The total surface area of skin in an average adult is 300 sq inches. The thickness of skin is 0.53 to 3 mm (0.02 - 0.12 inch). Structurally, skin has three layers:

a. Epidermis - epithelium
b. Dermis – it is an in-between part made of fibres from dermis to subcutaneous layer.
c. Subcutaneous layer or superficial fascia - this layer is attached to underlying tissues.

**Functions of the skin**

1. The skin provides protection from infections.
2. It conserves the body fluids which is essential for health.
3. Regulation of temperature – the skin helps to adjust the body in adverse climatic conditions.
4. Excretion – the unwanted materials from body are released through the skin.
5. Feeding the body is yet another important function of the skin, it helps in production of Vitamin D.
6. Most significantly, skin is the major agency to stimulate sensory response.

**Physiology of Skin**

*Conversant of body fluids*

Body water is distributed in three compartments

a. Intracellular - in the cell = 40 percent
b. Extra cellular - outside the cell / intravascular = 5 percent
c. Interstitial - In tissue space = 15 percent

Skin regulates fluid level by a sweat gland activity. The normal important electrolytes contain potassium and sodium. In certain conditions, the physiology of the skin is liable to alteration in 0-48 hours.

**Emergency / Metabolic / Resuscitative phase of burns.**

1. *Oedema and Haemocountration*

There is intense vasodilatation and increased capillary permeability in and around the burned area. This allows an escape of plasma proteins and electrolytes from the blood vessels. The leakage occurs in these manners.

- To the surface as exudates.
- Beneath the layers of the skin as blister fluid.
- To the extra cellular space as oedema.

Red blood corpuscles (RBC) do not usually leak through the capillaries, however, only the plasma-like fluid escapes. The fluid in circulation becomes concentrated with RBC. This process is known as haemoconcentration.

2. *Oligaemic shock / Burns shock*

In extensive burns, the haemoconcentration may be marked. This reduction in the circulatory volume may lead to burns shock or oligaemic shock.

3. *Renal Shutdown*

RBCs are destroyed due to haemolysis and bleeding at the burnt site. Free haemoglobins are released from the destroyed RBCs and may produce renal damage.

4. *The body’s defence*

The natural defence is for vasoconstriction to occur in the undamaged blood vessels of the skin and splanchnic areas. This reduces the blood flow to these areas and increases the blood flow to the vital organs.

**Pathophysiology of Burns**

1. Burns are caused by transfer of energy from a heat source to the body. Heat may be transferred through conduction or electromagnetic radiation.
2. Burns are categorised as thermal, reduction or chemical.
3. Tissue destruction results from coagulation, protein denotation or ionisation of cellular contents. The skin and mucous of upper air ways are the sites of tissue destruction.
4. Deep tissue including the viscera can be damaged by electrical burns or through prolonged contact with heat source.
5. Disruption of the skin can lead to increased fluid loss, infection, hypothermia, scarring, compromised immunity and charges in function, appearance and body image.

6. The depth of the imaging depends on the temperature of the burning agent and the duration of contact with that agent.

Areas Affected in Burns

These can be:
1. Skin
2. Tissues
3. Deeper tissues
4. Fluid and electrolyte status
5. Whole body system (due to defence mechanism).

Depth of Burns

1. Superficial partial thickness injuries - epidermis and portion of dermis.
2. Deep partial thickness injuries - epidermis and upper layer of tarmacs and injury to deeper portion of dermis.
3. Full thickness injuries - epidermis + dermis + underlying tissue.

Determining the depth of burn can be difficult even for the experienced burn care providers. Various features of burn according to depth are shown in Table 1.

Extent of body surface area injuries can be described as under:
1. Rule of nine
2. Lund and browder method
3. Palm method.

Rule of Nine: Estimated percentage of total body surface area (TBSA) in the adult is arrived by sectioning the body surface skin areas with a numerical value related to nine.

Local and Systemic Response

a. Burns less than 25 percent TBSA produce a primary local response.

b. Burns above 25 percent TBSA may produce primary and systemic response.

Systemic responses are due to the release of cytokines and the mediators in systemic circulation.
Initial systemic responses are:
- Homodynamic instability, resulting from loss of capillary integrity and subsequent shift of fluid, sodium & protein from the ultra-vascular space to the interstitial space.
- Homodynamic instability involves cardio vascular third and electrolyte, blood volume, pulmonary and other mechanism.

CVS Response

Hypodermic- I COP-perfusion and O₂ delivery. In response, the sympathetic nervous system releases catecholamine resulting in an increase in peripheral resistance (vaso constriction) and increase in pulse rate.

Myocardial contractility may be suppressed by the release of inflammatory kinera necrosis factors (Wolf, Prougli & Henderson, 2002.)

The Treatment - Fluid Resuscitation

Despite this, CVP, PAWP remain low during the burn shock period. Generally the greater volume of third leak occurs in the first 24-36 hours after the burn, peaking by 6 to 8 hours. As the capillary begin to regain their integrity, burn shock resolves and returns to vascular compartment, blood volume increases.

If renal and cardiac function is adequate, urine output increases. Diuresis continues from several days to 2 weeks.

Local Response: Burn Oedema

Oedema is defined as the presence of excessive fluid in the tissue spaces (Lund, 1999). Burns involving less than 25 percent TBSA, the loss of capillary integrity and shift of fluid are localised to the burn itself, resulting in
in blister formation and oedema locally. Burns more than 25 percent TBSA leads to systematic oedema. Oedema is usually maximal after 24 hours. It begins to resolve 1 to 2 post burn and usually resolves completely by 7-10 days and posts enjoy.

As oedema increases in circumferential burns, pressure on small blood vessels and nerves in the distal extremities causes on obstruction of blood flow and consequent ischaemia. This complication is known as compartment syndrome. An escharotomy may be essential to relieve the constricting effect of the burned tissue.

**Effect on fluids, electrolytes and blood volume**

1. Circulating blood volume decreases dramatically during burn shock. In addition, evaporative fluid loss through the burn wound may reach 3 to 5 litre or more over a 24-hour period until the burn surfaces are recovered.

2. During burn shock, serum sodium levels very in response to fluid resuscitation. Usually hyponatremia (sodium depletion) is present. Hyponatremia is also common during the first week of the acute phase, as water shifts from the interstitial to the vascular space.

3. Immediately after burn injury, hyperkalaemia (excessive potassium) results from massive cell destruction. Hypokalaemia (potassium depletion) may occur later with fluid shifts and inadequate potassium replacement.

4. At the time of burn injury, some red blood cells. These may be destroyed leading anaemia. Despite this, the haematocrit may be derated due to plasma loss. Blood loss during surgical procedures, wound care, and diagnostic studies and ongoing haemolysis further contribute to anaemia. Blood transfusions are required periodically to maintain adequate haemoglobin levels for oxygen delivery.

5. Abnormalities in coagulation, including decreased platelets, and prolonged clotting and prothrombin times, also occur with burn injury.

**Pulmonary Response**

Inhalation injury is a leading cause of death in fire victim. Inhalation injury has a significant survivalibility of a burn patient. Deterioration in severely burned patients can occur without evidence of smoke inhalation injury. Broncho-constriction caused by release of histamine, serotonin and thromboxane, a powerful vasoconstric-

ator, as well as chest constriction secondary in circumferential full thickness chest burns causes this deterioration. One-third of all burns patients have a pulmonary problem related to burn injury (Flynn, 1999).

S/S - Airway obstruction within hours, decreased lung compliance, decreased ABG and respiratory adores. Treatment involves intubations and mechanical ventilation.

**Other Systemic Responses**

1. **Renal failure**

Due to myoglobin and haemoglobin myoglobin are released due to muscle damage. If there is in adequate blood flow through the kidneys, the haemoglobin and myoglobin occlude the renal tubules, resulting in acute tubular necrosis and renal failure.

2. **Immunological alteration**

Serious burn injuries diminish resistance to infection. As a result, sepsis remains the leading cause of death in thermally injured patients (Cioffi, 2001). Research suggests that burn injury results in loss of T-helper cell lymphocytes (Munster, 2002). There is a significant impairment of the production and release of granulocytes and macrophages from bone marrow after burn injury. The resulting immune suppression places the burn patient at high risk for sepsis.

3. **Temperature disregulation**

Loss of skin also results in an inability to regulate body temperature. Burn patients may therefore exhibit low body temperatures in early hours after injury. Then, as hypermelabolism resets core temperatures, burn patients become hypothermic for much of the post burn period, even in the absence of infection.

4. **Gastro intestinal complications**

Paralytic ileus and Curling’s ulcer: Decreased peristalses and bowed sounds are manifestations of paralytic and bowel sounds are manifestations of paralytic ileus resulting from burn trauma. Gastric distension and nausea may lead to vomiting unless gastric decompression is initiated. Gastric bleeding secondary to massive physiologic stress may be signalled by occult blood in the stool, regurgitation of “coffee ground” material from the stomach or blood vomitus. These signs suggest gastric or duodenal erosion (Curling’s ulcer).