Progress in the Surgical Treatment of Severe Burns

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Despite the fact that no radical departures have been made in recent years from traditional methods of treating severe burns, we feel that multiple minor improvements in technique and the development of a sound system of treatment have significantly lowered mortality and morbidity. In almost every country in the world severe burns continue to constitute one of the major forms of trauma, requiring efficient, well-timed, intelligent therapy. It is our purpose in this paper to present a standardized technique in handling severe burns and present a detailed study of two cases to illustrate the program presented.

GENERAL TREATMENT

The majority of severe burns are first seen by a physician in the emergency room of the hospital where facilities and trained personnel are available to institute immediate, orderly, progressive, purposeful treatment. Here an immediate, accurate appraisal of the patient should be made, and life-saving therapy initiated immediately. Intravenous morphine or demerol may be given to relieve severe pain; nasal oxygen may be administered to decrease hypoxia; and the adequacy of the airway may be evaluated. If there have been severe flame burns around the face and neck with resulting laryngeal edema, a tracheotomy should be done. We have long been the protagonists of the transverse tracheotomy incision to decrease future scarring.

In third degree burns involving over 20 per cent of the body surface, an immediate phlebotomy is performed on an extremity free from burn under rigid aseptic precaution. A polyethylene catheter is introduced which becomes the patient's life-line, and an intravenous infusion of electrolyte plasma or plasma expander is begun. The patient is immediately typed and cross-matched for 1500 cc of whole blood, and a hemoglobin and hematocrit determination are done immediately. The patient is catheterized and the urine measured in volume, checked for specific gravity, and sent to the laboratory for analysis. An indwelling Foley bag catheter is placed in position and clamped with a small hemostat. The patient is placed in Trendelenburg position. During this period of preparation the nursing staff is secured burn record forms which facilitate the gathering of all pertinent information about the burn patient on one sheet. This record carefully tabulates intake and output, urine volumes and specific gravity every two hours, hemoglobin and hematocrit levels every two hours during the first 48 hours, temperature, respiration, and drugs administered. It is difficult to emphasize sufficiently the importance of keeping very accurate records in severely burned patients.

LOCAL TREATMENT

When shock has been controlled, our attention is directed to care of the burn area. An accurate appraisal of the extent of burn has already been made and recorded, this appraisal assisting materially in determining the nature of the local treatment. In general, we have preferred to use the exposure technique in burns of the face and genitalia, and in some instances, non-circumscribing burns of the trunk, reserving the closed technique for all other areas. From the beginning, all personnel in the emergency room are capped and gloved and great care is exercised to avoid any contamination of
the wounds themselves. As soon as the patient is admitted, sterile sheets are applied until attention can be given to the burn surface. When the patient's condition is satisfactory, the burned areas are gently cleansed with a G-11 soap solution without attempting any major debridement. Ragged burn tissue is gently trimmed away and blisters opened only when they are large ones. Furacin-vaseline gauze impregnated in fine mesh gauze rolls is then applied to the burn surface, followed by conforming burn rolls of gauze liberally applied. In recent years we have been using Johnson Cling bandages very effectively, finally covering the area with Curon elastic bandage.

These patients are now placed on a Stryker frame in order to facilitate turning every three hours. Frequent rotation of the patient is essential in the prevention of pulmonary edema. At this point a polyethylene tube is frequently inserted in the stomach through the nose and left in position for feeding. It is extremely difficult for severely burned patients to eat, and the burn, together with the administration of many drugs, frequently combine to make adequate feedings by mouth almost impossible. We have, therefore, from the beginning, employed the Barron food pump in order to administer much needed mineral and vitamin supplements and early initiate a soothing passage of bland food through the alimentary tract.

The physician may now plan a sustaining medical attack on the problem, administering tetanus toxoid, appropriate antibiotic therapy, antiemetic drugs if indicated, and sufficient narcotic to keep the patient comfortable. We have usually used equal amounts of plasma and blood and electrolyte, insisting that one physician only govern the intravenous fluid therapy. In our experience, the use of cortisone has only complicated our appraisal of the degree of sodium depletion in a severely burned patient, and we have reserved such therapy only for the most critically burned individuals.

After about a week most burn dressings become moist if they cover third degree areas. It is therefore, in our opinion, wise to redress the burns, and repeat the dressings every four or five days thereafter until separation of the eschar has occurred. In the beginning there is relatively little pain in dressing the burn, but as the eschar begins to separate, pain increases. We continue to apply the furacin-vaseline gauze, finding that the combination used in equal parts impregnated in fine mesh gauze keeps the burn scrupulously clean and does not tend to adhere. In small children we usually employ some anesthesia from the very beginning.

**SKIN GRAFTING**

In general, patients are ready for skin grafting at the end of the third week, or in some instances, between the third and fourth week of the burn. We have preferred to use the Barker vacuette, giving rapid coverage to very large surfaces by the application of postage stamp size grafts in a checker-board pattern. We have avoided debridement of eschar in severe burns since it only leads to additional blood loss in an already anemic patient. Grafts are cut thin at approximately .008 of an inch and initially as large an area as possible is grafted. Care is exercised, whenever possible, to avoid putting postage stamp grafts over kinetic areas. Here, such as in the popliteal space and in the antecubital space, sheets of skin are placed accurately in position. The postage stamp grafts are held in position by the application of furacin-vaseline gauze, and the usual pressure dressing is applied. In some instances we have utilized post-mortem homografts to reduce mortality in extensive burns. The families of potential skin donors are most cooperative when it is explained that the individual who dies may save the life of another person, even after his death. Where there is very little donor area available and the condition of the patient is poor, a "biological dressing" may be life-saving. The average homograft may be expected to survive approximately three to five weeks, after which there is gradual liquefaction of the grafts. One may then proceed with autogenous skin grafting in the usual fashion. We have also used placental membranes on granulating beds with indifferent success. In general, we feel that the cadaver grafts are far preferable.
The following case reports will illustrate the principles of treatment which we have outlined in the preceding paragraphs.

**Case 1**

H.P., a four year old girl, sustained extensive burns to that portion of her body covered by a short-sleeved nylon dress, a tee-shirt, and panties, which were ignited while she was lighting a trash fire. Immediate appraisal of the burn showed an estimated 80 per cent of the total body area involved, sparing the face and feet. Of this area, 75 per cent was classified third degree burn.

Emergency treatment consisted of administration of morphine sulfate for pain and sedation, cut down on the right internal saphenous vein at the ankle for type and cross-match, base-line hemoglobin and hematocrit, and route for intravenous fluids. A Foley catheter was inserted and the first urine specimen was submitted for complete urinalysis. The extensive circumscribing burns of the torso and extremities demanded closed treatment which was accomplished with furacin compression dressings following gentle cleansing with G-11 preparation.

Upon arrival on the floor, the child was placed with arms abducted, on a Foster bed and in an oxygen tent. The first maneuver was to prevent servere contracture about the axilla, to facilitate turning, and to prevent hypostatic congestion. The latter maneuver for temperature, humidity, and oxygen control. She received intravenous cortisone and antibiotics

Intravenous fluid therapy, including blood, plasma, dextrose, and electrolytes, was based on clinical findings, namely bi-hourly hemoglobin, micro-hematocrit, urine volume and specific gravity, and oral intake, rather than by rule of thumb. These orders were the responsibility of one physician. During the first 24 hours, a total of 2675 cc of fluid was administered, including: 500 cc blood, 1050 cc plasma, 750 cc oral fluid, and the remainder, dextrose and water and saline. The hemoglobin rose to 20.5 gm, the hematocrit to 53 per cent, eight hours after the patient was admitted. At the end of the first hours, the patient concentrated urine to a specific gravity of 1.020. The highest specific gravity, 1.030, was reached the second day, which coincided with a hemoglobin of 19.8 gm, and a hematocrit of 60 per cent. Total fluid intake this day was 1350 cc, including: 350 cc blood, and 200 cc plasma.

Hemoglobin and hematocrit levels on the third day dropped to 17 gm and 55 per cent respectively. Urinary output was recorded at approximately 600 cc for each of the first two days and reached 950 cc third day.

A total of 14 procedures, each requiring general anesthesia, were performed. These included 7 dressings, without grafts, 4 autogenous free split thickness skin grafts, 3 homografts with 2 cadaver grafts, and 1 amion graft. Prior to the dressings and grafts, hemoglobin and hematocrit levels were obtained and whole blood was administered accordingly. After each procedure the Foley catheter was changed and nasal oxygen administered.

The first dressing change at 11 days post-burn demonstrated 66 per cent third degree burn, involving anterior neck both forearms, entire torso, both buttocks, and thighs, perineal region, and 9 per cent second degree burn, involving half of each forearm and leg, and the posterior neck, totaling 75 per cent of the body. The anterior abdominal wall, a portion of the anterior chest, and the back, were cadaveric in appearance, the area being dense and yellow brown. These areas were the last to slough and form granulations. It is believed that this thick tissue prevented much fluid loss. No debridement was attempted at this time. All of the dressings were removed and the burned areas were covered with equal parts of furacin-vaseline impregnated in fine mesh gauze. A voluminous pressure dressing was applied and held in place by elastic bandages.

Debridement of slough and eschar was accomplished at successive dressing changes, spaced at approximately 4-6 day intervals. On the 24th day post-burn, the first free split thickness skin grafts were obtained from the right leg, after healing of the second degree burn had taken place, and these were applied to other cleaned areas of the neck and axilla where contractures were most likely to be
deforming. Homografts from a fresh young cadaver were taken on the same day and banked in a solution of 250 cc N. saline, and 200,000 units of penicillin at a temperature of 8 degrees C. These were applied in strip fashion over the entire torso and thighs 4 days later. After 5 days the homografts demonstrated an estimated 85 per cent take and persisted for a period of 33 days. The patient received cortisone, antihistamines, and potassium chloride solution orally during this phase.

Various instruments were utilized to obtain the split thickness skin grafts. Of these, the most useful were the Reese dermatome, Barker vacutome, and the Ferris Smith knife. Skin yield was increased by the subcutaneous injection of sterile normal saline. The grafts were cut into 1 cm squares and placed in a checkerboard fashion over the burned areas to accomplish the greatest amount of coverage with the small amount of skin. Occasional grafts were banked in the refrigerator in saline penicillin solution. Autografts were obtained from the legs, alternately, after healing of the previous donor sites. The donor sites were dressed dry, employing Owen's surgical rayon and a compression type dressing.

On the 56th day post-burn, fetal membranes were taken at the time of a Cesarean section and were applied to the ungrafted areas. These demonstrated poor take at the end of four days.

Tub baths commenced on the 64th post-burn day, and the patient walked un-assisted on the 84th day. At this time she had almost complete coverage. Areas of approximately 1 cm remained uncovered and were allowed to be filled by proliferative margins.

Total hospitalization required: 145 days.

Case 2

I. B., a four year old girl, demonstrated 65 per cent of body area burned (50 per cent third degree burn), after ignition of a towel and clothing which had come in contact with flame of a gas stove. Initially the child received demerol, 20 mg I.M., for pain and sedation. Type and cross-match, hematocrit, and complete urinalysis determinations were requested. Bilateral internal saphenous veno-

tomies at the ankles were accomplished and saline and whole blood were soon started. The burn area was lightly prepared with G-II soap and dressed with voluminous compression dressings of furacin-vaseline impregnated in fine mesh gauze.

Later the child was placed with arms abducted on a Foster bed and in an oxygen tent. Antibiotics were administered and a skin test for horse serum was carried out, after which the patient received 1500 cc TAT. A special duty nurse was assigned to the patient and an accurate fluid balance record was maintained. Fluid therapy was based on bi-hourly hemoglobin, micro-hematocrit, urine, urine specific gravity, and output. This method of achieving balance has been most satisfactory.

Twelve hours after admission, hemoglobin was recorded at 19.0gm, hematocrit at 60 per cent, and urine specific gravity at 1.027. During this period the patient put out 20-40 cc of urine every two hours. At the end of hours, the child had received 3365 cc of fluid: of this 940 cc blood, 975 cc plasma, and 305 cc orally. Urine output was 540 cc. During the second 24 hours, the patient received 5250 cc of fluid: of this 210 cc blood, 1075 cc plasma, 1605 cc of dextrose and water and saline, and 355 cc oral fluid. Urine output was 1423 cc with a urine specific gravity of 1.010. Hemoglobin was 16.0 gm., and hematocrit was 52 per cent. Fluid therapy was reduced, and hemoglobin level was maintained at 14-15 gm and hematocrit at 40-50 per cent.

Dressings were changed at 4-6 day intervals with the exception of the first, which was accomplished at 9 days post-burn. The time interval between dressings was based on temperature, appearance, and odor of dressings. At each dressing change, the burn site and donor site were prepared similarly. The areas were first cleansed with septisol, G-II soap mixture, and aqueous zephiran, and then rubbed vigorously with ether, establishing a clean field. Basic dressings for burn sites consisted of a single thickness of fine mesh gauze, impregnated with furacin-vaseline, over which 4x8 dressings and abdominal pads were placed and secured with an elastic roller bandage. Donor sites were dressed with
Owen's surgical rayon, 4×8 dressings moistened with saline, and abdominal pads held securely with proper pressure by elastic bandages.

Debridement of devitalized tissue presented a suitable recipient site at 25 days post-burn. Split thickness skin grafts of .008 of an inch were taken from healed areas of second degree burn with the Reese dermatome and Barker vacutome, were cut into squares, and then applied in checker-board fashion over the properly prepared recipient areas. At successive staged grafting procedures, hypertrophic granulation tissue was removed easily with a tongue depressor, a very useful tool.

A total of 4 autogenous free split thickness skin grafts and one placenta dressing established complete coverage at 101 days post-burn. The child enjoyed tub baths at 28 days post-burn, and walked at 46 days post-burn. Contracture of the left axilla was corrected by Z-plasty, and the patient was discharged to Mary Free Bed Hospital for physiotherapy at 101 days post-burn.

CONCLUSION

A general approach to the treatment of the severely burned patient has been presented and a technique outlined for the general and surgical care of such patients which has proved highly successful in our hands. It is hoped that a summation of these methods may prove useful to others.
Fig. 1. Four year old girl who had sustained third degree burns of 70 per cent of the body surface three weeks after the injury. Granulations are firm and clean, and have been treated since the onset of burn with furacin-vaseline gauze.

Fig. 2. Cadaver hemografts have been utilized to cover all burned areas in this severely injured child. Long sheets of skin are applied as a "skin dressing" and sutured in position with immediate improvement in the patient.
Fig. 2. Normal saline is being injected into the thin legs of a burned child to facilitate the removal of skin grafts. "Blowing up" the donor leg with saline may be essential to the removal of adequate grafts.

Fig. 4. Six months after grafting, the "checker-board" grafts show typical mottling with very little contracture. After a year the grafted areas are usually smooth.