EARLY EXCISION AND PROMPT WOUND CLOSURE IN BURNS
A REVIEW

*Mithilesh J. Sharma, M.D., M.S.

The large full thickness defects are associated with serious surgical fatalities of bacterial contamination, metabolic derangements, depletion of heat resistance and severe malnutrition. Mortality in burns is not due to thermal involvement of skin but due to open wounds created by necrosed skin and its secondary effects. It is necessary to close these defects immediately to prevent bacterial contamination and protein calorie deprivation. The topical antimicrobials and antibiotics effectively can limit the bacterial colonization but a more rational approach to the problem is necessary. i.e. rapid excision of devitalized tissue and immediate coverage of exposed wounds. The effectiveness of antibacterials is limited if the burned area exceeds 60-70 percent of the body surface.

Wound closure has also been a great problem due to the lack of available skin in the same patient and rejection of temporary allograft. Various means have been used to achieve prompt wound closure associated with the use of controlled environment of the Bacteria controlled Nursing Unit (BCNU), Nutritional Support, topical as well as systemic antibiotics in the treatment of massive thermal burns. Closure of burn wound should be the main goal in the management of burned patient. A method of prompt excision and immediage grafting at the same operation comparing with Silver nitrate treatment was used in 200 patients by J. F. Burke[4]. The patients included up to 65% of the body surface and the hospital stay was reduced tremendously with zero mortality.

Methods of Excision

The clinical judgement to determine the depth of the burn wound is the best tool in addition to various indirect methods available. A decision is made about a flame burn versus scald, clothed patient versus the bare, sensations and colour of the scar and time elapsed since the time of treatment,[24]. Various dyes and flourescin have been used to differentiate deep from superficial burn but sometimes in a deep burn, flourescin will not be visaulized in superficial portion even though the deeper tissues may be viable,[13]. Thermocouples are impractical because too many of them are needed. Infrared thermography is too expensive, however multispectral photographic analysis could be used.

Wound biopsy is a direct approach to confirm the depth of the burn as well as quantitative analysis of bacterial invasion. The use of ultrasound with a laser is a possibility in future to look at the burn wound. Various methods of excision have been devised depending upon the thickness of burn. In a full thickness burn cold steel, electrocautery, CO_2, lasers, plasma scalpels are now becoming available. Dr. Vistnes at Stanford preferred electrocautery, CO_2

*Department of Surgery, Mt. Carmel Mercy Hospital, 6071 W. Outer Drive Detroit, Michigan 48235

lasers are a bit expensive.[24] In partiala thickness burn, dermabrasion has been used by some and tangential excision with a dermatome by others. This excision is performed after the patient has been stabilized, that is 3-4 days later. Currently available commercial chemical debriding agents are not effective,.[13] Vistnes has mentioned about maggot farm in cleaning burns,.[24]

Several aspects of supportive care are important for successful excision. Maintenance of nutrition, physiologic and bacteriologic monitoring for selection of patients for excision, blood transfusions, intraoperative care and anesthesia.

Two main techniques are used for excision of deep dermal and full thickness burns. The first one is the fascial excision, which is direct excision of the entire thickness of the destroyed skin and subcutaneous tissue, down to the deep fascia. Complete hemostatis is necessary because the grafting of the wound is essential during the same operative procedure.[2] The second technique is called sequential eschar excision, and is employed when the burn injury is combined with deep dermal and full thickness injury without extensive involvement of the subcutaneous tissue. A freehand guided knife is used and burn eschar is removed in sequential layers until viable dermis is encountered. Hemostasis is essential as in the last technique. Grafting is performed immediately. Recently, T.D. Gant[10], has reported the enzymatic debridement and grafting in the deep burns of the hand. All second degrees hand burns are cleansed by removing debris with sterile water or saline. Sterile Travase ointment is applied directly over burn area. The ointment is covered with a fine mesh gauze and 4×4 inch gauze squares soaked in normal saline. A constant moist dressing is necessary for optimal action of the enzyme. Change of dressing is necessary for 3 times in 24 hours. Sutilaines bacterial enzymatic ointment is proteolytic and fibrinolytic enzyme produced by Bacillus Subtilis. The action of enzyme is best promoted in well hydrated moist environment. e.g. fresh burn wound surface.

Biological dressing and skin substitutes

The treatment of burns would change over night if a functional and reliable skin substitute and skin tissue culture techniques become available,[21]. This would enhance very early recovery of the patient with autologous healthy skin cultured in tissue lab.

The biologic Skin Substitute[22].

—Human Allograft (Homograft)
—Cadaver donor (Fresh)
—Cadaver donor (Frozen)
—Amniotic membrane
—*Xenograft* (Heterograft)
Living donor fresh
Frozen, radiated or dried
Tissue Derivatives
Collagen, sheet, fabric, or sponge
Bioplast fibrin.

Closure of bacteriologically acceptable burn wounds with homograft (generally less than 10^5 bacteria per gram of tissue) accomplishes vascular connections with the bed and may take. The dressings have demonstrated to reduce fever, pain, decreases evaporative water loss, restores function, increases appetite and general well being. It also decreases bacterial contamination and stimulates granulation tissue. It should be changed every forty eight to ninety six hours. If allowed to remain in place it begins to reject

and causes an intense inflammatory reaction, necrosis, dissolution and deleterious effects on burn wound[18].

Heterograft primarily from pigs is now extensively used for coverage of large burn wounds. It is readily available with low cost but its use is limited due to its short survival. The graft does not establish true vascular connection with the granulation bed. There is no evidence of host sensitization therefore the graft could be used as a temporary biologic dressing rather than a true xenograft. The mean survival of a skin allograft between healthy volunteers is 12-16 days[8]. Apart from the condition of graft bed or trauma to the graft. the survival is based on host's immunologic response to the foreign antigens which is based on two factors i.e. the degree of immune competence of the recipient and antigenic incompatibility between donor and recipient. The altered immune response may be responsible for prolonged graft survival which has been demonstratrated clinically as well experimentally[1, 16] if treated initially by primary excision, skin allograft and immunosuppression in severe burns,[14]. Different immuno-suppressive agents—like A.T.G., A.L.S., azathioprin, corticosteroids ensured adequate graft survival. ALS proved highly effective.

Amniotic membrane

The two surfaces of amniotic membrane-the outer shiny cuboidal epithelium provides watertight seal and the inner loose syncytium becomes vascularized on receptive bed. The membrane is more useful for temporary wound coverage than skin homograft[9]. Amniotic membranes are generally changed every forty eight hours until definitive procedure is performed. Spontaneous healing of partial thickness burn occurs in seven to ten days when aminotic membrane is applied. The omentum is too thick to be vascularized and hence it is not used.

Biologic Tissue Derivatives

Collagen base dressings offer many advantages with the better methods of purification. Its structure and immunologic chemistry are very well characterized and the alteration of its antigenicity is postible. The particular advantage of collagen is its hydrophilic surface for adherence and hemostatic effect. It has been used as a collagen--fabric composite film[11], reconstituted collagen strips[7] and many different forms like dermal collagen allografts, microcrystalline powder, collagen sponge graft[12].

The adherence of modified bovine collagen membrane is equivalent to intact skin and there is evidence that graft materials adhere to surface by Collagen-Fibrin media. These dressing stimulate the formation of vascularized granulation tissue. Bioplast Fibrin has not yet been evaluated in burn care.

Synthetic Dressings

A search for synthetic materials with ideal properties of skin has been made like polyvinyl alcohol, polyvinyl chloride, polyurethane, silicon polymer membrane, etc., but the adhesion to the burn wound, porosity and water vapor transmission, antibacterial activity have shown to be markedly inferior to true biological dressings. The most important function to be served by prosthetic material to a de-epithelized surface is adherence. This adherence of skin substitute to split thickness defects can reduce pain and limit infection with subsequent graft take. This adhesion to the raw surface must be strong enough to resist shear stresses. The adherence that occurs due to the entrapment

of the graft material in the coagulum on the tissue surface which determine the strength of the bond. If the prosthesis becomes incorporated in to the dermis it may require redebridement before new grafting[17].

The use of Frozen Skin Bank

Closure of large burned areas must be done with in a matter of weeks otherwise patients die due to metabolic abnormalities or infection. In an extensive full thickness burn the extent of skin available for grafting is not adequate to provide sufficient closure. In these situations two approaches are used. The first one is to use the temporary skin transplant to augment the available donor sites[3]; the second is the use of immunosuppression which delays the rejection of temporary transplants enabling additional donor sites to become available later.

It is well known that no alternative is available that can replace or approximate the biologic properties of human skin. During the past two decades, allograft skin has served a means of providing temporary physiologic wound closure which has been ennanced by the development of the frozen skin bank. [15, 23]. Skin procurement centres[19] and skin banks have developed in many institutions. Several researches resulted in improved methods of harvesting, treating and transporting, storing and evaluating tne preserved tissue[20].

Fresh allograft can be used as an intermediate allograft (long term allograft) as well as a biologic membrane[25] but unfortunately the demand for fresh allograft is not always matched by the supply of available cadavers. The skin bank makes it possible to harvest available autograft, allograft, freeze it and store it in a viable state.

Technique

Skin grafts are obtained from human donors or cadavers using a padgett dermatome set at 0.10 inch. Grafts are impregnated with 15% glycerol in Ringer's Solution for a period of two hours at 4°C,[5]. The split thickness sheets of skin are then laid on adaptic gauze and packaged in sterile, polyster polyethylene sealed film bags. These packages are then placed in dry ice chest at a temperature of -70°C for 12 hours. Then placed in a rack and brought into the bank, and maintained at -160°C with liquid nitrogen. When the frozen skin is needed for grafting, it is thawed rapidly in a 37°C water bath or microwave oven[25] before removal from the plastic package.

Nitrogen frozen skin is commonly accepted as a viable product[9] which adheres by vascularization and participates in normal healing. There is controversy over viability of frozen, stored skin because of the cellular trauma of freezing and thawing process but the viability can be determined by organ culture and radioautography and assays of enzyme activity.

Experience with frozen banked autograft or allograft and freshly harvested autograft or allograft has not shown any significant difference. Skin allograft stored for longer or shorter periods are equally successful. The most useful adjunct to skin bank is the development of tissue typing. Using autologous lymphocytes it will be possible to identify the compatibility.

Banked skin provides all of the physiologic benefit of primary closure of a large wound, it makes it possible to close open wounds as an emergency procedure providing restoration of metabolic function.

References

1. Alexander, J. W., Moncrief, J. A., Alterations of the immune response following severe thermal injury, *Arch. Surg.*, 93:75, 1966.
2. Burke, J. F, Quinby, W. E., Early excision and prompt wound closure supplemented with immunosuppression, *Surg. Clinics of N. America*, 58 (6) : 1141-1151, 1978.
3. Burke, J. F., Contribution of Frozen Skin Bank to Treatment of Massive Burns. *Acta Med. Pol.*, 19 (11) : 924, 1979.
4. Burke, J. F., Tne benefits of prompt excision, *The Journal of Trauma*, 19 (11) 19 (11) : 924, 1979 924, 1979.
5. Burke, J. F., Quinby, W. C. *et al. Ann. Surg.*, 186 (3), 377, 1977.
6. Bondoc, C. C. ; Burke, J. F., Clinical experience with viable frozen human skin and a frozen skin bank *Ann Surg*, 174 : 371 ; 1971.
7. Copenhagen, H., A new collagen tape in reconstructive surgery, *Brit. J. Surg.*, 52 , 897 ; 1965.
8. Cosimi, B. A., Burke, J. F., Russell P. S., Transplantation of Skin, *Surg. Clinics of N. Amer.*, 58 (2) : 435-451, 1978.
9. Douglas, B., Conway, H. *et al* : The fate of homologus and heterologous chorionic transplants as observed by transparent tissue chamber technique in the mouse *Plast Reconstr. Surg*, 13 : 125, 1954.
10. Gant, T. D., Tne early enqymatic debridement and grafting of deep dermal burns to the hand, *Plastic and Reconstructive Surg.*, 66 (2) 185-189 ; 1980.
11. Guldallian, J., Jelenko, C., *et al* A comparative study of synthetic and biological materials for wound dressings, *J. Trauma*, 13:32 ; 1973.
12. Hait, M. ; Stark, R, *et al* : Microcrystalline collagen as a biological dressing, vuscular prosthesis, and hemostatic agent, *Surg Forum*, 20:51 ; 1969.
13. Jurkiewicz, M. J. : Consensus Summary on Excisional Therapy, *Journ. of Trauma*, 19 (11), 933-934 ; 1979.
14. Kouman's, R. K. ; Burke, J. F., : Skin allograft and immunusupression in the treatment of massive injury, *Surg.*, 66:89 ; 1969.
15. Malinin, T., : University of Maimi tissue bank : Collection of post-mortem tissue for clinical use and laboratory investigation, *Transplant proc.*, 8 (Supp 1) : 53 ; 1976.
16. Ninnemann, J. L. ; Fisher, J. C. ; Frank, H. A. Prolonged survival of human skin allografts following thermal injury, *Transplantation*, 25 (2) 69-72 ; 1978.
17. Oliver, R. F. ; Grant, R. A., *et al.* Incorporation of stored cell free dermal collagen allograft in to skin wounds a short term study, *Brit. J. Plast. Surg* 30:88, 1977.
18. Peters, W. J. : Biological dressings in Burns—*A review*, *Annals of plastic Surgery* 4 (2) 133-137 ; 1980.

19. Roberts, M. : The role of the skin bank, *Ann Roy Coll Surg Engl*, 58 : 70 ; 1976

20. Robson, M. C. ; Krizek, T. J. : Predicting skin graft survival, *J. Trauma*, 13 : 213 ; 1973.

21. Tavis, M. J. ; Danet, R., : Currentt Status of Skin Substitutes, *Surgical clinics of N. America*, 58 (6), 1233-1248 ; 1978.

22. Tavis, M. J. ; Thorton, J. W. ; *et al* : Graft adherence to de-evpihelialized surfaces : A comparative study, 184 : 594, 1976.

23. Trier, W. C., Sell, K. W. : United States Navy Skin bank, *Plast. Reconst. Surg*, 41 : 543 : 1968.

24. Vistnes, L. M. : Methods of excision, *The J. of Trauma*, 19 (11) 924-925 ; 1979.

25. Wachtel, T. L. ; Ninnemann, J., *et al* : Viability of Frozen Allografts, *Am. J. of Surgery*, 138, 783-787 ; 1979.