissues are totally dead.
The normal time for liquefaction to appear is 4~6 days after injury. A piece of pH test paper can be used to test the wounds to determine whether wounds liquefaction process is normal and have infection signs, pH value ranging 7.3~7.5 are the most suitable. If pH is more or less than this range, in addition, if there are swelling and thermal pain around the wounds, wounds have petechia, body temperature and blood picture are high etc, all of which suggest that wounds have been infected. The processing method is to clear the dead tissues and liquefaction in time. When the dead layer is comparatively thick or has a soft crust, a blade shall be used to cut them thin, then MEBO shall be applied several times each day, generally normal liquefaction of wounds will be achieved after 3~4 days and infection will discontinue. The wounds liquefaction will be totally removed to clean in about 14~15 days, hereafter wounds will come to wound healing stage, and the wounds at this time shall be treated with MEBO to keep wounds moist and intact, epidermic cells will fully regenerate and repair after about 11 days, left and right stratum corneums will form basically after 30 days, and it is considered that protective treatment in the 30 days is the essential measure to prevent scars.

2.3 Ⅲ-degree burns

Burn wounds are leathery, dendritic blood vessel blockage can be seen on them, and the complete disappearance of algesia is Ⅲ-degree burn. In order to protect the appendages of skin surviving in subcutaneous tissues, skin tension releasing, ploughing and weeding therapy shall be used immediately after injury, with MEBO applied on the subcutaneous tissues, and MEBO can be used repeatedly after 24 hours of injury. Its therapeutic actions can be summarized as follows:

① Relieve dead layer as soon as possible to relieve pressure;

② Increase skin temperature as soon as possible and accelerate MEBO to become liquid to enter tissues;

③ Urge MEBO to exert its drug effect as soon as possible and save parabiotic tissues.

The occurrence of white, yellow or green liquefaction on wounds will last about 6~8 days, during this period, there may be fever, but the frequency of fever heat is 1~2 time at most each day, such shall not be considered as infection, wound debridement without injury still shall be enhanced and moist environment shall be kept, epithelized regeneration and repairing are generally achieved in 25~32 days. Hereafter the wounds come to restoration stage, which further makes skin tissues change to physiological healing, and the duration is about 6 months. The scar lotion for external use shall be used each day 3~5 times.

Deep Ⅲ-degree burns always impair muscles and skeleton, and conventional therapy caused many serious disabilities. In recent years plastic technicians use early reshaping to solve part of the questions, but there is no ideal therapy for the treatment of extensive wounds. Our hospital used burn skin regenerative therapy in recent
years. First we used MEBO to protect the wounds, supplied nutrients and ensured full drainage, all of which not only facilitated the growth of granulation tissues, but also avoided infection. For skeletal burn patients, the debridement and boring with skeleton exposed was used, then MEBO was used as nutrient to protect wounds, generally granulation tissues would grow at the bored region in 15 days and gradually expand to the surrounding bored region, then cover the exposed skeleton. A date would be chosen to conduct auto blade-thickness skin grafting or intermediate split thickness skin grafting to close the wounds. The rehabilitation lasting 6 ~10 months would be conducted after wounds were closed to decrease scar formation and keep good function.

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