Philippine Society for Burn Injuries

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Algorithm for the Management of Burn Wounds

1. Burn Wound

2. Minor burns?
   
   N

3. With blisters?
   
   Y

4. Leave intact and allow wound to heal spontaneously. or Puncture at one end and evacuate fluid.

5. Extensive Burns


7. Apply topical antimicrobial cream

8. Eschar?
   
   Y

9. Full thickness burns

10. Surgical therapy "tangential excision"

11. Hyper-trophic scar & contracture?
   
   N

12. Deep dermal partial thickness burns

13. Clean wound. Apply a mild topical antibiotic. Cover with mesh gauze or absorbent gauze dressing.

14. Superficial partial thickness burns

FIGURE 1
Algorithm for the Management of Inhalation Injury

1. Inhalation injury

2. Initial Assessment*

3. Signs of laryngeal edema? Y N

4. Inhalation injury above the glottis? Y

5. Careful consideration to physical findings of airway obstruction

6. Intubate prior to transfer to Burn Center Go to # 11

7. Carbon monoxide poisoning

8. Inhalation injury below the glottis N

9. 100% Oxygen therapy

10. Immediate endotracheal intubation prior to transfer to Burn Center

11. Intubation successful? Y

12. Perform specific laboratory tests: Arterial blood gas Chest x-ray Carboxyhemoglobin levels

13. Perform immediate cricothyroidotomy

FIGURE 2

* Is there history of unconsciousness? Were noxious chemicals involved? Did the burn injury occur in a closed space?
ACUTE BURN INJURIES

INTRODUCTION

Burn injuries are among the worst problems which can befall man. A burn is an injury resulting from exposure to an open flame, hot liquids, contact with hot objects, exposure to caustic chemicals or radiation, or contact with an electric current. A review of the following topics will help in formulating an initial management plan for all types of burn.

• Definitions related to extent and depth of burn injuries.
• Classification of burn injuries.
• Initial assessment and stabilization procedures.

I. Determining Severity of the Burn Injury

A. Depth of a Burn

The depth of tissue damage due to burn is dependent on the temperature and duration of contact with the tissue (skin). Skin contact with heat, chemicals or electricity results in tissue destruction of variable degrees. Due to the thinner skin in the very young and the very old, special considerations are given to patients of these age groups. Burns in these age groups may be deeper and more severe than they initially appear.

• First Degree Burns (Superficial thickness burns)
  Injury involves only the epidermis and is rarely clinically significant other than being painful. The involved skin is red and hypersensitive. Erythema is due to vasodilation, desquamation eventually ensues and usually heals without a scar in 7 - 10 days. The most common example of this type of burn injury is “sunburn”.

• Second Degree Burns (Partial Thickness Burns)
  Injury involves the epidermis and part of the dermis. These are further categorized into superficial and deep. In superficial injuries, all of the epidermis is destroyed as well as varying superficial portions of the dermis. These lesions are usually pink to cherry red, painful and blistering is often present. Healing will generally occur within 2 weeks with minimal scarring. Therapy is directed at preventing infection.

  In deep partial thickness burns all the epidermis and most of the deep dermis is destroyed. There will be less blister formation and is usually mottled white to red which blanches on pressure with rapid capillary refill. Re-epithelialization is greatly retarded in these wounds. Healing may occur in 21 to 35 days with some degree of scarring.

• Third Degree Burns (Full Thickness Burns)
  Burns of this degree involve necrosis of the entire thickness of skin, leaving no chance for healing except for very small wounds which may heal by contraction and epithelialization from the wound edges. Involved skin is white and leathery with a charred appearance. Sensory nerves are destroyed therefore all sensation to pinprick is lost in the burned area. Third degree wounds routinely are treated with excision and grafting.

B. Extent of Burn Injury

Many decisions regarding care of the burn patient are based on “estimate” of extent of burn injuries and therefore should be recorded as accurately as possible using a body diagram. Extent of burn is commonly estimated using the “Rule of Nines” because it is easy to remember. The body surface of an adult is divided into 11 segments of 9 percent with 1 percent reserved for the perineum.

An alternative method is the use of the palm of the patient’s hand which represents approximately 1 percent of the patient’s body surface. This is useful in estimating scattered burns of limited extent anywhere in the body.

Fig. 1 “Rule of Nines” (Calculating percentage of body burned)

* In children subtract 1 % from head for each year over one year old;
**Add ½% to each leg for each year over one year of age

Frequently, a modified chart, devised by Lund and Browder is used to estimate burn size in children because this chart may be more accurate. It also allows estimating burn size for adults. Either method of estimating burn extent is acceptable to most clinicians. Superficial areas of burn are not used in the estimate. Only partial
I. Initial Assessment, Management and Stabilization of Moderate and Major Burns

A. Assessment

1. **Primary Survey** – The initial assessment of the burn patient is like that of a trauma patient. A convenient approach to the primary survey is through the methodology of ABCDEF:

   - **A** - Airway
   - **B** - Breathing
   - **C** - Circulation
     - Cardiac status
     - Spine immobilization
   - **D** - Disability
     - Neurologic Deficit
   - **E** - Expose and Examine
   - **F** - Fluid Resuscitation

a. **Airway**
b. **Breathing**
   The patient’s airway and breathing must be assessed immediately. The compromised airway must be controlled by simple measures, including:
   - Chin thrust
   - Jaw lift
   - Oral pharyngeal airway in the unconscious patient
   - Auscultate for breath sounds in both lungfields
   - Assess adequacy of rate and depth of respiration
   - High flow oxygen is started on each patient at 15 L (100%) using a non-rebreathing mask
   - Circumferential full thickness burns of the upper trunk may impair ventilation and must be closely monitored
c. **Circulation**
   Assessment includes evaluation of skin color, sensation, peripheral pulses, and capillary refilling. Remember that limb circulation may be impaired in a circumferential full thickness burns as a result of edema formation so maintain a high index of suspicion and careful observation
   - **Spine Injuries**
     Remember to stabilize the spine before doing anything that will flex or extend the spine.
d. **Disability/Neurologic deficits.** This should be checked and treated to prevent aggravating condition.
e. **Expose and examine.** Be sure to make quick full body survey so as not to miss any other concomitant injury.
f. **Fluid resuscitation.** The goal of successful resuscitation is to replace intravascular volume and maintain adequate tissue perfusion.

**Calculation of fluids for the first 24 hours**

A. **Adults:** Plain Lactated Ringer’s solution at 2-4 mL x kilogram body weight x TBSA percent burn
B. **Children:** Plain Lactated Ringer’s solution at 3-4 mL x kilogram body weight x TBSA percent burn.

The infusion rate is regulated such that 1/2 of the calculated volume is given in the first 8 hours from the time of the burn. The second half of the estimated fluid is given within the subsequent 16 hours. The rationale for such a schedule is that the time of greatest capillary permeability and intravascular volume loss is within the first 8 hours post-injury. It must be kept in mind that the formulae presented are only meant to act as guides in the institution of fluid therapy. Fluid resuscitation is thus adjusted according to the individual patient’s response to the burn and the treatment regimen.

With prompt and adequate resuscitation, there is note of a modest decrease in blood and plasma volume within the first 24 hours post-injury. Plasma volume, however, is restored to normal levels by the end of the 2nd post-injury day.

**Resuscitation Fluid Composition**

- **The First 24 Hours**
  Crystalloid fluid is the fluid of choice in the initial 24 hours of fluid resuscitation. In fact, it has been mentioned that crystalloid fluid is the keystone of initial resuscitation of burn patients. With increased capillary permeability, colloids have no significant influence on maintaining intravascular volume during the initial hours post burn. Due to the leakage of large molecules of proteins through open capillary membranes, colloids have little role in resuscitation. Between 18 to 24 hours the capillary leak begins to seal sufficiently so
that colloid may remain within the intravascular space. Colloid replacement at this time may be estimated at 0.5 cc/kg/ % burn. Either Albumin or Fresh Frozen Plasma is used and calculated amount is replaced over one to two hours.

• The Second 24 Hours

Capillary permeability approaches normal during the latter half of the first post burn day with restoration of functional capillary integrity by the 2nd post burn day. The amount and composition of the fluids required thus changes after the first 24 hours because of these pathophysiologic changes. 5% dextrose in water at the rate of 1 cc/kg/% burn. The serum sodium should be maintained between 133 and 135 mEq/dl.

Monitoring of Resuscitation

Fluid resuscitation in each patient must be individualized, because each person has varied reactions and responses to burn injury and fluid resuscitation. The actual volume of fluids infused must be adjusted according to the individual’s physiologic responses. One must also keep in mind that it is more difficult to remove excess fluid than to infuse additional fluid.

The optimal resuscitation regimen is that which decreases volume and salt loading, prevents acute renal failure and has low incidence of pulmonary and cerebral edema.

A. Hourly Urine Output

Hourly urine output monitoring utilizing an indwelling urethral catheter is the most readily available and reliable guide to adequacy of fluid resuscitation.

Adults: 30-50 cc/hour or 0.5 to 1 cc/kg/hour
Children: (weighing less than 30 kg) 1 cc/kg/hour

If urine output falls below or exceeds these limits by more than 1/3 for two to three hours, fluid infusion may be increased or decreased by one third accordingly.

1. Management of Oliguria

a. Alteration of Fluid Infusion Rate

Oliguria, in conjunction with increased systemic vascular resistance and decreased cardiac output is most commonly due to inadequate fluid resuscitation. The use of diuretics at this point is contraindicated. Rapid fluid infusion is the measure to be instituted in these cases.

b. Use of Diuretics

A diuretic may be administered to prevent the development of acute renal failure in patients with extensive burns who remain oliguric despite fluid therapy, that is assuming that they have received their calculated fluid needs and have no other evidence of a significant persistent blood volume deficit.

2. Management of Myoglobinuria and Hemoglobinuria

In cases of high voltage electrical burns and those with extensive soft tissue damage which may also be due to mechanical trauma, patients may present with significant amounts of myoglobin and hemoglobin in their urine. Increased fluid administration is needed to address the problem. Maintaining urine output of 75-100 cc/kg/hr (or 1.5 to 2 cc/kg/hr.) is necessary to clear the body of heme pigments. This situation eliminates the need for diuretics.

If with the increase in fluid infusion, the patient’s urine does not clear up, Mannitol may be given at 12.5 g per liter of resuscitation fluid. This may help in clearing the heme pigments.

Once adequate urinary output has been achieved and pigment density decreases, fluid therapy is continued without the need for the use of diuretic agents.

Alkalinization of urine with Sodium Bicarbonate is instituted as needed. Heme pigments are more soluble in an alkaline medium. This would thereby facilitate clearance of the pigments.

With the administration of diuretics, the use of the hourly urine output as a guide to fluid therapy is no longer reliable as a parameter for assessment of the adequacy of volume replacement. Other parameters must then be monitored.
and relied upon.
Monitoring of patient response should include the following parameters:
• Hourly urine output monitoring
• Frequent assessment of the patient’s general condition
• Baseline laboratory examination of hematocrit, hemoglobin, serum chemistries and arterial blood gases. Subsequent studies needed as indicated by the patient’s clinical course.
• Chest X-rays
• ECG as needed/indicated

Fluid Resuscitation in Pediatric Patients

Children need special attention because the burned child is more susceptible to fluid overload and hemodilution owing to a lesser intravascular volume per unit surface area burned in the child. Children have a greater surface area per unit body mass which accounts for the relatively greater amount of resuscitation fluid needed.

Hypoglycemia is also another pediatric problem. Children have limited liver glycogen stores available. This, in turn, is rapidly exhausted by elevated levels of circulating steroids and catecholamines during the early post burn period. As such, vigilant monitoring of the pediatric patient’s blood glucose levels should be done and if hypoglycemia develops, a glucose containing electrolyte solution (e.g. D5LR) may be used for resuscitation.

In the young child, electrolyte free fluids in the second 24 hours post-burn should be avoided. This is because of the high incidence of hyponatremia. Half normal saline solution should be utilized instead.

Initial Procedures Specific to the Type of Burn

A. Thermal Burns – Cover the burn area with a clean, dry, and warm sheet. Covering all burn wounds prevents air currents from causing pain in partial thickness burns. Ice should never be directly applied to the burn due to the possibility of frostbite. Cold application, if used, should be brief so that body temperature is not reduced.

B. Electric Burns - An electric current passing through an individual may cause extensive internal damage. A major concern is the effect the electric current has on normal cardiac electrical activity. Serious dysrhythmias may occur even after a stable cardiac rhythm has been obtained. Continuous cardiac monitoring may be necessary during the first 24 hours post injury. Note that even if the visible surface injury does not appear serious, there may be inapparent severe, deep tissue injury.

C. Chemical Burns – Chemical agents should immediately be flushed from the body surface with copious amounts of water. Powdered chemicals should be brushed from the skin prior to flushing the body surface area. Remove all contaminated clothing. Chemical eye injuries require continuous irrigation until its discontinuation is instructed by a burn physician.

D. Initial Laboratory Studies – Burn injuries can cause dysfunction of any organ system. Baseline laboratory studies are necessary to evaluate the patient’s subsequent progress. Upon admission, obtain baseline studies:
• Hematocrit
• Electrolytes
• Blood Urea Nitrogen
• Urinalysis
• Chest X-ray

Special Considerations
• Arterial Blood gases (if indicated)
• ECG - with all electric burns or pre-existing cardiac problems
• Carboxyhemoglobin (if indicated)
• Glucose (in children) and diabetics

Inhalation Injury:

In essence, three distinguishable types of inhalation injury have been identified:

1. carbon monoxide poisoning
2. inhalation injury above the glottis
3. inhalation injury below the glottis

Initial Management

A. Oxygen Therapy and Airway Management

The simplest and probably the best treatment for carbon monoxide poisoning is administration of 100 percent oxygen. This would decrease the half-life of carboxyhemoglobin from 4 ¼ hours to about 50 minutes. A face mask with a non-rebreather bag could appropriately administer oxygen with an FiO2 of 100%. Care, however, should be exercised in
patients with chronic lung disease in whom hypoxia provides the primary respiratory drive.

If signs of laryngeal edema appear – hoarseness, brassy cough, stridor or noisy breath sounds – , indications of impending upper airway obstruction, immediate endotracheal intubation is indicated. The transnasal route is the preferred method, if facilities and staff are available for such practice; however, if this is not possible, the transoral route is the most expeditious method. Caution should however, be practiced in the case of potential cervical spine injury. A cross table lateral x-ray may be performed prior to airway intubation.

The integrity and proper positioning of the endotracheal tube must be ascertained by 1) auscultation and 2) chest roentgenogram. The tube must then be properly and safely secured with particular consideration of the inherent difficulties in securing a tube in the burned face. This is best done using an umbilical tape passed around the head. Newer devices have been constructed for proper securing of the tube. These, however, are not currently available in our setting.

If endotracheal intubation is not successful or not possible owing to various factors such as marked edema of the upper airway, immediate cricothyroidotomy should be performed to secure a patent airway.

B. Specific Laboratory Tests

After initial airway management is instituted, an arterial blood gas, chest xray, and carboxyhemoglobin levels (where possible) should be obtained.

Assessment and Management

A. General Assessment Findings

The following are considered to be important considerations in the initial assessment of patients with probable inhalation injury.

1. History –
   a. Is there a history of unconsciousness?
   b. Were noxious chemicals involved?
   c. Did the burn injury occur in a closed space?

   It is important to note that a high percentage of patients with documented inhalation injury were in an enclosed space at the time of the burn. However, there is a subset of patients with inhalation injury who were in an open area at the time of the burn.

   Physical findings suggestive of respiratory tract injury are the following:

   a. Carbonaceous sputum
   b. Facial burns, singed nasal hairs
   c. Agitation, tachypnea, anxiety, stupor, cyanosis
   d. Rapid respiratory rate, flaring nostrils, intercostal retractions, especially of the lower rib cage
   e. Hoarse voice, brassy cough, grunting, guttural respiratory sounds
   f. Rales, rhonchi, distant breath sounds
   g. Erythema, swelling of the oro- or nasopharynx
   h. Mucosal slough/burns of the oro- or nasopharynx

B. Treatment for each Type of Inhalation Injury

1. Carbon Monoxide Poisoning

   There is actually no specific therapy for carbon monoxide poisoning except to displace it from hemoglobin by mass action. This is accomplished by the administration of 100% oxygen until levels of less than 15% are achieved. The administration of 100% oxygen reduces the half-life of CO in the blood from about 4½ hours down to around 50 minutes. Hyperbaric oxygen for these patients is currently still of unproven value. Efforts to institute hyperbaric oxygen therapy should not hamper efforts to transfer the patient to a burn center. In our setting, hyperbaric oxygen facilities are unavailable.

2. Inhalation Injury Above the Glottis

   The development of upper airway obstruction can occur very rapidly when the condition arises. Patients with pharyngeal burns, hoarseness, stridor, a brassy cough or noisy breath sounds have a high likelihood of developing upper airway obstruction, and thus should be intubated prior to transfer to the burn center. Monitoring of arterial blood gases would not be of primary import in this setting. One should give careful consideration to the physical findings of airway obstruction in such a situation.
3. Inhalation Injury Below the Glottis

Patients with inhalation injury sometimes manifest primarily with symptoms of bronchial and bronchio-lar injury – bronchorrhea and/or expiratory wheezing. In this situation, intubation is indicated prior to transferring the patient for purposes of clearing secretions, relieving dyspnea and/or establishing safe levels of arterial blood gases.

Inhalation injury may, however, occur chiefly at the level of respiratory gas exchange. This form of injury is often times delayed in onset. The earliest manifestation of such type of injury is impaired arterial oxygenation rather than an abnormal chest roentgenogram.

It is mandatory that this subset of patients be transferred to a burn center as soon as possible. If, however, transfer would be delayed, respiratory management and ventilation should be coordinated with the burn center. It is essential that vigilant monitoring of the patient’s respiratory status and overall condition in order to identify the possible need for ventilation with a volume ventilator if the need arises.

The existence of circumferential burns of the chest may require escharotomies to improve the overall ventilation of the patient. The use of steroids in patients with inhalation injury should not be practiced.

4. Inhalation Injury in Pediatric Patients

The development of upper airway obstruction in the pediatric age group may be particularly more rapid in onset owing to the relatively smaller caliber of the pediatric patient’s upper airway. If, indeed, endotracheal intubation is required, a tube of proper size should be utilized. Proper positioning of the tube should be confirmed by auscultation and by a chest roentgenogram. The use of small uncuffed tubes in the pediatric age group makes it particularly easier to displace, and therefore, greater care must be exercised in securing the tube.

Chest wall escharotomies in pediatric patients should be performed promptly with the first evidence of ventilatory impairment. This is due to the fact that the development of respiratory failure secondary to the decrease in chest wall compliance associated with constrictive circumferential chest burns is more rapid in children.

Burn Center Referral

A. Burn Center Characteristics

A burn center is a service capability based in a hospital that is dedicated to care for the burn patient. The burn center is staffed by a team of professional with expertise in the care of burn patients. Care includes both acute care and early rehabilitation. The burn team provides educational programs regarding burn care to all health care providers and involves itself in research related to burn injury. A burn unit is a specified area within the hospital, which has a specialized nursing unit dedicated to burn patient care.

B. Referral Criteria

The American Burn Association has identified the following injuries as those requiring a referral to a burn center. Patients with these burns should be treated in a specialized burn facility after initial assessment and treatment at an emergency department.

- 2nd and 3rd degree burns of more than 10% BSA in patients under 10 and over 50 years old.
- 2nd and 3rd degree burns of more than 20% BSA in other age groups.
- 2nd and 3rd degree burns in serious threat of functional or cosmetic impairment that involve face, hands, feet, genitalia, perineum and joints
- 3rd degree burns greater than 5% BSA in any age group
- Significant electric burn injuries including lightning injury.
- Chemical burns with serious threat of functional or cosmetic impairment
- Inhalation injury with burn injury
- Circumferential burns of an extremity or chest
- Burn injury in patients with pre-existing medical disorders which could complicate management, prolong recovery or affect mortality
- Any burn patient with concomitant trauma (i.e. fractures) in which the burn injury pose the greater risk of morbidity or mortality
- Burned children should be transferred to a hospital with qualified personnel and equipment.

Initial Management of the Burn Wound

After the initial patient assessment and institution of
measures to life threatening problems, attention is turned to local care of the wounds. Loose, devitalized tissue is generally trimmed away. Pain and bleeding are kept to a minimum.

Blisters of a medium size are preferably left intact and allowing underlying wounds to heal spontaneously. Arguments, based on several studies, advocate puncturing the blister at one end with a needle and evacuating the fluid but leaving the blister over the wound as a protective biologic covering. The burn wound with intact blister covering is dressed protectively with a light topical antimicrobial cream.

The wound is gently irrigated or washed with warm water and a mild bland soap. Chlorhexidine soap is desirable for its antimicrobial activity. After thorough rinsing with water, the involved area is gently dried and topical antimicrobial cream is applied.

Closed wound dressings on burns are used to serve three main purposes:

- Provide protection and isolation of wound from the environment
- Absorb drainage
- Decrease wound pain

These closed dressings are preferred for extensive burns specially of the deep partial thickness injuries. Likewise it is ideal in a setting where the patient is confined in a ward with other patients to prevent cross infection between patients.

After cleansing, a mild topical antibiotic is placed and wound is covered with mesh gauze (Xeroform or Adaptic) or absorbent gauze dressing held in place by elastic gauze bandage (Kling or Kerlix) or stockinette. Joints are dressed to facilitate range of motion. Fingers are dressed individually.

The frequency with which dressings are changed is arbitrary. Recommendations range from twice daily to as infrequent as once a week. The author prefers once daily dressing changes in order to permit daily inspection of the wound.

One of the most effective ways to reduce incidence of infection in burns is to eliminate edema from a burned part. More often, there is also a tendency for the patient to hold an injured part immobile in a dependent position. To eliminate edema, an injured part should be exercised regularly and maintained slightly above the level of the heart.

**Topical Antimicrobial Agents**

Burn injury not only damages the normal skin barrier, but also disrupts host immunological defenses. Systemically administered antimicrobial agents may not achieve reliable therapeutic levels in the avascular eschar. Topically applied antimicrobials will provide higher concentration of the agent on the wound surface where microbial numbers are usually highest. Topical agents penetrate eschar to a variable extent, which should be considered in the selection of the topical antimicrobial to be used.

The normal cutaneous bacterial flora are sparse but after burn injuries the bacterial count become significantly increased. The usual burn wound will have *Staph aureus* as the predominant flora. Subsequently, gram negative opportunistic species appear. These include *Proteus, Klebsiella* and coliform species as well as *Pseudomonas*. Anaerobes are infrequently isolated, although Clostridial myositis may be encountered particularly in high voltage electrical injuries.

The goal of topical antimicrobial therapy is to initially delay and minimize wound microbial colonization. These agents need not penetrate the eschar too deeply. They should have activity against common pathogens, they should not retard wound healing, and should have acceptable toxicity.

**Specific Agents:**

**A. 1% Silver Sulfadiazine**

The white cream is relatively painless to apply and does not stain bed linens. It has *in vitro* activity against a wide range of organisms including *S. aureus, E. coli, Pseudomonas, Proteus, Enterobacter*, and *Candida*. The drug penetrates the eschar poorly but softens it. Its toxic effect is a transient leukopenia which is reversed on discontinuation of the cream.

**B. Mafenide**

It is a water soluble cream which has excellent antibacterial activity against most gram positive and gram negative organisms with good eschar penetrance. The downside is that it is painful on application. The drug is rapidly absorbed and thus ideally applied twice a day. A toxic effect of Mafenide is that it is a potent carbonic anhydrase inhibitor. As a result, hyperchloremic metabolic acidosis is frequently seen. Moderate to severe
hyperventilation as a respiratory compensation for the acidosis is characteristic. The risk of systemic toxicity increases in proportion to the wound area being treated and the duration of treatment. It is ideal as a short term treatment, however, it is no longer available commercially in the local market.

C. 0.5% Silver Nitrate solution
The agent is effective against most strains of Staphylococcus and also has activity against Pseudomonas as well as common gram negative organisms. Solutions greater than 0.5% are histotoxic. The bolus gauze dressing has to be wet every several hours leaving messy, stained bed linen. It leaches electrolytes especially sodium from the wound surface so hyponatremia occurs rapidly especially in infants or children with major burns.

D. Cerium nitrate with silver sulfadiazine
Studies have shown that the improved bacteriostasis in burn wounds with this combination is due to the improved cell mediated immune response from cerium nitrate. It retains the usual efficacy of silver sulfadiazine.

E. Nitrofurazone
A water-soluble cream has good activity against burn wound pathogens such as Staphylococcus, but has no significant activity against Pseudomonas.

Surgical Wound Debridement and Closure
Superficial partial thickness burns usually heal with minimal scarring in about 2 weeks time. If well taken care of with regular dressings and application of topical antibiotics, no surgical debridement is needed except for removal of loose blister covering.

Deep dermal (partial thickness) burns extend into the reticular dermis and generally takes 3 or more weeks to heal by re-epithelialization. Hypertrophic scar and contracture which limit function are common sequelae of burn of this type. Full thickness burns have devitalized soft tissue (eschar) which encompass the full thickness of the skin and even the subcutaneous fat (or even the periosteum). Wound closure cannot occur while eschar remains in situ. Often too, eschar may not spontaneously separate as expected (around 2 weeks). Studies have shown that although metabolically inactive, eschar produces toxins which may cause distant organ dysfunction. Eschar also serves as a good medium for bacterial growth, and so the earlier eschar is removed, the better. A more aggressive, earlier and more frequent use of surgical therapy is the common practice today. Often “tangential” excision of eschar is done early (5 – 7 days) after burn injury. Tangential excision entails sequentially shaving the eschar from the burn surface until a viable tissue plane is reached.

Small but deep burns on lax skin areas such as the buttock, the female breast or the limbs and torso in the elderly can on occasion be excised and closed primarily by suturing or by staples, particularly if cosmesis is not a major issue. Soft tissue defects after debridement are usually closed with autologous split thickness skin grafts. This is supposing that there is adequate, non injured autologous donor skin. In cases where there is a large burn area with inadequate donor skin, the option available is staged debridement and autologous skin graft closure. It is advisable in cases of large burn areas (greater than 30% TBSA) to do staged debridement wherein no more than 20% of TBSA burned is debrided and skin grafted per session. The next session will then debride another 20% of the TBSA burned and closed with skin grafts. The usual time interval between the staged debridement is 10 days or until sufficient donor skin becomes available. Progressive wound closure is thus achieved in a series of planned operative procedures. The unexcised burned area is still cleansed daily and applied with silver sulfadiazine. Silver sulfadiazine with the addition of cerium nitrate has been found to be useful, because this topical antimicrobial preparation is resistant to bacterial colonization and can be safely left in place until it can be excised and closed with autologous skin graft.
Drugs Mentioned in the Treatment Guideline

This index lists drugs/drug classifications mentioned in the treatment guideline. Prescribing Information of these drugs can be found in the Philippine Pharmaceutical Directory (PPD) and the Philippine Pharmaceutical Directory Review (PPDr).

### Antiseptics

**Chlorhexidine**
- Dermexin
- Improved Phisohex

### Colloids

**Albumin (Human)**
- Albuman Berna
- Albumione 20%
- Albuminar-25
- Albutein

**Dextrose**
- Braun 5% Dextrose in Lactated Ringer's Soln
- Braun 5% Dextrose in Water
- Braun 10% Dextrose in Water
- Euro-Med Dextrose 5% Lactated Ringer's Soln
- Euro-Med Dextrose 5% in Water
- Euro-Med Dextrose 10% in Water
- LVP D5LR
- LVP D5W
- LVP D10W

**Mannitol**
- Euro-Med 20%
- Mannitol Injection
- Lacryvise*
- Osmofundin 20%*

### Diuretics

**Acetazolamide**
- Diamox

**Bumetanide**
- Burinex

**Furosemide**
- Aquadrine
- Edemann
- Europharma
- Furosemide
- Flexamide
- Frusema
- Furoscan Injection

### Parenteral Electrolytes

- Braun Lactated Ringer's Solution
- Euro-Med Lactated Ringer's Solution

### Topical Anti-bacterials

**Bacitracin/Neomycin sulfate/Polymyxin B sulfate**
- BNP Ointment
- Trimycin
- Trimycin-H

**Gentamicin sulfate**
- Bactiderm Ointment
- Garamycin 0.1%
- Cream/Ointment

**Nitrofurazone**
- Furacin

**Oxytetracycline HCl/Polymyxin B sulfate**
- Terramycin Skin
- Antibiotic*

**Silver sulfadiazine**
- Flammazine
- Innoxiderm
- Sterizol

**Silver sulfadiazine/Cerium nitrate**
- Flammacerium

**Sodium fusidate**
- Fucidin Intertulle
- Fusoderm 2% Ointment

**Sodium fusidate/Fusidic acid**
- Fucidin Ointment/
- Cream