

Surgical treatment

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Early versus staged full-thickness burn excision Opinion varies on the timing of burn eschar excision. Early total burn excision refers to excision of the entire burn on arrival at the burns unit or as soon as logistically possible. Once the patient is cleared of trauma in the emergency department, the airway is secure and intravenous access and monitoring achieved, then the decision is whether to take the patient straight to theatre for burn wound debridement/escharectomy or to transfer the patient to the intensive care unit. The advantage of early burn excision is to exploit the time period or 'window' before the overwhelming systemic response to the burn reaches a crescendo. The 'anaesthetic' window refers to the effect of the burn on the airway - an upper airway burn can be bypassed by endotracheal intubation but a lower airway burn inhalational injury can cause chemical pneumonitis that may progress to acute respiratory distress syndrome. This usually becomes problematic after 48 hours; therefore, it is prudent to exploit this window and perform the burn excision during the time prior to lung injury decompensation. The 'haemodynamic' window refers to the progressive inflammatory vasodilation and potential coagulopathy. This leads to an increasing resistance to vasoconstrictor agents in tumescence fluids with the potential for blood loss and need for blood transfusion which can drive further immunocompromise. Excising a full-thickness burn early, prior to these changes, can result in less blood loss. Additionally removing the eschar, which plays a role in driving the fluid shifts, will result in less oedema and lower fluid requirements. Finally the 'bacterial' window is also important. Excising a full-thickness burn, which is essentially necrotic material, can help to reduce the bacterial load, thereby reducing the risk of infection.

- Summary box 46.15 Early burn excision

Early burn excision is dependent on the appropriate staff, resources, equipment and time. When these are not readily available a staged approach is also utilised. This involves serial debridement of the burn over several operating sessions in the first week of the burn. Proponents of this approach advocate shorter operating times and reducing the requirements for blood transfusions. This technique also relies on managing the remaining burn eschar until excision to prevent bacterial colonisation and to prepare for surgery. This is achieved by using silver-based dressing/creams containing antibacterial properties including Pseudomonas aeruginosa and methicillin-resistant Staphylococcus aureus.

Upper limb Midaxial. Anterior to the elbow medially to avoid the ulnar nerve Hand Midline in the digits Release muscle compartments if tight Best done in theatre Midaxial. Posterior to the ankle medially to avoid Lower limb the long saphenous vein and anterior to the head of the fibula to avoid the common peroneal nerve Down the chest lateral to the nipples, across the Chest chest below the clavicle and across the chest at the level of the xiphisternum Extend the wound beyond the deep burn General Diathermy any significant bleeding vessels rules Apply haemostatic dressing and elevate the limb postoperatively Removal of eschar reduces bacterial load Majority of surgery is performed prior to substantial lung injury Allows effective use of vasoconstrictive fluids Requires adequate theatre, staff and facilities

Dressings with silver that are commonly used include: Silver sulphadiazine cream (1%). This gives broad-spectrum prophylaxis against bacterial colonisation. Mafenide acetate cream. This is popular, especially in the USA, but is painful to apply and has been associated with metabolic acidosis. It is usually used as a 5% topical solution. Silver sulphadiazine and cerium nitrate induces a sterile eschar on the burned skin and has been shown in certain instances, especially in elderly patients, to reduce some of the cell-mediated immunosuppression that occurs in burns. It is especially useful in treating burns when a conservative treatment option has been chosen. Cerium nitrate has also been shown to boost cell-mediated immunity in these patients. Acticoat. This is a nanocrystalline silver barrier dressing and is an effective antimicrobial against a broad spectrum of bacteria. The keystone of burns surgery is control, regardless of whether early or staged excision is the plan. A wide-bore cannula should be used and the patient's blood pressure must be monitored adequately. If a large excision is considered, then an arterial line (to monitor blood pressure) and central venous access are needed. The anaesthetist also needs measurements and control of the acid-base balance, clotting time and haemoglobin levels. The core temperature of the patient must not drop below 36°C, otherwise clotting irregularities will be compounded. For most burn excisions, subcutaneous injection of a dilute solution of adrenaline (epinephrine) 1:1000 or 1:500 and tourniquet control are important for controlling blood loss. The tumescence fluid is injected into both the burn and the donor sites.

Figure 46.7 (a-d) Extensive full-thickness burns at first operation. Note the placement of the escharotomies on the chest and the lower limb. The leg had an escharectomy followed by escharotomy. (d) Shorter but more frequent surgical theatre trips will require managing/binding of remaining eschar

In deep dermal burns, tangential excision is performed until punctate bleeding is observed and the dermis can be seen to be free of any small, thrombosed vessels. A topical solution of 1:500 adrenaline also helps to reduce bleeding, as does the application of the skin graft/substitute. Full-thickness burns require full-thickness excision of the skin. In certain circumstances, it is appropriate to go down to the fascia but, in most cases, the burn is viable fat. Wherever possible, a skin graft/substitute should be applied immediately (Figure 46.8). The plane deep to the graft and at the horizontal margins where it meets unburned skin. Split-skin grafts can be left as intact sheets where function (over major joints, hands and fingers, anterior neck), cosmesis (face, dorsum of hands) and future growth (developing breasts) are particularly important; however, skin grafts can never result in 'normal' skin. Because we rely on spontaneous healing of the site from which they are harvested (the donor site), they are thin, consisting of the epidermis and a variable proportion of the superficial dermis. They are often harvested as between 0.30 and 0.38 mm and thus their application into the burn wound creates a donor defect. Because the dermal component of the graft is raft contraction post application occurs. The thinner the harvested graft, the greater the degree of contraction and the greater the degree of functional disability and dysaesthesia. The donor site is painful; as a result techniques must be employed to reduce the size of the donor site in an effort to minimise the pain. These include meshing the graft by putting it through a series of blades mounted on rollers that create off-raft in horizontal lines. Post meshing, set incisions in the skin and these cuts can be pulled open, extending the graft and resulting in diamond-shaped defects. This has the

advantage of reducing the likelihood of graft haematoma/seroma. Meshing can be performed at different ratios. As the ratio increases, the size of the diamond defect increases. deep burn does not Since the burn bed after excision of contain tissue capable of healing without modification of the bed structure, a small bleb of granulation tissue forms in these results in a character - diamonds between the graft struts. This r istic mesh pattern scarring. The wider the mesh, the worse the appearance. Although the epidermis can regenerate, the dermis removed from the donor site during skin graft harvesting can scar forms under the new epidermis only repair and a layer of at the donor site, which is 'thinner' than it was pre-harvest. The donor site is thus not an infinite resource. With serial graft harvesting, the donor site can become so deep a wound that adnexal structures are no longer present and the donor site has to heal by secondary intention, or receive a skin graft itself. In very extensive burns, where the burn size exceeds donor site availability , the surgeon tends to rely on higher ratios (1:3, up to 1:9) and harvests the skin grafts more thinly . This allows the donor site to heal more rapidly , facilitating earlier reharvest when serial grafting is required. Postoperative management of these patients requires care - ful evaluation of fluid balance and levels of haemoglobin. The outer dressings will require attention and regular changing because of expected fluid leaks. Physiotherapy and splints are important in maintaining ement and reducing joint contracture. Eleva - range of mov tion of the appropriate limbs is important. The hand must be splinted in a position of function after grafting, although the raft needs to be applied in the position of maximal stretch. g Knees are best splinted in extension; axillae in abduction. vement by the physiotherapists, usually under Supervised mo direct vision of any a ff ected joints, should begin after about 5 days.

(b) (c) Figure 46.8 Full-thickness leg burns. (a) Marked for excision; /uni00A0 (b) excised to healthy tissue fat/fascia; (c) skin graft at /f_i rst dressing change.

Burn excision surgery /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF

Deep dermal burns need tangential shaving and split-skin grafting or dermal substitutes All but the smallest full-thickness burns need surgery The anaesthetist needs to be ready for signi /f_i cant blood loss Tumescence /f_l uid and topical adrenaline reduces bleeding All burnt tissue needs to be excised Stable cover, permanent or temporary, should be applied

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decompensation. The 'haemodynamic' window refers to the progressive inflammatory vasodilation and potential coagulopathy. This leads to an increasing resistance to vasoconstrictor agents in tumescence fluids with the potential for blood loss and need for blood transfusion which can drive further immunocompromise. Excising a full-thickness burn early, prior to these changes, can result in less blood loss. Additionally removing the eschar, which plays a role in driving the fluid shifts, will result in less oedema and lower fluid requirements. Finally the 'bacterial' window is also important. Excising a full-thickness burn, which is essentially necrotic material, can help to reduce the bacterial load, thereby reducing the risk of infection.

Summary box 46.15 Early burn excision

Early burn excision is dependent on the appropriate staff, resources, equipment and time. When these are not readily available a staged approach is also utilised. This involves serial debridement of the burn over several operating sessions in the first week of the burn. Proponents of this approach advocate shorter operating times and reducing the requirements for blood transfusions. This technique also relies on managing the remaining burn eschar until excision to prevent bacterial colonisation and to prepare for surgery. This is achieved by using silver-based dressing/creams containing antibacterial properties including *Pseudomonas aeruginosa* and methicillin-resistant *Staphylococcus aureus*.

Upper limb Midaxial. Anterior to the elbow medially to avoid the ulnar nerve
Hand Midline in the digits
 Release muscle compartments if tight
 Best done in theatre
Lower limb Midaxial. Posterior to the ankle medially to avoid the long saphenous vein and anterior to the head of the fibula to avoid the common peroneal nerve
Chest chest below the clavicle and across the chest at the level of the xiphisternum
 Extend the wound beyond the deep burn
General Diathermy any significant bleeding vessels rules
 Apply haemostatic dressing and elevate the limb postoperatively
 Removal of eschar reduces bacterial load
 Majority of surgery is performed prior to substantial lung injury
 Allows effective use of vasoconstrictive fluids
 Requires adequate theatre, staff and facilities

Dressings with silver that are commonly used include:

- Silver sulphadiazine cream (1%). This gives broad-spectrum prophylaxis against bacterial colonisation.
- Mafenide acetate cream. This is popular, especially in the USA, but is painful to apply and has been associated with metabolic acidosis. It is usually used as a 5% topical solution.
- Silver sulphadiazine and cerium nitrate induces a sterile eschar on the burned skin and has been shown in certain instances, especially in elderly patients, to reduce some of the cell-mediated immunosuppression that occurs in burns. It is especially useful in treating burns when a conservative treatment option has been chosen. Cerium nitrate has also been shown to boost cell-mediated immunity in these patients.
- Acticoat. This is a nanocrystalline silver barrier dressing and is an effective antimicrobial against a broad spectrum of bacteria.

The keystone of burns surgery is control, regardless of whether early or staged excision is the plan. A wide-bore cannula should be used and the patient's blood pressure must be monitored adequately. If a large excision is considered, then an arterial line (to monitor blood pressure) and central venous access are needed. The anaesthetist also needs measurements and control of the acid-base balance, clotting time and haemoglobin levels. The core temperature of the patient must not drop below 36°C, otherwise clotting irregularities will be compounded. For most burn excisions, subcutaneous injection of a dilute solution of adrenaline (epinephrine) 1:1000 or 1:500 and tourniquet control are important for controlling blood loss. The tumescence fluid is injected into both the burn and the donor

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Figure 46.7 (a-d) Extensive full-thickness burns at first operation. Note the placement of the escharotomies on the chest and the lower limb. The leg had an escharectomy followed by escharotomy. (d) Shorter but more frequent surgical theatre trips Will require managing/binding of remaining eschar

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