Critical Care of the Burned Patient

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The initial management of major burn injuries in hospitals that do not have specialized burn units should be conducted in those areas of the hospital that are least contaminated. Intensive care isolation rooms and surgical recovery rooms best meet this need. The recovery room is particularly ideal, for of all hospital locations, it most closely approaches the pathogen-free environment needed to prevent burn wound contamination. For this reason alone, many burn units accomplish the initial burn wound management in their own operating suites and recovery areas.¹

Thus, the medical personnel of the intensive care units and/or the recovery areas of those hospitals without burn units should be familiar with the appropriate care of the severely burned patient. Training in the management of burns and the associated problems of burned patients will lessen the anxiety of personnel when involved in caring for burn victims. Additionally, such training will undoubtedly improve the initial care and overall prognosis of these patients.

Adequate management of the initial post-burn period as well as the later stages of burn wound care requires an organized approach similar to that used in caring for any major medical or surgical problem. Coordination of the efforts of all physicians, nurses, and paramedical personnel involved in the care of the patient is essential. In addition to the problems peculiar to the burned patient, concurrent injuries sustained during the same accident or fire must be detected and treated. Fractures should be immobilized, ocular injuries treated, and other soft-tissue injuries appropriately attended to.

Regarding the burn injury itself, initial management involves 1) assessment of the extent of the wound and 2) appropriate fluid replacement and physiologic support of unstable vital functions. As in all major trauma, severe burn injuries result in a temporary if not prolonged period of disequilibrium. The physician's role during this period is to support the other organ systems until the integrity of the skin can be restored. Only when the skin repairs itself, or when irretrievably injured portions are replaced by grafting, can it resume its functions of maintaining heat regulation, water balance, and defense against infection.

Assessment of Injury

Only serious burns that may threaten the survival of the patient are ordinarily treated in an intensive care unit. For such patients, portions of the detailed history and physical examination may often be postponed in favor of urgent treatment. The following information should, however, be obtained as soon as possible.

1) When and where the burn occurred. Knowledge of the approximate time of the burn is important for planning appropriate fluid therapy. In all fluid therapy formulas, regulation of the first 24 hours is based on hours after burn, not hours after admission. The environment in which the burn occurred should be identified. Flame burns due to fires that occur indoors are more likely to be complicated by inhalation of smoke of noxious gases. A patient burned by gasoline flames as a result of an automobile collision must be suspected of having injuries associated with the automobile accident.

2) Etiology of the burn. Identification of the agent (flame, flash, explosion, scald, hot plastic or hot metal contact, chemical, or electric) and the circumstances causing the burn (accidental, self-inflicted, or intentional) gives clues to the probable depth of the burn, helps to define the patient's prognosis, and alerts the physician to anticipate specific complications. Most scald and flash burns are partial-thickness injuries. Flame burns, particularly when the victim's clothing has been ignited, usually contain some areas of full-thickness injury. Burns due to prolonged contact with hot metal of melted plastic are more often full-thickness. Initially, chemical injury often appears similar to thermal injury; however, the depth of burn is frequently underestimated and tends to produce cosmetically unfavorable scars. High-voltage electrical contact may cause extensive undetected tissue destruction between the sites of entry and exit and may be compounded by ischemia secondary to vascular injury, renal complications, and severe acidosis.

Most burns are accidental, but it is important to identify those that are self-inflicted or intentional. Knowing the etiology helps the physician anticipate the character of the injury; conversely, the character of the injury often suggests the etiology. For example, when a mother intentionally burns her child by sub-

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merging his extremities in hot water (child abuse is a frequent mechanism of burns in children), the burn is likely to be deeper than accidental scalds. Normally a child would reflexly withdraw from the hot water before a full-thickness injury could occur. Therefore, circumferential full-thickness hot-water burns of the lower extremities in a child signal the possibility of an intentional injury. Similarly, self-inflicted burns may indicate the possibility of psychiatric disorder and should alert the physician to the potential for later attempts at suicide.

3) Prior treatment. When the patient has received some medical care prior to arriving in the intensive care unit, it is important to know the exact nature of that care. When, for example, tetanus prophylaxis has been administered, such knowledge would prevent an unnecessary second dose. Some emergency facilities administer narcotics to relieve discomfort and anxiety during transportation. It is important to inquire whether one has been administered and if so, to determine the identity of the drug, the dosage, and the route of administration. When such information is not obtained, inadvertent overdosage may be precipitated. When intravenous fluids have been administered, the physician should know the type and the quantity so that the amount given can be included in the calculated fluid requirements.

4) Pertinent past history. As in any medical admission, an accurate history of prior heart disease, renal disease, diabetes, peptic ulcer, or allergies (especially to drugs) will influence initial therapy. In obtaining the past history, inquiries should be directed at the important category of illness that may have contributed to the occurrence of the burn itself: alcoholism, epilepsy, psychiatric disorders, or cerebrovascular insufficiency. Patients are frequently burned from smoking in bed while confined there for serious primary illnesses.

5) Patient’s weight. Knowledge of the patient’s weight prior to injury is essential in planning and regulating fluid therapy and is also helpful in planning the nutritional support needed by patients who have extensive thermal injuries.

**Physical Examination**

In major burns, as in all serious trauma, the adequacy of ventilation as well as the existence of concomitant injuries must be assessed immediately. Any sign of respiratory compromise demands immediate attention before continuation of the remainder of the physical examination. It should be remembered that smoke inhalation or (occasionally) heat inhalation injury may be the patient’s primary problem during the initial post-burn period. When the patient’s respiratory status is stable, the physical examination may be completed in an organized fashion.

The extent of the burn injury can be reasonably estimated using the “rule of nines.” Later, a more precise calculation can be achieved using charts prepared for various age groups, which show the contribution of each part of the body to the total body surface area (TBSA). The examining physician should attempt to distinguish between partial and full-thickness injuries. The percentage of burn that is full-thickness is an important determinant of morbidity and mortality, and an accurate appraisal of depth yields a more substantial estimate of the prognosis. These determinations are frequently difficult, however. The difficulty stems from the knowledge that the depth of the burn may not be uniform, and that major burns such as flame injuries and hot-liquid injuries are frequently deeper in the center than at the periphery. Many of these burns may need to be temporarily classified as “indeterminate,” and should be re-evaluated frequently as the differentiation between partial and full-thickness injury becomes clear.

**Treatment**

Because urgent measures in the initial care of a severely burned patient must be performed almost simultaneously, two or more members of the medical staff should be involved. The following discussion does not suggest the sequence in which these measures are to be performed in a specific case. Priorities are determined by the requirements of the individual patient.

**Fluid Therapy**

In all cases of major burns at least two large-bore intravenous lines should be inserted, one in an extremity (upper if possible) and the other through either the subclavian or the internal jugular vein into the superior vena cava for central venous pressure (CVP) monitoring. When there are extensive burns on the neck and anterior chest, CVP measurements can be accomplished by long intravenous lines threaded from more distal sites on extremities. Although percutaneous access is preferable to venous cutdown, the latter is occasionally necessary.

All formulas that have been used for initial fluid therapy of burned patients attempt to predict both insensible losses and the total amount of fluid sequestration into the burn wound. The most commonly used formula today is the Parkland formula, which estimates the fluid requirements for the first 24 hours:

Total fluid/initial 24 hours post burn

\[= (4 \text{ ml}) \times (\text{body weight in kg}) \times (\% \text{ TBSA of burn})\]
Thus, a 50-kg man who had a 40 per cent TBSA burn would need (4) (50) (40) = 8,000 ml of fluid. Half of this total (in this case, 4,000 ml) should be given over the initial eight hours, then a fourth of the total (2,000 ml) infused over each of the two remaining eight-hour periods.

The solution of choice during the initial 24-hour period is a balanced salt solution, such as lactated Ringer’s solution. Blood transfusion is not necessary unless there is evidence of concomitant blood loss.

Urinary output, traditionally the mainstay of determining adequacy of fluid therapy, should be monitored at least hourly, along with the CVP and other vital signs, in order to follow fluid management. The CVP is particularly important in patients who are intolerant of fluid overload and should always be employed in management of infants, patients more than 45 years of age, and persons known or suspected to have heart disease. The CVP is less essential, but useful, for management of healthy young adult patients and children who are severely burned and need massive, rapid fluid infusion. In such cases, CVP measurement provides an additional safeguard against short-term misjudgment of fluid requirements.

Pulmonary wedge pressure (PWP), an indirect but sensitive measurement of left-heart function, is also useful in evaluation of the patient’s response to fluid therapy, and is particularly helpful in the early recognition and monitoring of left-sided cardiac failure and respiratory failure. The pressure reading is obtained through a Swan-Ganz catheter inserted through a peripheral vein into a branch of the pulmonary artery. Wedge pressures, normally in the range of 10–15 cm H₂O, will often rise dramatically in the face of left-sided congestive cardiac failure or with pulmonary edema.

During the second 24 hours, 5 per cent dextrose in water plus appropriate amounts of sodium, chloride, and potassium should be given in quantities designed 1) to maintain serum electrolyte and serum protein concentrations within the normal physiologic ranges; 2) to anticipate other avenues of electrolyte loss such as gastrointestinal loss; 3) to maintain an adequate urinary output.

This regimen should be continued until diuresis begins, usually on the third or fourth post-burn day. Proper hydration and electrolyte replacement are signalled by:

1) Satisfactory urinary output of .5–1 ml/hr/kg, the low end of the range in adult patients and the high in children;
2) Clearance of hemoglobinuria, usually within 2–3 hours;
3) Decrease of urinary specific gravity from the post-burn peak concentration;
4) Progressive reduction of hematocrit;
5) Improvement and stabilization of blood pressure, the pulse rate declining accordingly;
6) Stabilization of CVP between 5 and 12 cm H₂O and PWP at 10–15 cm H₂O;
7) Stabilization of serum electrolytes at normal to slightly dilute levels. BUN should decline and the blood pH should approach normal.

From 24 to 72 hours post-burn (depending on burn size and depth), capillary integrity returns and edema fluid is mobilized and returned to the circulation. Unless renal damage has been too great, prompt diuresis ensues. Fluid replacement during this period should not attempt to restore fluid lost through this increased urinary output, but should be directed at replacing normal insensible losses and burn wound evaporative loss. Electrolyte administration in 5 per cent dextrose and water is determined by frequent serum electrolyte determinations. Occasionally, large doses of potassium chloride are needed to maintain normal serum levels. The diuretic period will usually last two to four days, during which time blood pressure, pulse, urinary output, and CVP must be closely monitored to guard against hypovolemia and hypernatremia. By the end of the diuresis, most patients will tolerate adequate oral fluid intake.

**Respiratory Tract**

Early respiratory embarrassment after a burn is due to the inhalation of physical and chemical irritants, including smoke, steam, superheated air, and products of combustion. The predominant pathologic changes occur in the upper respiratory tract; the epiglottis, the vocal cords, and the upper trachea may be acutely inflamed and edematous. Many patients who have respiratory-tract injuries show external evidence such as burns of the face, or singling of nasal hair, carbonaceous material in the naso-oropharynx, or injection of the visible portions of the mouth and pharynx. Patients who are thought to have respiratory-tract involvement should have humidified oxygen administered at 8–10 l/min. This can be most adequately accomplished using a soft plastic face mask that delivers a 40 per cent mixture of oxygen. The head of the bed should be elevated to ease respiratory effort and in the hope of relieving by gravity the edema of the head and neck. Such edema may aggrivate the respiratory problem, but is rarely its sole cause.

Signs of respiratory distress may occur initially or as late as five or seven days after the burn. Thus, frequent
monitoring of respiratory function by way of arterial blood-gas determinations is mandatory in all cases of severely burned, high-risk patients. Intubation or tracheostomy should not be performed routinely in patients with facial burns or minimal clinical signs of respiratory distress, because it complicates nursing care and introduces an additional potential source of sepsis. However, difficulties in oxygenation and carbon dioxide retention signal respiratory compromise and demand aggressive therapy. The initial procedure of choice is mechanical respiratory support after nasotracheal intubation with a soft-cuffed nasotracheal tube. These tubes may be safely used for eight to ten days without fear of tracheal erosion. When mechanical ventilation is needed beyond the tenth day, standard tracheostomy should be considered.

**Urinary Tract**

Any patient who has a burn large enough to necessitate intravenous fluid therapy, with a history of renal disease, or with burns of the perineum and genitalia, should have an indwelling urinary catheter inserted. By this means urinary output can be precisely monitored, mechanical difficulties with later catheterization resulting from edema of the genitals can be circumvented, and urinary contamination of adjacent burns can be prevented. Although acute renal failure rarely complicates minor burns of less than 15 per cent TBSA, extensive thermal trauma and electrical injuries are attended by a high frequency of renal complications. The possibility of renal failure in such patients should be anticipated when there is severe hemoglobinuria or when there has been a prolonged period of oliguria or shock. The cardinal principles for preventing renal complications are the early establishment of adequate urinary output and the earliest possible correction of hypovolemia. Oliguria in burned patients is usually due to inadequate fluid replacement.

**Gastrointestinal Tract**

A large-diameter nasogastric tube should be inserted in all cases of patients who have burns of 20 per cent or more of the total body surface. This eliminates the occasional occurrence of acute gastric dilatation and provides treatment for the adynamic ileus that often accompanies burns of moderate and major severity. Even patients who have smaller burns may have nausea and vomiting, which are treated better by temporary gastric suction than by drugs. A nasogastric tube also facilitates the early diagnosis of upper gastrointestinal-tract hemorrhage (Curling's ulcer), should that complication occur. Fluid should not be given orally in response to a complaint of thirst, nor should this route be considered an alternative to intravenous fluid therapy in major burns. Nasogastric suction is discontinued, the tube removed, and oral fluid intake permitted only when the patient is alert and able to swallow and peristalsis has returned.

**Wound Treatment**

Thorough cleansing and debridement of the burn wounds is an important aspect of the initial wound care. Personnel performing this task should wear masks and gloves and be attired in clean (not necessarily sterile) gowns or scrub suits. The entire patient is washed, using gauze sponges and an antibacterial soap. Blisters are unroofed and all loose and devitalized skin removed. When the scalp and other hair-bearing areas are burned, they are shaved to permit accurate evaluation and to facilitate topical treatment. Topical antibiotic therapy, when indicated, is usually begun at this time.

The choice of modalities and techniques of wound treatment is not critical. Burn wounds can be treated either “open” or “closed.” In a recovery room on an intensive care unit, to minimize cross-contamination and facilitate patient handling, the “closed” treatment is preferred for those areas to which it is applicable. Closed treatment is also preferred for those patients for whom transfer to another medical care facility is anticipated. Bulky dressings are applied in layers with fine-mesh gauze adjacent to the burn wound, followed by successive layers of cut gauze, fluffs, and finally, a circular wrap with roller gauze, Kling, or Kerlex.

**Escharotomy**

Full-thickness or deep partial burns result in immediate shrinkage of the burned skin and a loss of normal elasticity. The effect of the skin shrinkage is accentuated by the formation of subcutaneous edema of the burn wound. The combination of these factors in a circumferential burn produces constriction of the involved part. When the involved part is an extremity, the constriction may progress to occlude arterial circulation; when the involved part is the abdomen or chest, the contracted eschar can severely restrict respiratory movements. In such circumstances, incision of the eschar results in gaping of the edges and permits restoration of circulation or motion. The wrists and ankles are frequently the most tightly constricted areas. The need for escharotomy of the extremities is suggested by signs and symptoms in the hands and feet: edema, cyanosis, lividity, slow capillary
filling, pain or anesthesia, and loss of motion. Escharotomy is rapid, simple, and painless, and hemostasis by suture or cautery is usually not necessary. Incisions should be on the medial and lateral aspects of the extremities. The incision of the trunk is carried down the anterior axillary line to below the costal margin, across the epigastrum, and up the opposite anterior axillary line. Occasionally an additional presternal midline incision is necessary.

**Nutrition**

Optimum nutritional support of the burned patient is essential from the immediate post-burn period until wound closure has been achieved. In burned patients, as in all victims of major trauma, a state of hypermetabolism quickly develops in response to the injury. Mediated primarily by excess catecholamine secretion, this hypermetabolic state attempts to compensate for the large heat and water losses through the injured tissue. Basal metabolic rate (BMR) will increase in a linear fashion until the burn involves 40 to 50 per cent of TBSA, at which point maximum or near-maximum heat production is achieved. Caloric needs for more than 6,000 cal per 24 hours are not uncommon in these situations. Without adequate nutritional support, such metabolic states rapidly progress to: 1) weight loss; 2) depletion of intracellular constituents; 3) severe negative nitrogen balance.

Basal energy and nitrogen nutritional needs can be reasonably estimated from the following two formulas:

Energy: Calories per day = 2,000 (TBSA in sq m)

Nitrogen: Grams per day = 15 (TBSA in sq m)

Daily hydration requirements after the initial fluid resuscitation can be estimated:

Water loss = 25 + % TBSA burn (TBSA in sq m) - ml/hr

The means of delivery of nutritional support depends on the condition of the patient. Enteral feeding should always be employed when possible. Oral intake is certainly the more desirable, but liquid feeding via nasogastric or gastrostomy tubes is usually well tolerated. When diarrhea becomes a problem, Kapectate or paregoric can be added to the feeding solution.

When ileus or concomitant abdominal injury makes gastrointestinal feeding undesirable, parenteral hyperalimentation is indicated. Daily nitrogen, vitamin, and caloric requirements are easily supplied through an intravenous infusion into a large central vein (subclavian or internal jugular). Administration of the hyperalimentation solution is most safely and accurately accomplished using a continuous-infusion type of pump. The solution itself consists of 4 to 8 per cent synthetic amino acids in hypotonic dextrose (10 to 50 g dextrose/l) with appropriate additives of vitamins, trace elements, and electrolytes. Patients can be maintained on this regimen for long periods, but as soon as gastrointestinal function returns, the transition to combined enteral/parenteral feeding should be started.

Intravenous hyperalimentation is not without hazard, and special procedures must be used at all times. Foremost in importance is catheter care. Sepsis from an infected central venous catheter is a disastrous complication in a burned patient, and is best prevented by sterile, meticulous, daily cleansing of the catheter site with an iodine solution and changing of the catheter dressing. Most burn centers advocate changing the catheter site at least every three days, and under no circumstances should the hyperalimentation line be used for any purpose (such as CVP monitoring) other than alimentation. Any patient receiving intravenous hyperalimentation in whom an unexplained spiking fever develops should have his central venous lines changed and the catheter tips sent for bacterial culture.

Patients receiving intravenous hyperalimentation should be closely monitored for glucosuria and hyperglycemia. This can be accomplished by frequent assessment of urinary and serum glucose. Severe hyperglycemia is best treated by small doses of regular insulin given intravenously as needed. Frequent monitoring of serum electrolytes is also indicated to permit immediate detection of hypokalemia, hyperkalemia, or hypernatremia.

Peripheral infusion of fat-emulsion solution (Intralipid) can also aid in satisfying caloric and some carbohydrate as well as fat requirements. Intralipid provides about one calorie/ml, and the solution used is isotonic; therefore, small peripheral veins are satisfactory for the infusion. No special catheter care is necessary, although frequent inspection for localized cellulitis is recommended.

**Relief of Pain**

The pain caused by a burn is related to size and depth. A full-thickness burn destroys the cutaneous nerve endings and abolishes sensitivity to touch and to painful stimuli. An extensive partial-thickness scald is usually more painful than a deep flame burn of the same size. Pain tolerances vary greatly from person to person. Thus, the severity of the pain experienced by an individual patient often cannot be predicted by
examination of the wounds, and complaints of discomfort must be considered valid.

Administration of narcotics to burned patients, however, must not be done on a routine basis or necessarily immediately. Narcotics are given to responsive, complaining patients only after ventilatory embarrassment has been ruled out as the cause of restlessness. In a previously healthy adult patient, 2–4 mg morphine, iv, every 2 hours as needed is usually sufficient. The addition of 25–50 mg hydroxyzine (Vistaril or Atarax) may aid significantly in reducing anxiety, and will allow substantial reduction of narcotic dosages.

Recovery Room and Postoperative Care

The recovery room or postoperative care of the burned patient provides a continuation of the concentrated care given in the operating room. Special equipment to meet the peculiar needs of burned patients, such as Circ-O-Lectric beds, ropes, weights, and pulleys for positioning and applying traction to extremities, should be available.

Postoperative intravenous fluid management is a particularly important part of the burned patient’s care. Many patients who have severe burns are chronically dehydrated and hypovolemic. On occasion, even the most detailed and sophisticated studies will not indicate these conditions preoperatively. Chronic hypovolemia may often be revealed only with the administration of anesthesia, and hypotension may continue after the patient has left the operating room when fluid replacement has been inadequate.

A burned patient is operated on for one or more of three primary purposes: 1) wound debridement, 2) skin grafting, and 3) correction of contractures. Less common operations include tracheostomy, escharotomy, and the insertion of wires in bones and across joints for traction and immobilization.

Recovery Room Care Following Wound Debridement

Surgical debridement of a burn wound may be either primary or delayed. Primary excision is performed within the first four to five days of injury, before significant bacterial invasion of the subcutaneous tissue has occurred. In the case of small (to as much as 20 per cent TBSA), well-delineated, full-thickness burns, the hospital stay can be shortened by complete excision of the burn wound. This is usually performed soon after injury and includes the removal of eschar and subcutaneous tissue down to the underlying deep fascia. Following such excision, the patient rarely presents a significant postoperative or recovery room problem. Almost all such patients have dressings applied to the areas of debridement. These dressings should be observed for wound drainage or contamination by urine, feces, or emesis. A change of dressing is indicated when the dressing appears soaked or soiled.

Delayed surgical debridement is performed when burn eschars are slow to separate. Since these burns are often large or numerous and the procedures are lengthy, estimations of operative blood losses may be inaccurate. Large burn wounds that are surgically debrided are invariably dressed at the time of debridement. These wounds have a greater propensity to ooze blood and plasma than the smaller burn wounds that are excised primarily. Therefore, it is important to watch the vital signs, urinary output, state of consciousness, the peripheral circulation, and watch the wound dressings for signs of bleeding and excessive transudation. Patients who have large wounds that have been surgically debrided may need oxygen postoperatively. In order to manage these patients objectively, they should have blood-gas studies, serum electrolyte determinations, and frequent determinations of peripheral hematocrit. Recovery room personnel should keep the responsible surgeon informed of excessive wound drainage or hemorrhage and of laboratory results and the patient’s clinical response while in the recovery room.

Recovery Room Care of Skin Grafts

Skin grafts are applied to burned patients to replace full-thickness skin losses and to cover skin defects created by scar excision on contracture release during reconstructive surgical procedures. In the acute phase, when the eschar has separated or has been excised, the burned patient is usually treated with autogenous split-thickness skin grafts (taken through the level of the dermis). Split-thickness skin grafts applied to a patient in an operating room are usually autografts that have been removed during anesthesia. Either they are applied as removed from the donor in large strips (sheet grafts), or the sheets of skin are meshed (meshed grafts) to increase the coverage of the wound and to allow for adequate drainage. Meshing will allow expansion of the area of the graft up to ninefold—an expansion of two- to threefold is optimal. Although sheet grafts and meshed grafts can be treated either by covering with a dressing or by exposing the grafted area, exposure is generally preferred. It allows the wound to be inspected frequently and makes obvious the accumulation of any exudate. Accumulation of exudate beneath the graft should be recognized immediately and evacuated promptly.
by locally compressing the graft with a moist cotton applicator. When the graft is large and the exudate appears centrally, a hole for evacuation may be made over the accumulation, which prevents it from spreading under uninvolved areas of the graft.11 Treating the grafted wound, exposed, imposes a significant obligation upon the recovery room personnel, who must prevent dislodgment of the grafts. Grafts may be dislodged by motion of the patient, by contact with bed clothing, or by hospital personnel not familiar with the techniques involved. Exposure of the grafts is preferred for ease of observation and treatment. However, there are certain relative indications for dressing grafted areas: 1) uncooperative patients (adults and children); 2) children too young to follow instructions; 3) grafted areas around joints in some patients; 4) grafts in dependent areas.

Granulating burn wounds are often treated with homografts and heterografts (pigskin xenografts) as temporary biologic dressings. This method of treating wounds is usually performed with the patient in his bed or in a treatment room with the patient awake. The application of homografts and heterografts is quite acceptable to most patients, because they tend to reduce pain and simplify care. Therefore, dislodgment and graft loss are not major problems. Post-application care is the same as for autografts.

The sites from which skin grafts have been taken can be dressed or exposed. The capillary ooze from the donor sites has usually subsided by the time the patient reaches the recovery room. When this bleeding persists, it should be treated by the continued application of moist, warm lap pads every 10 to 15 minutes. A dressing to apply mild, even compression is indicated when the oozing continues for more than an hour.

Maintaining the proper postoperative position of the patient with recently applied grafts about joints is crucial to prevent dislodgment of the grafts by normal joint motion, the pull of muscles, the effects of gravity, and the contracting forces of scar tissue. Plaster splints and strong traction devices are often necessary to prevent these factors. When contractures about the elbow, knee, or shoulder are released, the postoperative position is one of almost full extension, if this position can be attained. The position of the hand following a contracture release is one of elevation, and usually a functional position of the wrist and fingers.

Hypothermia is often initiated by the administration of an anesthetic in the operating room and perpetuated by exposed wounds and donor sites in the recovery room. The application of dressings lessens the loss of heat by convection and evaporation. However, hypothermia in itself is not an indication to dress the patient's wounds or donor sites. We prefer to warm the patient by a source of radiant heat, such as a heat lamp or warming canopy.

References