REVIEW OF LITERATURE
Despite the rapid strides of advancement that
the medical sciences have undertaken, the problem of
management of burns remains a complex one and still
poses a potential threat to life. With ongoing
industrialisation, thermal injuries have assumed greater
importance due to increasing frequency and complexity.
The management of a case of burns comprises two parts -
(1) General management viz., maintenance of airway,
intravenous resuscitation, analgesics, sedation, tetanus
prophylaxis and antibiotics, (2) Management of local
wounds. The present day management of burns is the
outcome of ideas, observations and experience of various
workers. There are two methods much prevalent for the
treatment of burns -

Exposure method:

The principle is that drying the wound inhibits
the growth of bacteria and ultraviolet light is hostile
to bacterial growth. Eventually a dry surface is obtained
and topical agents may be applied as a further deterrent
to bacterial growth.
**Closed method**:

The underlying principle is that majority of burns are sterile or contain no pathogenic organisms on their surface in the first few hours. If the area can be sealed off from the surroundings by means of sterile dressings, infection can be checked.

The literature regarding treatment of burns dates back to as old as 1500 B.C. when there is mention of Papyrus who used cowdung application topically to treat burns.

Ancient Indian literature reveals that Sushruta used a mixture of butter with red achro or the bark of a fig tree. He also debrided severe burns with loose skin and flesh.

Around the 5th or 6th centuries B.C., the Egyptians were making use of incineration and a mixture of gum, goat's hair and milk from a lady who gave birth to a male child. Extracts made from tea leaves and tinctures were being employed for a similar cause in 430 B.C. by the Chinese and the Japanese.

In ancient Rome, three methods were in practice - Celsius suggested a mixture of honey and bran, exposure method was suggested by Pliny and Elder while Galen suggested local application of vinegar or wine over the burn surfaces.
Paulus of Aegina used various emollient preparations in the 7th century A.D. Rhazes (980-923 A.D.) used white lead and oils of rose and wax, and also ice cold water locally. Surgery had no place in burn management apart from the excision of contracted scars as described by Celsius.

Ambrose Pare (1517-1590) gave the concept of use of ointments for the treatment of burns. Claw (1591) used 5 different complex preparations on different parts of the body affected by burns. Vinegar and chalk poultices were used locally by David Claghrac (1792). That ice cold water could relieve pain and prevent or minimise oedema formation was suggested by Sir James Earle in 1799. Syme in 1827 described the use of dry cotton wool dressing applied with firm pressure.

Hippocrates, the father of Medicine, used resins and bitumen mixed with melted swine seam spread over a piece of cloth on the burn surface after warming. He also used warm vinegar soaked dressings to relieve pain. Later, he used a solution of oat bark for tanning of the burns.

The father of German surgery, Gailhemus Fabricus Hildanus in 1607 described 3 degrees of burns according to depth while Heister (1683-1758) classified burns into four degrees according to depth and including time factor.
Royer (1314) classified burns into 3 degrees -
(i) erythema, (ii) blisters leading to superficial ulcers, and (iii) eschar.

Dupuytren (1932) classified burns into 5 degrees according to depth of involved tissue -

i) Erythema or superficial ecchymosis which blanches on pressure.

ii) Cutaneous inflammation with loss of epidermis and vesicle formation.

iii) The destruction of a portion of the papillary body.

iv) The disorganisation of whole dermis to a subcutaneous cellular tissue.

v) The formation of eschars of all the carbonisation of the whole thickness of the burnt part.

He also described the 4 periods during the natural course of burn injury -

i) Period of irritation,

ii) Period of inflammation,

iii) Period of suppuration,

iv) Period of exhaustion.

Simultaneously he also gave description of gastrointestinal hemorrhage in cases of burns. Later Curling
recognised gastric and duodenal ulceration as the cause of the hemorrhage in burn cases.

The dry method of dressing received prime attention and usage in the period between 1833-1868. This method had been already in use in the British Isles prior to 1833. Syme (1834) in his book 'Principles of Surgery' described that the dry method was superior clearly to the application of carron oil and linimentum aqua calcis.

The exposure method for the management of burns was put into use by Copeland in 1871. The followers of Lister started applying his antiseptic techniques to burns. 2.5% carbolic acid in oil was used to soak the lint applied to the burn wound and the dressings were changed on alternate days. This met with some undesirable effects. Local gangrene resulted in many cases and partial thickness burns were converted into full thickness ones. Absorption of the compound through the burn area led to symptoms and signs of phenol poisoning.

The period ranging from the year 1885 and 1910 was the era in which saline wet dressings were in great use. Wet dressings of sodium bicarbonate were first applied to the burn surface followed by picric or boric acid. Picric acid poisoning was reported in several cases by E.J. Elliot (1906). The systemic absorption of boric acids also caused many undesirable side effects as rashes,
desquamation of skin, restlessness, confusion and weakness, hypothermia, hypotension, tachycardia, loss of hair and renal damage.

Wax dressings were in high recommendation between 1910 to 1926. Wax contains 25 mg/l B-naphthol and it was used for application warm at a temperature of 50 to 60° C. B-naphthol however produced the very undesirable side effects like hepatic and renal damage, convulsions and sometimes death.

The idea of application of Tannic acid to burn surfaces which was put forth by Daxitson in 1894 was soon discarded owing to the fatal hepatic degeneration and conversion of initial partial thickness burn to full thickness that were associated with such therapy. Aldridge (1933) advised the use of gention violet as an escharotic agent.

Moving to the recent era we see the use of petroleum gauze piece locally over burn wounds which was done during World War II by Allen & Koch in 1942.

The exposure method of treating burns was elaborately described and put into practice by Wallace of Edinburgh (1949) in Britain and Fulaki Artzi & Blocker of U.S.A. in 1950. Later on, many a surgeons followed suit in adopting this method with a view that development
of crust provided physiological covering of the burn surface, thus reducing the effects of a raw area.

Ludbug, Neiss & Artzi (1953) focussed on the fact that the primary cause of death due to burns was septicaemia and staphylococci were the main offenders.

With the advent of potent antibiotics, sepsis due to the much resistant organism Pseudomonas became more common and deaths were attributed to it. It was the gram negative organisms and some other microbials that led to the search and subsequent development of antimicrobial agents that could penetrate the burn surface to combat these organisms. 0.5% Silver nitrate (Mayer), Cerium nitrate (Williams W. Monafo), Silver sulfadiazine (Fox, 1975; Stenford, 1969) were tried and continue to be in use. However, these are effective only in controlling the growth of the organisms. From an average of $10^7$ micro-organisms per gram of tissue the number was reduced to $10^4$ per gram by these agents.

0.5% Silver nitrate were shown to produce beneficial effects on the healing of burns but such therapy was associated with certain dangers. Metal toxicity, depletion of body salts and necrobiosis were seen. The dangers of sodium chloride depletion are so immediate that the dressings should not be used without very frequent monitoring of sodium chloride and bicarbonate concentrations.
Silver sulfadiazine was used as application on burn surfaces with the following advantages -

1. Quick penetration into eschar.

2. Eschar does not adhere to the dressing.

3. Silver ions are released from the preparation slowly and the concentrations are toxic to pathogens. Silver ions combine with sulfhydryl carboxyl phosphate and other biologically active groups. Such interaction involves proteins and often cause its precipitation. Silver ions act on the cell surface of bacteria and cause its death by causing drastic alteration of cell membrane characteristics. This drug inhibits nearly all pathogenic bacteria and fungi and also exerts a prominent action against Pseudomonas (Rosenkraz, 1972).

On the other hand, the disadvantages associated with the use of Silver sulfadiazine are -

1. The absorption of the compound can cause crystalluria.

2. Bacterial resistance to the sulfonamides may occur with the use of this compound.

3. Side effects of burning, rash, itching can occur.

4. The drug is expensive.
This was followed by the era of use of biological dressings. If a functional skin substitute and a reliable skin tissue culture technique would become available some day, the treatment of burn injuries would change overnight. Eschar would be excised early in post-burn period and covered with a skin substitute. Within a week or two the patient was fit for discharge. About a month later, small pieces of autologous healthy skin grown in tissue culture would be used to replace this. In the coming period this method may well become a reality.

The ideal properties of a skin substitute can be taken as follows -

1. It must adhere rapidly and strongly enough with the underlying raw areas.

2. It should possess water vapour transfer properties like normal skin.

3. It should have enough elasticity to stretch freely over the joints.

4. It should be reasonably durable.

5. It should serve as an intact bacterial barrier.

6. It should be non-antigenic and non-toxic.

7. It should possess antiseptic properties.

8. It should have homeostatic properties.

9. Its application as well as removal should be easy.

10. It should be cheap.
The materials used for the purpose of treating burns which are used as skin substitute include -

2. Biologic

a) Human allograft (Homograft)
   Living donor
   Cadaveric donor fresh
   Cadaveric donor frozen
   Amniotic membrane

b) Xenograft (Heterograft)
   Living donor fresh
   Frozen radiated or dried

c) Tissue derivatives
   Collagen sheet fabric or sponge
   Bioplast fibrin

2. Synthetic

Solid silicon polymer membrane
Other plastics
Microporous materials

3. Composite materials

Surface membrane (Silicone, Microporous, trydron, adherent substrate.
Collagen, cotton gauze, synthetic polymer sponge, vetour, flecking or fabric.)
Biological dressings:

Homografts - It was Polbeck (1871) who first applied the first homograft to a burn patient. In 1881, Girdner treated a lightening burn patient with skin from a suicide victim. In the same year, aedea used skin from an amputation specimen as well as from cadavers within 24 hours. The use of fetal skin as homograft on burn surface owing to its more energetic vitality was stressed by Ivunova in 1890.

Temporary homografts were used over II and III degree burns by James O'Neill Jr. in 1967. This was found to be of distinct benefit following eschar separation. Sharma et al. (1976) have reported similar results.

Allograft skin though being satisfactory biological materials have their own limitations. The number of cadavers suitable for skin donation are limited and the cost of procuring and applying cadaveric homografts is high.

Amniotic Membrane - The amnion or the inner fetal membrane has an inner surface in contact with fetus and fluids while the outer surface is separated from the uterus by decidual. The amniotic membrane has the following parts:

1. Placental amnion—lines the inner aspect of the placenta.
2. Reflected amnion—lines the rest of the chorion.
3. Dependent amnion—overlies the internal os of the cervix.
Histologically 5 layers are identifiable: Epithelium, basement membrane, compact layer, fibroblast layer and sponge layer. The following effects of amniotic membrane dressing were observed by Pigeon in 1950:

(A) Immediate effects:

1. Pain was relieved at once and analgesics were not required.

2. Antibiotics were required only after complications developed.

3. The dressings were generally found dry.

4. Healing was quick and complete.

(B) Delayed effects:

1. No discoloration of the skin was seen.

2. The scar tissue formation was minimal.

3. No contractures were observed.

**Xenografts** - These came into use owing to the limitations associated with homografts. Burleson and Tavis showed that the adherence of xenografts and allografts was similar. Heterografts provide a readily available, easily stored and sterilised dressing in comparison to homografts.

In 1950, canine skin was used by Switzer et al. Porcine skin is the xenograft material of choice, however, pig skin has been used by Bromboy et al & Elliot and Koch.
Variable results were reported from early re-epithelialisation to conversion to full thickness burn with skin loss. Salisbury (1973) reported some poor results in the form of increased inflammation and delayed repair following treatment. Immediate and lasting relief from pain was a striking feature with the use of porcine grafts. Xenograft has most of the properties of an ideal skin substitute. A viable xenograft is antigenic but the dead one is not. The major problem with the use of xenografts is the propensity to digestion by wound collagenase and subsequent infection.

Collagen sheet - Collagen, a fibrous protein is distributed in various animal tissues like skin, muscle etc. When implanted in living animal tissues in pure form it does not invoke any antigenic reaction. Collagen sheets are derived from serous and sub-serous layers of freshly slaughtered cattle intestine. These are available in 4" x 6" size and packed in cylindrical glass tubes containing ethylene oxide which acts as the sterilising agent.

Singh (1972), Shanker (1975) and Gupta et al (1976) used collagen sheets as primary layer material in the management of burns. Gupta & Chaturvedi (1974) used it to cover donor areas. Thukral & Gupta (1976) have used collagen material in the repair of hernia and to cover surgical defects. Elhans et al (1978) used sheets as
biological dressing and reported its role in prevention of infection and increasing rate of healing. Similar findings were reported by Jain et al in 1976 also.

The effects that the collagen sheets produce include: prevention of airborne infection, minimisation of fluid loss, and promotion of formation of healthy and pink granulation tissue. However, it is an expensive material and is not available at every centre.

*synthetic material:* It was Pickrell in 1942 who worked on sulfonamide film. Many of the synthetic materials adhere by entrapment of coagulum, in the interstices of the material. Silicon polymer membrane is the best available material because it is elastic, durable and its water vapor characteristics can be controlled by varying its thickness. Kornberg et al (1977) used thin silicon membrane bound to cotton gauze for temporary substitution of skin. But this lacked elasticity and the pattern of adherence was not uniform either. Other materials include modified polyvinyl chloride or similar plastics which provide more elasticity and water vapor transfer characteristics (James et al, 1975; Fowsend, 1977). These materials seem to of promise as temporary skin substitutes and short term applications. The disadvantages of biological dressings despite of the fact that they are best dressing material for burns are:
1. Subgraft suppuration.
2. Limited supply in case of autograft and others.
3. High cost.
4. Lymphoillised allograft skin shows less adherence to the wound, undergoes dermal-epidermal separation after application to the wound with subsequent destruction of the exposed dermis.
5. Possible transmission of disease like hepatitis in case of allograft.

Increasing importance is now being gained by the problem of burn wound infection. The inability on the part of systemic therapy to control local sepsis has led to the use of many treatment modalities aimed at this problem, e.g. topical ointments (Fox, C.L.; Stanford, W., 1969), early surgery i.e. escharotomy or skin grafting (Burke, J.F.; Bandoc, C.C. and Quinby, W.C., 1974) or amniotic membrane application (Bose, 1979).

Topical therapy has led to a considerable reduction in the rate of sepsis. We must consider the properties that an ideal topical drug should have. The desirable properties of such a drug can be summarised as follows (Zellner, F.R. and Buggi, S., 1985):

1. It must be non-toxic.
2. It must have antiseptic properties or a good antimicrobial spectrum.
3. It must not kill viable tissue nor harm the surviving and proliferating tissue.

4. It must penetrate the eschar.

5. It must be non-antigenic.

6. It must have tanning effect.

7. It must be inexpensive.

8. Its application and removal, both, should be easy.

9. It should be durable.

10. It should be easily procurable.

In order to establish these criteria, a number of newer techniques were evolved. These have their own merits and demerits.

Out of these, Povidone-iodine is an agent quite suitable for the treatment of burns. However, it lacks the ability to actively penetrate burn tissue which is quite a disadvantage. Povidone-iodine can be applied locally with ease alone or with Ascarbine (Kock, D.M., 1985). PVP is active against a wide variety of gram positive and negative organisms as well as fungi, but it causes pain on application and excessive drying of eschar (Schwartz, Sherin & Spencer, 1985). Prolonged use may affect the thyroid (Buer, M. and Riceabona, 1985).

On the other hand, Neosporin powder (Burroughs Wellcome) with the ingredients of Neomycin sulfate,
Zinc Bacitracin and Polymyxin B can also be used to treat burns. It is locally acting bactericidal drug having adverse effects as otonephro-toxicity and to a certain extent the depression of the respiratory system. This combination can well be presumed to act as an excellent adjuvant to the use of povidone-iodine. Beneficial and encouraging results were observed with the use of a combination of povidone-iodine plus neosporin powder by Sinha et al (1988).

The microbial ecology of burn wounds of the patients of burns changes from time to time and alterations in flora occur as a series of minor epidemics with a succession of predominant organisms.

In view of the wide spectrum of organisms affecting burn wounds a topical agent with a wide spectrum of coverage is obviously desirable. FVP with Neosporin may prove ideal for this purpose.