الفرقة الثانية
2017/2018

Complications of wound healing

1. Wound failure.
2. Hypertrophic scar: the scar is raised above the surface but within the confines of the wound.
3. Keloid formation: the scar is raised above the surface and extends beyond the confines of the wound.
4. Stretching of the scar: Widening of the scar tissue.
5. Contracture: shortening of the scar tissue.
6. Surgical site infection.

Blood Transfusion

is a complex method to restore the anatomical and functional integrity.

Types of Wound Healing

Primary Healing (First Intention)

It occurs in a clean incised wound or surgical wound. Wound edges are approximated with sutures. There is more epithelial regeneration than fibrosis. Wound heals rapidly with complete closure. Scar will be linear and smooth.

Secondary Healing (Second Intention)

It occurs in a wound with extensive soft tissue loss like in major trauma, burns and wound with sepsis. It heals slowly with fibrosis. It leads into a wide scar, often hypertrophied and contracted. It may lead into disability.

Tertiary Healing (Third Intention)

After wound debridement and control of local infection, wound is closed with sutures or covered using skin graft.

Treatment

Treatment of hypovolaemic shock wouldn't be successful without arre volume loss. As mentioned in chapter4 hemostasis is of supreme importa mainstays of initial treatment of shock are the infusion of fluids and the adminis oxygen. Close clinical and laboratory monitoring guides the magnitude of resuscit

1. **Fluid resuscitation.**
   - **Venous access.** At least two large-gauge catheters are inse appropriate veins. At the same time, blood is drawn for typing and cross matching (Chapter 4).
   - **Lactated Ringer's solution**. An infusion of lactated Ringer's solution is begun immediately. The lactated Ringer's solution is run at a rapid rate so that in a period of 45 minutes between 1000 and 2000 ml of lactated Ringer's solution are given intravenously. The procedure is a highly effective therapeutic trial to determine the pre-existing amount of blood loss or the presence of continuing blood loss. It is often observed that the blood pressure will return to normal, become stable, and remains so in patients with minimal blood loss and in whom haemorrhage is not continuing.
   - **Blood**. If blood loss has been severe or haemorrhage is continuing, the elevation of blood pressure and reduction in pulse rate that occur with rapid IV infusion of lactated Ringer's solution are usually transient. When this occurs, blood that has been accurately typed and cross-matched is given immediately.
   - **Colloid solutions**. In the absence of whole blood, many substances have been proposed as human plasma, albumin solution, dextran and artificial blood substitutes. Hypovolaemic shock from other causes other than bleeding, e.g., plasma loss in major bums, or crystalloid loss in intestinal obstruction does not usually need blood, and infusion is by plasma or crystalloids respectively.

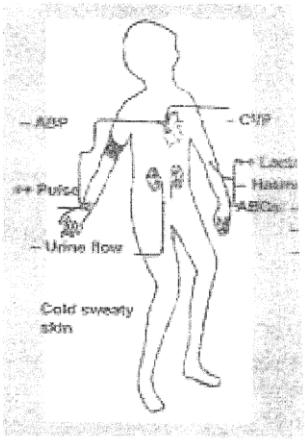
HYPOVOLAEMIC SH(

Decreased blood volun

Common causes
- Hemorrhage
- Burns
- Acute pancreatitis

Early signs
- Tachycardia (mild)
- Orthostatic hypotens
- Anxiety
- Sweatirig
- Pallor

Late signs
- Depressed mental st
- Decreased BP
- Tachycardia (marked



The best indicator of perfusion is urine flow.

...based on arterial gas measurements.

- Evidence of respiratory failure is an indication for endotracheal intubation and mechanical ventilation.

3. **Monitoring.** A patient with hypovolaemic shock should have meticulous monitoring to check the adequacy of volume replacement.
   - Clinical parameters as the pulse, blood pressure, state of filling of veins and capillary perfusion.
   - A Foley catheter is introduced to check urine output every hour. Optimum output is 0.5-l ml/kg/hour.
   - Central venous pressure (CVP). The CVP is the venous pressure in the right atrium and is equal to the end-diastolic pressure in the right ventricle and is a measure of the preload to this chamber. To measure the CVP, a catheter is placed in the right atrium via the median-cubital vein, the subclavian vein or the internal jugular vein. The position of the venous catheter is checked by chest X-ray. The radiograph also serves to rule out pneumothorax due to accidental pleural injury during its insertion. The normal pressure is 5-10 cm of water. Assuming that cardiac function is normal, the CVP roughly corresponds to the blood volume. Thus, a fall

- – Bacterial infection
- – Malaria transmission
- – Epstein-Barr virus infection
- Syphilis.

4. ☐☐ Air embolism
5. ☐☐ Thrombophlebitis
6. ☐☐ Coagulation failure

- – Dilution of clotting factors
- – DIC
- – Dilutional thrombocytopenia occurs in patients with

7. massive blood transfusion
8. ☐☐ Circulatory overload causing heart failure
9. ☐☐ Haemochromatosis in patients with CRF receiving repeated blood transfusions

10. ☐☐ Citrate intoxication causes bradycardia an hypocalcaemia. For every four units of blood

1. □□ Congestive cardiac failure

2. □□ Transfusion reactions:

- – Acute Hemorrhagic reaction: It is due to ABO incompatibility. Major and minor reactions with fever, rigors, pain & hypotension.
- – Pyrexial reactions due to pyrogenic ingredients in the blood

- – Allergic reactions to specific proteins in the donor's plasma.

3. Infections

- – Serum hepatitis
- – HIV infection
- – Bacterial infection
- – Malaria transmission
- – Epstein-Barr virus infection
- Syphilis.

4. □□ Air embolism

5. □□ Thrombophlebitis

6. □□ Coagulation failure

therapy may continue. Several formulae have been proposed for estimating the patient's fluid needs, keeping in mind that the greatest loss of fluids occurs during the first 8 hours post-burn and continues more slowly over the next 16 hours.

Parkland's formula is commonly prescribed. It is estimated as follows (Fig. 8.10):

- First 24 hours: 4 ml/Kg/1% surface area as lactated Ringer's solution. Half the calculated amount is administered in the first 8 hours and other half over the next 16 hours.
- Over the next 24 hours half the previous amount is administered.
- Administration of blood is usually needed in major deep burns. It can be started after 48 hours, guided by the haematocrit value.
- It is to be noted

It is to be noted that in all formulae, the maximum percentage of burn calculated is 50%, otherwise serious overinfusion may occur. Oral intake is avoided during the first 48 hours to avoid gastrointestinal complications and is started gradually after that.

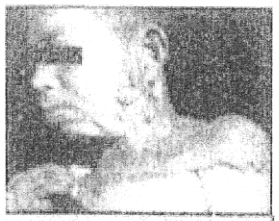


Fig. 8.9 Contracted keloidal scar of the neck that followed spontaneous healing of a deep burn

Management of Burns

This needs the utmost care and attention, and it is better to treat patients with r urns in special centers.

irst aid

1. A patent airway should be assured. If there is airway obstruction, an endotrac tube should be inserted.
2. A strong analgesic as 50 mg pethidine is administered IV. Intramuscular injec are avoided as absorption is poor. Analgesic administration is repeated as neede
3. Tetanus prophylaxis.
4. Saline or tap water, at room temperature, can be poured over the burnt area fc minutes to limit the depth of burn, decrease oedema and relieve pain. Using ice- water from a refrigerator is contraindicated as it may induce more tissue damage

dmission to hospital

Minor burns (less than 15% in adults and 10% in children) can be treate itpatients. In such cases the treatment consists of dressing using the proper emotherapeutic (mentioned later), and analgesia.

Indications of the admission to the hospital

1. inhalation injury.
2. Burn size over 15% in adults or 10% in children.
3. Any full thickness burn.
4. Burn in association with trauma or comorbidity.
5. Electric burns.
6. Chemical burns.

If it is decided to admit the patient, the following is performed

- A wide bore IV. cannula is inserted rapidly before the veins get collapsed.
- A Foley urethral catheter is introduced to check urine output.
- Treatment essentially consists of fluid therapy to compensate for the exter losses and local care of the burn wound.
- The value of systemic antibiotics in prevention of burn wound infectio controversial.

suscitative fluid therapy

The amount and rate of fluid replacement are determined by the weight o ient and the percentage of the total body surface area injured. It is essentially give first 48 hours and after that according to the response of the patient a mainten rapy may continue. Several formulae have been proposed for estimating the pati d needs, keeping in mind that the greatest loss of fluids occurs during the first 8 h t-burn and continues more slowly over the next 16 hours.

kland's formula is commonly prescribed. It is estimated as follows (Fig. 8.10):

... in critical cases.

The nutritional status

Of the patient should not be neglected. Patients who have extensive burns are liable to have a serious catabolic status due to the combined effects of anorexia, extensive water and consequently caloric losses and due to sepsis if present. Introduction of intravenous hyperalimentation (Chapter 9) has made it easy to correct this problem and to support the patient nutritionally during this critical period.

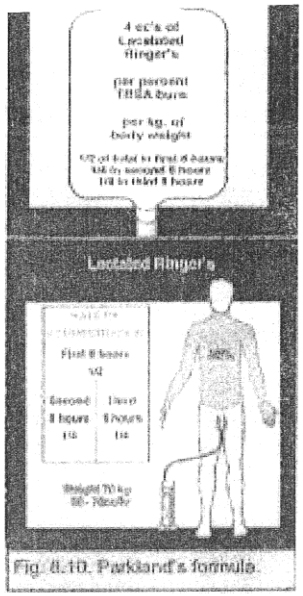


Fig. 8.10. Parkland's formula

Local burn wound care

Early care

After general resuscitative measures have been started, attention should be directed to the burn wound.

1. **Escharotomy**. Constricting eschars (in the limbs and chest) may have to be released immediately (Fig. 8.11). Sometimes, fasciotomy (in deeper burns) may be limb saving and has to be done as a first aid measure.
2. **Cleansing**, removing loose skin, and initial conservative debridement. The aim of the local wound care is to avoid infection.
3. **Topical antimicrobial** agents should be applied. The ideal topical cream should be in a water soluble base, prevents dryness, not painful, nonallergenic, non toxic and most importantly bactericidal but not injurious to viable dcells in the burn wound. The three most commonly used topical agents are; silver suiphadiazine, silver nitrate solution and mafenide acetate.

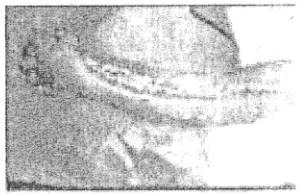


Fig. (8.11) Escharotomy for deep circumferential burns

4. After application of the local cream, the wound is managed by either leaving it exposed (the exposure method) or by covering it by a bulky occlusive dressing (the occlusive method) that is changed every 2- 3 days depending on the state of the burn wound. Both the occlusive and exposure methods are equally effective. However the

they get arrang... the wou...
increase in the tensile strength of the wo... should be noted
remodeling continues for about one year. It should be noted
that a wound never attains its full original tensile strength.

pes of wound healing

aling by primary intention. This occurs in clean wounds
en they are immediately closed by sutures or clips. Healing occur
h minimal fibrosis leading to a nice neat scar (Fig. 1.2).

aling by secondary intention. This occurs when the wound
es are not approximated or when gaping occurs as a result of a
matoma or wound infection. Healing occurs by in-filling with
ulation tissue and so there is more fibrous tissue. The resulting
is ugly (Fig 1.3).

ling by tertiary intention. Wounds which are contaminated
ft open for about 5 days. At the end of this period if there are no
of infection, delayed primary sutures can be performed.

41).

2. **Stretching of the scar.**
3. **Hypertrophic scar.** The scar is raised above the surface but it remains within the confines of the wound. Within months it may regress. This problem is common in the shoulder and presternal area.
4. **Keloid formation.** There is over-activity of the healing process leading to excessive scar tissue which is raised above the surface, and extends beyond the confines of the original wound.
   It can follow burns, traumatic or surgical wounds, inflammation, ear-holing and vaccination.
   Persons with dark skin are more prone to keloid formation (Fig. 1.4) and there is a familial predisposition. Certain areas as the ear lobules, shoulder and presternal areas are more liable to keloid formation.
   Treatment of hypertrophic scars and keloids:
   - Continuous pressure by silicone gel sheets. Continuous pressure causes ischaemia of the small blood vessels leading to diminished activity of fibroblasts and diminished collagen synthesis.
   - Intralesional corticosteroids. Triamcinolone and a local anaesthetic are injected in the dermal region of the scar.
   - Surgical excision. Recurrence rate after simple excision may reach 80%. To minimize recurrence intramarginal excision of the scar is recommended together with intraoperative injection of steroids.
5. **Contracture.** This is pathologic shortening of scar tissue resulting in deformities if the scar overlies a joint (Fig. 1.5). Proper positioning of the joint during healing can minimize the deformity.
6. **Wound infection.** (Chapter 7).

are the infusion [illegible] monitoring [illegible]
clinical and laboratory
resuscitation.

1. **Fluid resuscitation.**
   - **Venous access.** At least two large-gauge catheters are inserted into appropriate veins. At the same time, blood is drawn for typing and cross matching (Chapter 4).
   - **Lactated Ringer's solution.** An infusion of lactated Ringer's solution is begun immediately. The lactated Ringer's solution is run at a rapid rate so that in a period of 45 minutes between 1000 and 2000 ml of lactated Ringer's solution are given intravenously. The procedure is a highly effective therapeutic trial to determine the pre-existing amount of blood loss or the presence of continuing blood loss. It is often observed that the blood pressure will return to normal, become stable, and remains so in patients with minimal blood loss and in whom haemorrhage is not continuing.
   - **Blood.** If blood loss has been severe or haemorrhage is continuing, the elevation of blood pressure and reduction in pulse rate that occur with rapid IV infusion of lactated Ringer's solution are usually transient. When this occurs, blood that has been accurately typed and cross-matched is given immediately.
   - **Colloid solutions.** In the absence of whole blood, many substances have been proposed as human plasma, albumin solution, dextran and artificial blood substitutes. Hypovolaemic shock from other causes other than bleeding, e.g., plasma loss in major burns, or crystalloid loss in intestinal obstruction does not usually need blood, and infusion is by plasma or crystalloids respectively.
2. **Pulmonary support.**

- Oxygen mask. For all shocked patients oxygen at high concentration is initially administered through a face mask. Later adjustment of rate and concentration depends on arterial gas measurements.
- Evidence of respiratory failure is an indication for endotracheal intubation and mechanical ventilation.

3. **Monitoring.** A patient with hypovolaemic shock should have meticulous monitoring to check the adequacy of volume replacement.
   - Clinical parameters as the pulse, blood pressure, state of filling of veins and capillary perfusion.
   - A Foley catheter is introduced to check urine output every hour. Optimum output is 0.5-1ml/kg/hour.
   - Central venous pressure (CVP). The CVP is the venous pressure in the right atrium and is equal to the end-diastolic pressure in the right ventricle and is a measure of the preload to this chamber. To measure the CVP, a catheter is placed in the right atrium via the median-cubital vein, the subclavian vein or the internal jugular vein. The position of the venous catheter is checked by chest X-ray. The radiograph also serves to rule out pneumothorax due to accidental pleural injury during its insertion. The normal pressure is 5-10 cm of water. Assuming that cardiac function is normal, the CVP roughly corresponds to the blood volume. Thus, a high pressure indicates overtransfusion, while a low pressure indicates hypovolaemia.
   - Pulmonary artery wedge pressure (PAWP). When the right side of the heart is functioning abnormally, it is highly probable that the left side of the heart is equally affected. In such a case, it is recommended to measure PAWP by the use of a Swan-Ganz catheter which is passed into a small branch of the pulmonary artery where it becomes wedged (Fig. 6.4). As the balloon of the catheter occludes this small branch, the pressure measured at the catheter tip reflects that in the left side of the heart.
   - ECG.
   - Temperature. A simple non-invasive method of assessing cardiac output and peripheral perfusion is to measure the difference between the peripheral and core temperature. The former is measured by a sensor attached to the big toe, and the latter by a probe placed in either the rectum or the oesophagus. In a warm ambient temperature, the core is higher than peripheral temperature by a gradient that should not exceed 2°C. Any increase in this gradient is a very sensitive indicator of decreased perfusion.
   - Repeated hematocrit and haemoglobin assessment.
   - Blood gases:
     PO2 is normally between 80-100 mm Hg.
     PCO2 is normally between 35-45 mm Hg.
4. **Positioning.** Elevating both legs with maintaining the trunk and the remainder of the patient in the supine position is the preferred position in patients with hypovolaemic shock.
5. **Pain relief.**
   - If analgesics are needed the intravenous route is used because of the poor absorption from the subcutaneous tissues or the muscles which are hypoperfused.
   - Early immobilization of fractures.
6. **Inotropic agents** are used when the condition fails to improve despite adequate volume replacement and oxygenation. Dopamine and dobutamine are the most widely used. Both improve myocardial contractility while dopamine increases renal blood flow and urine output as well.

Irreversible shock. At some stage, hypovolaemic shock may become refractory to the above therapy. Complete vascular collapse with hypotension unresponsive to volume or drug intervention eventually leads to multiple organ failure (MOF) and lethal central nervous system and cardiac dysfunction.

How quickly is difficult to define, but has been related to the duration and volume of haemorrhage, the age and pre-existing cardiovascular fitness of the patient, and the coexistence of massive trauma with multiple injuries. Before the conclusion that refractory shock has occurred, other causes of failure to respond to therapy should be resolved.

- Ongoing intravascular blood loss into the chest or abdomen.
- Tension pneumothorax.
- Intrapericardial tamponade.
- Thoracic injuries including cardiac tamponade and haemopneumothorax.

Complications of blood transfusion

1. **Pyrogenic reactions.** These are the commonest unpleasant consequences of blood transfusion. The patient develops chills, fever, headache, nausea and vomiting. These reactions are due to either bacterial contamination or due to the presence of recipient antibodies against some components of donor's blood as white blood cells or platelets. Transfusion is stopped and the patient is given antihistamine and hydrocortisone.
2. **Allergic reactions.** These range from mild itching and urticaria to a severe reaction with laryngeal oedema and collapse. They are due to the recipient's response to allergens in the donor's blood. These reactions are common in those patients who received many transfusions in the past. Treatment is with antihistaminics and corticosteroids. If the reaction is severe, blood transfusion should be stopped.
3. **Congestive cardiac failure.** This is liable to occur in elderly persons especially if a large volume of blood is administered too rapidly. It is recommended to transfuse packed red cells rather than whole blood to correct anaemia in elderly persons.
4. **Haemolytic reactions.** Most often these reactions are due to the presence of antibodies in the recipient's blood against one or more of the antigens of the donor's cells. Occasionally transfused blood contains a high titre of antibodies against the recipient's RBCs. Clinically haemolytic reactions present after the transfusion of less than 50 ml by fever, chills, constricting pain in the chest, dyspnoea and pain in the flanks. Examination reveals tachycardia and hypotension. In anaesthetized patients the manifestations of haemolytic reactions are sudden tachycardia, hypotension and bleeding tendency. A major haemolytic reaction will lead to haemoglobinuria, jaundice and acute renal failure due to acute tubular necrosis. Consumption coagulopathy will lead to generalized bleeding tendency.

Management

- Stop the transfusion immediately.
- Send the donor's blood and a sample of the patient's blood for repeat typing and matching.
- Correct shock by infusion of crystalloid solution (Lactated Ringer) and IV corticosteroids.
- Insert a Foley catheter and check that there is an adequate urine output. An osmotic diuretic mannitol may be needed. Keep an alkaline urine to protect against acute renal failure. IV sodium bicarbonate may be indicated.
- Should the patient develop acute renal failure, he must receive the appropriate treatment.

Transmission of infection

- Viral hepatitis (B or C). This is now the most feared complication. The virus can be transmitted by blood or blood products. It is obligatory to test donors for hepatitis viruses.
- AIDS (HIV infection can be transmitted by blood or by its products.
- Syphilis. This is now rare. It is transmitted by blood or by its products.
- Malaria. This is now rare. It is transmitted by blood or by its products.

Factor IX	
Albumin 5% or 20%	Acute volume expansion. Hepatic failure

However, if the blood is allowed to warm, bacteria can grow and Gram-negative endotoxins can cause septicaemic shock.

6. **Hyperkalaemia:** With prolonged storage of blood, there is progressive loss of potassium from erythrocytes into the plasma. Transfusion of several units of aged blood may produce cardiac arrhythmias or even arrest due to hyperkalaemia.
7. **Citrate intoxication:** Excess citrate will bind to the recipient's calcium leading to hypocalcaemia which augments the effects of hyperkalaemia on the myocardium. If more than 2 units of blood are administered, it is important to administer 10 ml of 10% calcium gluconate for each two units of blood.
8. Air embolism.
9. **Complications of massive blood transfusion:** This implies transfusion of 2500 ml of blood at one time or 5000 ml or more over 24 hours.
   - Hypothermia. A special warming unit should be used to warm the blood before transfusion as hypothermia can cause acidosis or cardiac arrest.
   - Hyperkalaemia.
   - Hypocalcaemia.
   - Coagulation failure. This is due to the dilution of clotting factors and platelets when large volumes of stored blood are being used to replace blood losses, because stored blood is poor in platelets, factor VIII and factor V. In these situations it is recommended to transfuse one unit of fresh frozen plasma and platelets for every unit of stored blood.
   - Diminished O2 carrying capacity of red blood corpuscles.

Alternatives to homologous blood transfusion

Autologous blood transfusion: A patient who is going to have a

- Compensated [illegible]

(b) Delayed local complications

- Contractures across joints (Fig. 8.9)
- Scar formation (hypertrophic or keloid)
- Malignant transformation (Marjolin's ulcer) in long standing unstable scars [illegible]

Management of Burn

This needs the utmost care and attention, and it is better to treat patients with major burns [illegible]

First aid

1. A patent airway should be assured. If there is airway obstruction, an endotracheal tube [illegible]
2. A strong analgesic as 50 mg pethidine is administered I.V. Intramuscular injection [illegible] absorption is poor. Analgesic administration is repeated as needed.
3. Tetanus prophylaxis.
4. Saline or tap water, at room temperature, can be poured over the burnt area for [illegible] depth of burn, decrease oedema and relieve pain. Using ice-cold water [illegible] contraindicated as it may induce more tissue damage.

Admission to hospital

Minor burns (less than 15% in adults and 10% in children) can be treated as outpatients [illegible] treatment consists of dressing using the proper local chemotherapeutic (mentioned later) [illegible]
On the other hand all major and most moderate burns (except very superficial ones) [illegible] the burn unit.

If it is decided to admit the patient,

- A wide bore I.V. cannula is inserted rapidly before the veins get collapsed.
- A Foley urethral catheter is introduced to check urine output.
- Treatment essentially consists of fluid therapy to compensate for the extensive losses [illegible] burn wound.
- The value of systemic antibiotics in prevention of burn wound infection is controversial.

Resuscitative fluid therapy

The amount and rate of fluid replacement are determined by the weight of the patient and [illegible]