Acute Management of the Thermally-Injured Patient

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INTRODUCTION

A rational approach to the initial management of the thermally-injured patient begins with an understanding of the anatomy of the skin. By size and weight, the skin constitutes the second largest body organ system and comprises approximately 14%–17% of the body's total weight. Essentially, it is a covering consisting of two layers which rest on a padding of subcutaneous fat. The epidermis—the outermost layer—is relatively thin, measuring 0.06–0.08 ml in thickness. This layer is in contact with the dermis by means of multiple, irregular interpapillary ridges and grooves. This underlying dermis is approximately 20–30 times thicker and incorporates the nervous, vascular, lymphatic, and supporting structures for the epidermis, as well as the epidermal appendages (*Figure 1*).[1]

The depth of thermal injuries is determined by the combination of the burning agent, temperature, and length of exposure. The skin can maximally dissipate heat at a rate of 0.04 cal/sec/cm.[2] Variables affecting this tolerance include water content of the skin, its varying thickness within a given area, pigmentation, presence of hair, oil and dirt, and rapid changes in the peripheral circulation. The equilibrium point for normal skin is considered to be 44°C (111.2°F). Up to this point, a normal healthy adult can tolerate this temperature exposure for up to six hours without sustaining a thermal insult. The rate of cellular destruction, however, doubles with each degree rise in temperature from 44°C–51°C (111.2°F–123.8°F), so that between 60°C and 65°C (140°F–149°F) the rate of damage is ten million times greater than it is at 45°C. Thus, at 70°C (158°F) even fleeting exposure will produce total epidermal necrosis.[1,2]

Classification of Thermal Insult. Burns traditionally have been classified according to the depth and the extent of the body surface area involved. Formerly, depth was classified in degrees (*Figure 1*). In a first degree burn, destruction is superficial, i.e., involving only the epidermis. There is local pain and erythema. A systemic response, if present at all, is usually mild. Usually such burns require no treatment, except in very large burns of infants or elderly patients. Healing occurs spontaneously in three to five days without scarring. An example is sunburn. Resuscitation, when necessary, can be undertaken in the outpatient department, and the patient discharged after a few hours. Mild analgesics and commercially-available topical anesthetics may provide additional pain relief.

Second degree (or partial thickness, in present terminology) injuries involve both the epidermis and the dermis. The partial-thickness injury may be superficial, involving only the outer dermal layers and may heal within 10–12 days spontaneously. Deep second degree burns extend into the dermal papillae but the skin appendages are preserved. Provided nutrition is adequate and there is no infection, these burns may also heal spontaneously within three to four weeks. Spontaneously-healed, deep partial-thickness burns may result in poor quality skin, however, that is prone to breakdown in cicatrization. Therefore, skin grafting of such injuries is sometimes advisable in areas of functional or cosmetic importance, such as the back of the hand. The partial-thickness injury is characterized by blister formation, and tactile and pain receptors are usually intact, although the perception of the sensation of pain by burn patients can be an extremely variable phenomenon. These injuries are usually caused by flash, scald, or brief contact with hot objects.

Third degree (or full-thickness) burns involve the epidermis, the dermis, and occasionally the underlying subcutaneous tissue. The elasticity of the dermis is destroyed, giving the wound a dry, hard, leathery appearance. There is marked edema. These burns are usually painless to touch. All such injuries require grafting since all dermal elements have been destroyed. Usual etiologic agents are flame, high intensity flash, chemicals, electricity, and prolonged contact with the sources of heat.[3]

The appearance of burns can be extremely unreliable as a means of gauging their depth. Frequently the pigmentation of the site of thermal injury is merely a reflection of the pre-burn state of capillary dilatation. In our experience,

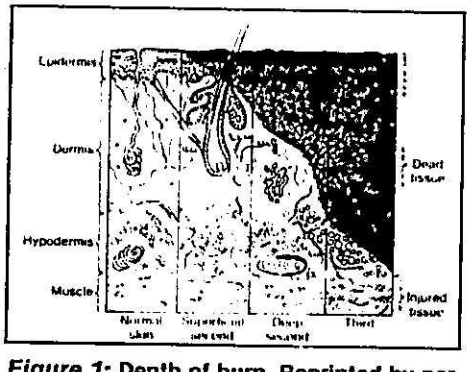

Figure 1: **Depth of burn. Reprinted by permission from *Burn Care for the House Officer*, Andrew M. Munster, MD. Baltimore, MD: The Williams & Wilkins Co., 1980.**

the most accurate way of predicting the depth of burn is by the sensation to the gloved hand of an examiner. Partial-thickness burns feel moist and watery and are generally tender to the touch, while full-thickness injuries are hard, dry, and insensitive. However, it takes a great deal of experience to estimate the depth of the burn and mistakes are made even by experienced clinicians.

The full appearance of a burn may not evolve for several days. The evaluation of the extent of thermal insult is categorized as the percentage of the total body surface area burned. There are two methods of evaluating the total burn size or extent. The simplest and most readily applicable is the rule of nines. The rule of nines states that the body is divided into areas corresponding to 9%, or multiples of nine, of the total body surface. The perineum represents the remaining 1%, as shown in *Figure* 2.

A more accurate method of assessing the extent of the total body surface area burned is the use of a Lund and Browder type of chart.[4] This chart is essentially the same as the rule of nines diagram, but it makes allowances for the changing proportions of the body surface area from infancy to adult life. For example, the head of an infant represents 20% of the total body surface area, while in an adult the same surface area represents only 7%. The best way to use the Lund and Browder chart is for a member of the medical team to make a careful sketch of the patient's burn injury following debridement after admission. The use of a colored pencil is helpful in distinguishing partial-thickness injures from full-thickness injuries. Then the various percentages of the body surface area which are burned can be added up to produce an accurate estimation of the total burn size.

Finally, the rule of the palm may be used to evaluate scattered burns or for determining the unburned portion of the body surface area in a major burn injury. The palm of the hand represents one and one-quarter percent of the total body surface area throughout life. Thus, either the patient's palm may be placed over scattered burn surface areas or the size of the patient's palm may be compared to that of the examiner's palm and appropriate adjustments made. The estimation of the extent of burn plays a major role in determining the fluid requirements of the thermally-injured patient in the resuscitative effort.

Natural History. The natural history of the major thermal insult is conventionally described in three phases: the

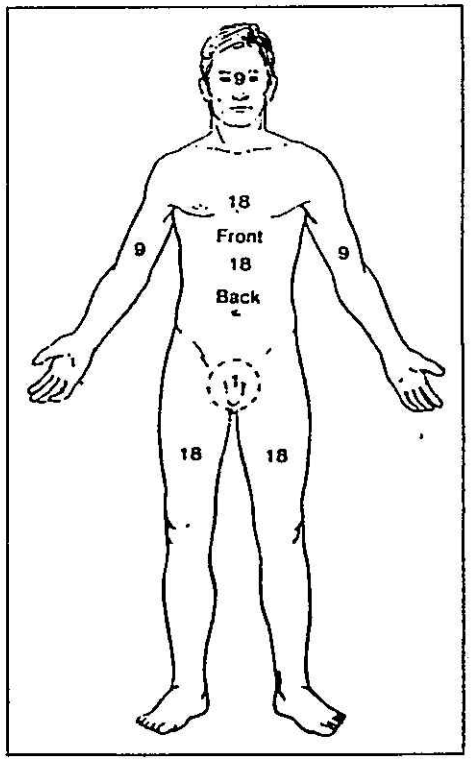

Figure 2: **The Rule of Nines. Reprinted by permission from *Burn Care for the House Officer*, Andrew M. Munster, MD. Baltimore, MD: The Williams & Wilkins Co., 1980.**

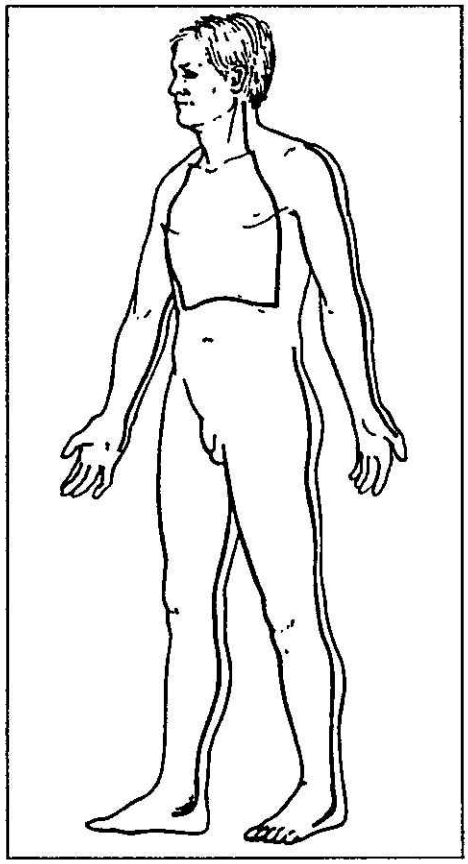

Figure 3: **Preferred sites of escharotomy. Reprinted by permission from *Burn Care for the House Officer*, Andrew M. Munster, MD. Baltimore, MD: The Williams & Wilkins Co., 1980.**

shock phase, the phase of eschar separation, and the phase of reconstruction. The shock phase is characterized by increased capillary permeability. This physiologic change is the result of both direct injury to the microvasculature by the noxious stimulant and is also mediated by the release of various vasoactive agents, including prostaglandins, kinins, histamine, and serotonin.[5] The resulting capillary leak is aggravated by constriction of venules at the distal end of the capillary bed and by sludging of the circulation in the viable tissues immediately underlying the burn. Fluid loss into extravascular tissues is initially rapid and is accompanied by increased lymphatic flow. Edema formation is most pronounced in the first 24 hours, and begins to slow as lymphatics become obstructed and capillary integrity is restored. Because of large extravascular fluid shifts, plasma volume contracts, cardiac output falls, and peripheral resistance rises. The increased capillary permeability persists for approximately 24 hours, and occurs not only in the burned areas, but is a total body phenomenon and includes the lungs as well.[6] The capillary leak resolves somewhat sooner in children; capillary walls seal and compensatory changes set in. There is usually an overcompensation in cardiac output which becomes supernormal and may actually persist until wound closure. Edema fluid is gradually absorbed and the circulating plasma volume returns to normal. Diuresis begins and the excess retained fluid is secreted. The shock phase concludes when the body weight has returned to normal and cardiovascular stability has been reestablished. Usually, this balance is achieved after 48–72 hours if appropriate resuscitative measures have been undertaken. A discussion of the eschar separation and reconstructive phases is not relevant to acute care management, and will not be described here.

TRIAGE AND TRANSPORTATION

Care in the Field. Because initial treatment of burn patients on the scene may be undertaken by personnel with a very wide range of skills—from highly trained and experienced paramedics equipped with advanced life support systems to volunteers with little or no specialized training—certain guidelines should be established regarding early management. Additionally, there may be considerable variation in the distance to available skilled medical help, ranging from an accident that occurs within a few miles from a major burn center to an injury sustained far from any medical facility. In order of urgency, the first matters to be taken care of are:

- Removal of the victim from the fire;
- Attention to the airway;
- Evaluation of associated injuries;
- Estimation of burn size and initiation of resuscitation and transportation.

The third item cannot be overemphasized. Particularly in the case of a vehicular accident, associated injuries such as fracture of the cervical spine, or comminuted fracture of lower extremity bones, or a sucking chest wound, will take obvious precedence over treatment of a burn.

Removal of the victim from the source of injury. If the patient still has burning clothes, he should be wrapped in a clean sheet or blanket to extinguish the fire. Smoldering clothing should be quickly removed. This technique is preferable to dousing the victim with water, since water supplies are often contaminated with *Pseudomonas aeruginosa*. Rolling the victim on the ground or immersing into a lake, a pond, or river are not recommended except as a last re-

sort, again because of the possibility of massive early contamination. In the case of chemical injury, the areas involved should be copiously irrigated with water for a period of 15–20 minutes on the scene.[7]

In the case of electrical injury, the victim should be removed from contact with current either by disconnecting the source or by using a nonconductor to move the victim from the point of contact. It is noteworthy that a current of 15 milliamperes provides enough stimulation to the nerves or to the muscles themselves to cause tetanic muscular contractions. If flexor muscles prevail and contact of the patient is with the palm of the hand, it may be impossible to let go of the shock source. At twice this current level, current density in the thorax becomes great enough to similarly affect respiratory muscles. Suffocation and death ensue if removal from the source is not possible. Beginning at 60 milliamperes, current density in the heart is great enough to cause the heart to fibrillate. It is important to note that these voltages are only one-hundredth of the power of those required to produce a burn of human skin.[8]

In the case of hot tar or asphalt contact injuries, it is preferable to cool the tar or asphalt as quickly as possible as opposed to removing the tar on the scene.

Assure the airway. Patency of the airway must be established using customary techniques. The neck is extended, the head is turned to the side. If the victim is unconscious and the tongue appears to be obstructing the airway, an oral pharyngeal airway should be inserted. If upper airway obstruction appears to be imminent from severe smoke inhalation, insertion of an endotracheal airway may be necessary. It is rare, however, for edema to develop so rapidly that upper airway obstruction will occur under 30–40 minutes from the time of removal from the fire. This should allow the placement of an endotracheal tube under conditions better than those that can be obtained in the field. Cardiopulmonary resuscitation may be needed in the case of massive carbon monoxide poisoning.

It must be emphasized that, in the case of known or suspected inhalation injury, an esophageal obturator airway is not an adequate substitute for an endotracheal airway since the pathology occurs at the level of the preglottic and laryngeal areas and is one of progressive edema.

Table I: Some chemical agents requiring special attention acutely.

Agent	Recommended therapy	Potential hazards
Hydrofluoric acid	Subcutaneous injection of 10% solution of calcium gluconate, following copious irrigation	Hypocalcemia
Elemental lithium	Removal of gross fragments and storage in mineral oil, followed by irrigation	Violent reaction with exposure to water
Chromium compounds	Consider early excision to prevent systemic absorption and toxicity from wounds	Stored in all body tissues, hemodialysis not always effective
Phenol	Polyethylene glycol lavage before water irrigation	Potential increases in absorption upon dilution with water

Table II: Sample admission orders.

1. Diagnosis:_____ burns,_____ % TBS_____
2. Condition:
3. Hourly VS and I & O
4. Urine sugar and acetone q4h x 24 hr
5. Daily weights
6. Protective isolation
7. NPO except for Maalox, 30 cc/hr *or* NG tube to low GOMCO, Maalox 30 cc/hr through tube, then clamp for 30 min
8. Bed rest, head and burned extremities elevated
9. Pulse checks to burned extremities q3h
10. Foley catheter to straight drainage
11. **Dressings:** Apply _____ q 12 hr
    Cover cream with Kerlix (extremities)
    Leave chest, face open
12. **IV Fluids:** Ringer's lactate at _____ cc/hr for _____hr, then _____ cc/hr for _____ hrs
13. Humidified oxygen by face mask at 5 L/min
14. **Medications:** Penicillin 300,000 U IV q6h x 3 days
    Morphine sulfate _____ mg IV q hr prn pain
    Other:
    Vitamin C 500 mg IV q6h
    MVI 1 amp. IV bid
    Vitamin A 100,000 U IV bid
15. **Call HO for:** Urine output <40 cc/hr
    Increase in hoarseness
    Respiratory rate >35/min
    Systolic BP >200 <100 mmHg
    T >101.5 oF
    P >160 or <60/min
    Change in state of consciousness
16. Other orders:

_____, MD

Performance of a secondary survey. A brief but thorough examination of the patient's head, neck, chest, abdomen, hips, and extremities should be conducted so that life-threatening injuries may be identified early and appropriate therapeutic measures instituted.

Intravenous resuscitation. The exact timing of intravenous resuscitation is controversial. Because of the rapid development of edema and the relatively slow nature of hypovolemic shock from burns, we currently do not recommend that an intravenous line be started in the field unless, in the opinion of the evacuating team, adequate medical help is more than an hour away from the scene. In that event, a large-bore plastic cannula should be inserted into a large peripheral vein and lactated Ringer's solution begun at the rate of 150 ml/hour.

Transportation. Certain practices should be avoided in the field. No oral fluids should be administered to patients. The temptation to immerse the patient in ice or very cold water should be resisted,[9] and tracheostomy should be avoided whenever possible.[10] The patient should be wrapped in a clean sheet or blanket, kept warm, and transported to an appropriate medical facility. If a burn treatment facility is within reasonable reach, e.g., an hour or so away, the patient should be optimally transported directly to that facility. If this is not the case, the patient should be transported to the nearest medical facility. This is especially true in the case of known or suspected inhalation injury.

If patients are to be evacuated by aircraft, a nasogastric tube should be inserted pre-flight because of the distension of the gastric bubble and progressive expansion of intestinal gases in reduced atmospheric pressure. Contraindications to aerovacuation include pneumonia, congestive heart failure, cardiac arrhythmias, recent gastrointestinal bleeding, and hypothermia.[11]

Indications for Transport to a Center Versus a Hospital. The following criteria are those used for Maryland State in the transfer of patients to a Burn Center. These criteria are standard: second and/or third degree burns of greater than 10% of the body surface area if the patient is under 10 or over 50 years, and greater than 20% of the body surface area in other age groups. All chemical and electrical burns are transferred

to a Burn Center. Finally, burns to "special areas" such as the face, hands, feet, joints, perineum, and any circumferential burns are best treated at a Burn Center. On occasion, the Burn Center may be called upon to provide care for patients suffering from massive skin loss from processes other than thermal injury. These include Steven-Johnson syndrome and ecthyma gangrenosa, for example.[12]

EMERGENCY DEPARTMENT ASSESSMENT

Indications for Admission and the Treatment of Outpatients. Upon the patient's arrival in the emergency department, the process of evaluation and treatment begun in the field is augmented and continued as follows:

- Check patient's airway and vital signs;
- Reassess presence or absence of significant associated injuries;
- Estimate total burn size. (To do this, any residual clothing of the patient should now be removed, and the extent and depth of the burn evaluated by inspection and palpation of the burn surface with the gloved hand as previously discussed.)

It is important to note that the estimation of burn size and depth again follows the assurance of adequate ventilatory and circulatory status and a secondary survey. At this time it is appropriate to obtain a pertinent history and to perform a physical examination. Highlights of this history should include patient's age, circumstances surrounding the injury, and specifically, whether the injury occurred within a closed space. It is of particular importance to ascertain if the patient lost consciousness. The usual data regarding patient's allergies, current medications, immunization status, history of previous surgery, and concomitant medical illnesses should be obtained.

OUTPATIENT MANAGEMENT

In those patients judged to be suitable candidates for *outpatient management*, a tetanus toxoid immunization should be administered if tetanus immunization is not current. The wounds should be debrided in a sterile fashion following the administration of appropriate pain medication. Bacitracin can safely be applied to facial burns and the use of silver sulfadiazine cream is recommended for other burn areas. Although silver sulfadiazine does not require closed-type dressings, a light wrap with clean bandages may be convenient for patients and will help to keep the topical antibacterial agent in contact with the wound. The patient can then be instructed to shower or bathe twice daily, preferably in the morning upon arising and before retiring. Such patients may safely enter the shower or tub with their dressings in place and these can be soaked free. Cleansing of the wounds can be undertaken safely with bland soap, and these wounds may then be blotted dry with a clean towel. The patient should be instructed to apply the silver sulfadiazine cream thinly over all open burned areas. Again, in the case of silver sulfadiazine, bandages are more a convenience than a necessity. The patient should be strongly advised against work while the wounds remain open and unhealed, but should be encouraged to maintain a level of activity consistent with the performance of the necessary tasks of normal daily life. Elevation of burned extremities is recommended. Ambulation should be restricted to the performance of functional trips.

It has been our custom to administer low-dose penicillin, i.e., 300,000 units p.o. q6h, to outpatients for the first three to five days post-burn.

It is imperative that a patient who has

been discharged from the emergency department be seen again within 48 hours by an individual knowledgeable in the care of burns. At this time, it may become apparent that the burn was deeper than first estimated, or vesicles may have developed large enough to require debridement, or other complications such as cellulitis may have ensued. The patient therefore should be given a return appointment within 48 hours to be seen in the Burn, Plastic, or Surgical clinic, or by his own physician, as appropriate. Prior to their discharge, all patients should be advised of the signs and symptoms of cellulitis.

PATIENTS FOR ADMISSION

Those patients selected for admission have more sophisticated care requirements; however, these needs can easily be met if approached in a logical fashion.

Intravenous Line. The adequacy of any intravenous lines which may have been inserted in the field or during transit can now be checked. Any patient with a burn greater than 15%–20% of the total body surface area usually requires intravenous fluid resuscitation. Smaller, uncomplicated burns in previously healthy individuals can be resuscitated by oral fluid administration. A large-bore (16–18 gauge) intravenous cannula should be placed, ideally, in an unburned area in the neck or extremity, and secured in place. In patients with very extensive burns (over 60% total body surface) two intravenous lines may be required. In such a patient, it may be preferable to start the intravenous line through a burned area. At the time of admission the burn is usually not colonized, and the unburned area can then be utilized when it is time to change the site of intravenous access two to three days later.

In patients who have anticipated needs for large volumes of fluid resuscitation—for example, 40% or more in burns—and in patients with underlying cardiopulmonary problems, most clinicians would prefer to start a central venous line via the subclavian or internal jugular route. In a recent review, Baxter commented on the contraindications of initial central vein catheterization. Complications are higher in all shock patients. Thermal insult induces hypercoagulability, with miniclots beginning almost instantaneously. Central veins will be needed later for intravenous alimentation or monitoring of central circulatory parameters.[13]

Nasogastric Tube. Patients with burns over 20% of the body surface have a similar initial response as trauma patients. As a result of severe splanchnic vasoconstriction, an early and sustained reflex ileus may occur. Acute gastric dilatation may occur early and be accompanied by abdominal distention, regurgitation, and possible aspiration. For this reason a nasogastric tube should be inserted and placed on intermittent suction until bowel function approaches normal—usually around 72 hours post-burn.

Foley Catheter. Any patient who requires intravenous resuscitation also requires a Foley catheter for the purpose of monitoring the hourly urine output. Additionally, patients with small burns who might not otherwise require intravenous resuscitation, but in whom the burns involve areas where urinary soilage might be a problem—for example, burns to the perineum—may have a Foley catheter placed to facilitate nursing care.

Tetanus Prophylaxis. The patient's immunization history should be obtained and tetanus prophylaxis administered as necessary, using the same indications as one would for any other major injury.

Antibiotics. Controversy remains

surrounding the administration of antibiotics to burned adults. Prophylactic penicillin was previously given to virtually every burn patient for the first three to five post-burn days. According to Pruitt, however, recent studies and reports suggest that even such brief prophylaxis increases the resistance of the residual bacterial population. Accordingly, they have administered no prophylactic penicillin for several years and have encountered no clinically-significant streptococcal infections. Those treating burned children are advised to consider the high frequency of recovery of *Streptococci* from the oropharynx of such patients to justify the administration of penicillin in the immediate post-burn period.[14] It has been our custom to administer penicillin in low doses, i.e., 300,000 units IV q6h for the first three days post-burn to prevent group A beta hemolytic streptococcal infection.

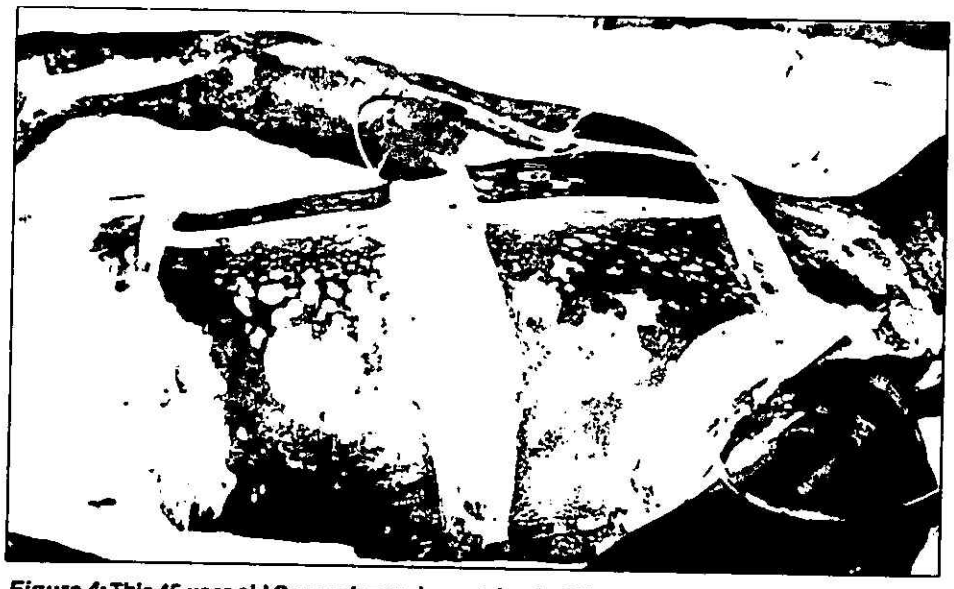

Figure 4: **This 45-year-old Caucasian male sustained a 50% TBSA flame burn. He experienced a respiratory arrest preceding his transportation by the burn flight team, and measured tidal volumes were markedly diminished. Escharotomy (as shown) produced dramatic restoration of ventilatory capacity.**

Pain Medication. Pain medication should be given now to ease the discomfort of debridement, dressings, and transportation to the ultimate destination. It is essential to give pain medication intravenously so that the absorption in effects of the drug are reliable and observable. Demerol, in doses of 5–10 ml intravenously, or morphine, in doses of 2–5 ml intravenously, repeated every two hours if necessary until the patient is stable, are appropriate.

Other Medications. Medications that the patient customarily takes should be continued until the patient's medical background can be better evaluated. Particularly important are the cardiac glycosides, insulin, and antiseizure medication for epileptics. Burn patients excrete a large number of pharmaceutical agents faster than other patients; this phenomenon has been reported particularly for the cardiac glycosides, Dilantin and the aminoglycoside antibiotics.

This should be kept in mind as these medications are ordered. Whenever possible, initial blood levels of the drug should be obtained two to four hours after the first and second doses.

Special Considerations in the Early Treatment of Chemical and Electrical Burns. Patients with chemical burns should have already been lavaged with water at the scene. If they have not, these patients should be placed in a hydrotherapy tub or shower and the area in question irrigated for a prolonged period of time. It is our custom, upon admission, to lavage such patients for a total of six hours' time. Neutralization of acid burns with alkali and alkali burns with acid is not recommended because dilution with water achieves the same effect, and the likelihood of error is lessened. The exothermic reaction of some acids and alkalis can produce rather intensive heat which can further the thermal damage. There are some chemical agents, however, for which neutralization is not sufficient (please refer to *Table I*).

For electrical burns, a strong initial diuresis must be made because of the possibility of massive myoglobinuria. In other than minimal electrical burns, therefore, we administer mannitol 12.5 g on admission and again six hours later until all pigment has been cleared from the urine and urine output is adequate. In those patients presenting with gross myoglobinuria, the initial dose is doubled to 25 g. Sulfamylon is the preferred topical agent in these injuries.

FLUID RESUSCITATION

The key alteration in the pathophysiology of the acute post-burn period leading to the need for fluid resuscitation is increased capillary permeability. This results in loss of water, colloid, and electrolyte not only into the burn wound but elsewhere in the body as well, including the lungs. The result is third spacing of the large amount of volume which cannot be reversed by any method of resuscitation until the capillary wall has healed well enough to retain colloid once again, enabling the plasma oncotic pressure to begin returning toward normal. The objective of fluid resuscitation is to maintain normal cardiovascular parameters while this healing process takes place, without fluid overloading the patient.

There are many formulas for the resuscitation of burn patients. A discussion of the advantages and disadvantages of each is beyond the scope of this article. It is recommended that a physician become thoroughly familiar with a method of resuscitation and that he note that all formulas are merely guidelines. The individual physician must be familiar with the indications for departing from his formula, and note that excellent and reliable intravenous routes must be used.

The calculation of formula requirements takes into account the time of burn, not time of admission or time of commencement of intravenous therapy. Our formula of choice is the Parkland Formula which requires that a patient receive 4 cc/kg body weight per % burn of lactated Ringer's solution. One-half of this volume is administered in the first eight hours from the time of burn and the other half is administered over the following 16 hours.

Monitoring recommendations are that 0.5–1.0 cc/kg body weight per hour of urine represents an adequate urine output. During the second 24 hours, colloid is administered: 0.5 cc/kg/% of burn in the first eight hours. In the remaining 16 hours, the patient's fluid requirements are met with free water, usually supplied as D_5W. The success

of resuscitation can be monitored by the following parameters: first, maintenance on a normal sensorium; second, adequacy of urine output; third, stabilization of hemodynamic parameters. It is worth repeating that more urine production is not a sign of a more successful resuscitation. If urinary output falls below the volumes acceptable, the rate of fluid administration should be increased rather than diuretics given. A checklist of orders used at the Baltimore Regional Burn Center for new admissions is found in *Table II.*

OTHER CONSIDERATIONS

Early in the burn patient's evaluation, the possible need for escharotomy should be assessed. Escharotomy may become necessary if the circumferential full-thickness burn involves the upper or lower extremity. Tissue swelling will first compromise the venous return and then the arterial supply to the extremity and probably cause ischemic changes in the intrinsic musculature, or eventual loss of digits, toes or the entire extremity. The need for escharotomy is usually apparent within a few hours of the burn insult and is signaled by loss of peripheral pulses (a Doppler may be used if desired), absence of color, absence of capillary refill in the nail beds, immobility, anesthesia, and pain in the affected extremity. A circumferential burn of the thorax may interfere with respiration. Escharotomy may be performed in the Hubbard tank or in bed using a razor blade or scalpel. The preferred sites of escharotomy are in the coronal plain anatomically. A properly-performed escharotomy will be painless and essentially bloodless.

If successful, the escharotomy will cause the eschar to separate and allow expansion of the swollen tissues with return of peripheral pulses, movement, and sensation. Escharotomy is an incision only through third degree or full-thickness eschar and one to two inches beyond. The preferred sites for escharotomy are shown in *Figure 3* and a patient photograph in *Figure 4.* Fasciotomy, or formal splitting of the deep investing fascia of muscle, is indicated less frequently and then only when escharotomy has not produced adequate relief, as may happen in the case of exceptionally deep burns, usually electrical in nature. Fasciotomy and decompression of the carpal tunnel is a surgical emergency in cases of high voltage electrical injury to the hand, when symptoms and signs of median nerve compression appear.

Finally, the importance of early involvement of physical and occupational therapists and social services cannot be overstated. The role of the burn team in determining the patient's prognosis and ultimate quality of life is crucial.

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EMS

FIRE PREVENTION WEEK