



Infection Control in Burns

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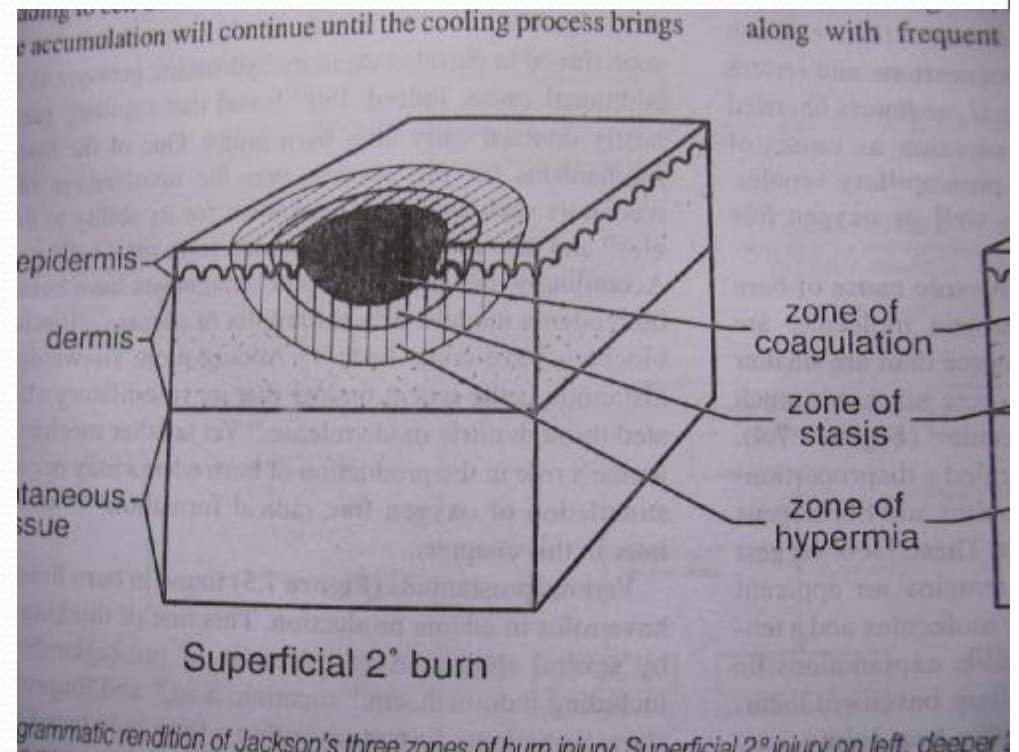


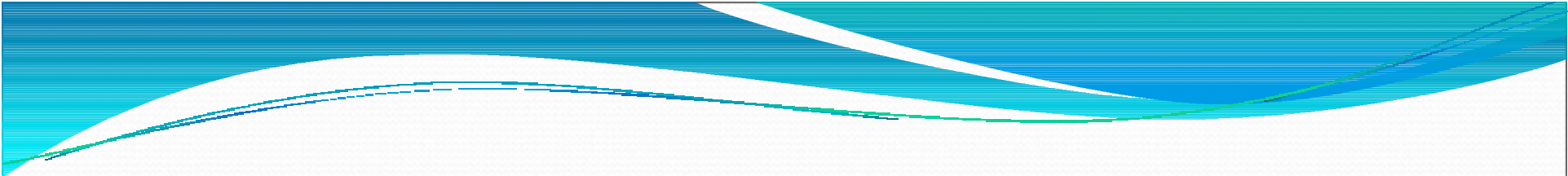
Types of infections in Burns

- Pulmonary**
- Urinary**
- Of Veins(Phelbitis)**
- Of Cartilage(Chondritis)**
- Burn Wound**

Burn Wound infection

- Burn wound is a three dimensional injury, varying in severity from the center to the periphery.
- The innermost zone, the ‘zone of coagulation’
- Middle is the “zone of stasis”
- Outer is the “zone of Hyperemia”.

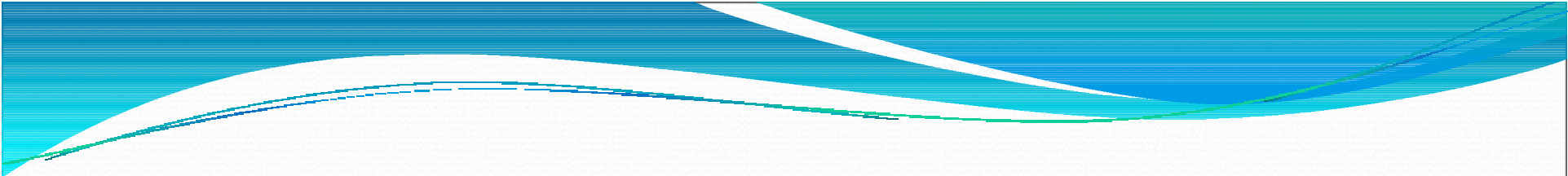




Skin is never sterile. It is colonized by two major groups of organisms, its resident flora and transient flora.

Pathogenesis of burn wound infection

- Bacteria proliferates _____ reach levels of greater than 10^5 bacteria per gram of tissue _____ break out of the hair follicles and glands _____ begin migration through the tissue _____ colonizing along the dermal-subcutaneous interface----grows along vessel
- Perivascular growth _____ thrombosis of vessels, _____ necrosis of any remaining dermal elements _____ converting partial thickness burn to full thickness loss.
- Levels in excess of 10^5 bacteria per gram of tissue constitute 'burn wound infection'.
- When level reaches $>10^5$,invasion and septicemia.



Occurrence of burn wound infection and septicemia is governed by certain factors that are divided into patient factors and microbial factors.



Patient factors :

- **Deep burns**
- **Extensive burns: > 30% are more prone.**
- **Extremes of age: Older and youngest are at risk**
- **Pre-existing diseases like diabetes and hypertension**
- **Immune response of patient. Burn patient is seriously immuno suppressed and this suppression is manifested in both cellular and humoral mediated immune response**



Microbial factors include:

- Density of organism**
- Motility of bacteria**
- Metabolic products**
- Antimicrobial resistance**



SOURCE OF BACTERIA IN BURN WOUND:

This aspect is somewhat controversial. Previously it was thought all infections are exogenous i.e. nosocomial so the complete isolation of patient was done and bacterial controlled units were created. The rate of infection in patients in whom all sources of exogenous infection are eliminated is still high, indicating that the endogenous source is an important one.

ORGANISMS RESPONSIBLE:

- Among gram +ve **Staph. aureus** and **Staph. epidermidis** and **Strept. pyogenes** are notorious.
- Among gram –ve **Pseudomonas** is predominant. Other gram negative are **Proteus**, **Enterobacter cloacae**, **Serratia marcescens**, **Klebsiella** and **E.Coli**.
- Fungal infections include **Candida albicans** and other **Phycomycetes** like **Mucor**, **Rhizopus** and **Aspergillus**.
- Among viral infections **herpes simplex virus** infection is important.
- Nowadays in **Karachi** we seeing virus 'Bufflo pox''



DIAGNOSIS OF SYSTEMIC OR INVASIVE WOUND INFECTION IN BURNS

Systemic sepsis and invasive infection in a burn wound are usually diagnosed by

- Local wound Signs.**
- Systemic Signs.**
- Laboratory Aids (including microbial status of burn wound and blood culture and other relevant studies).**

Local Signs

- Focal areas of dark brown or black discoloration.**
- Conversion of partial thickness injury to full thickness**
- Hemorrhagic discoloration of subcutaneous tissue.**
- Accelerated sloughing of burned tissue.**
- Edema & discoloration of skin at wound margins.**
- Appearance of ecthyma gangrenosa.**
- Presence of pyocyanin in subeschar tissue.**
- Focal subeschar fluctuance and variable size abscess formation.**
- Appearance of vascular lesions in healing or recently healed partial thickness burn .**

: ABNORMAL TEMPERATURE

- Large burns notoriously show large temperature variations for no apparent reason.**
- Hyperthermia of 40°C or more, tachycardia and hyperventilation are indicative of systemic sepsis but these are also characteristic of the hypermetabolic response to severe burn injury.**
- Hypothermia or sudden reversion to normothermia in a previously hyperthermic patient is often observed in life threatening gram-negative sepsis.**
- Never equate abnormal temperature with infection.**

SEPTIC SHOCK:

- Shaking chill**
- tachycardia**
- spiking fever or hypothermia,**
- hypotension with warm toes,**
- glycosuria, hyperglycemia, low central venous pressure,**
- low pulmonary capillary wedge pressure,**
- high cardiac output,**
- elevated mixed venous oxygen tension,**
- oliguria (usual), polyuria (rare), positive blood culture and thrombocytopenia.**

MULTI SYSTEM ORGAN FAILURE:

- Lungs: Adult respiratory distress syndrome, Pneumonia, Excessive CO₂.**
- Kidney: oliguria, non-oliguria, both leading to Acute Renal failure.**
- Liver: Cholestatic jaundice, coma (hepatic) due to disturbed metabolism of branched chain amino acids.**

Multi system organ failure

- Gut: Reflex ileus, stress bleeding , acalculous cholecystitis and pseudomembranous colitis.
- Heart: Myocardial failure.
- Coagulation: Thrombocytopenia, disseminated intra-vascular coagulation (DIC).
- Adrenals: Waterhouse-Friderichsen syndrome .
- C.N.S.: Non-ketotic hyperglycemic coma, obtundation of sensorium.

LABORATORY TESTS

TOTAL LEUCOCYTES COUNTS:

- Leucocytosis may be an early indicator of sepsis. Conversely leucopenia a frequent accompaniment of severe gram-negative sepsis may be a complication of silver sulfadiazine.



BLOOD GLUCOSE LEVELS:

- Heggens and Robson (1986) claim that patient showing signs of septicemia and having blood glucose levels more than 130 mg per dl usually have gram positive septicemia and patients who have blood glucose level less than 110 mg per dl usually have gram negative septicemia. According to these authors this findings are true in 80% to 85% cases.



PLATELETS, FIBRINOGEN, FDP:

- The presence of thrombocytopenia, hypofibrinogenemia or fibrin degradation products in the blood after 24 hours may indicate sepsis.



BLOOD CULTURE

- Blood culture studies are mandatory. They may not always be positive, especially in early stages of sepsis. Negative cultures must be interpreted in the overall context of the patient's condition and other laboratory findings.



MICROBIAL STATUS OF BURN WOUND:

There are various techniques used for monitoring the microbial status of burn wound. Some of these are

- Dry swab**
- Contact plates**
- Wound Biopsy**



DRY SWAB:

- Surface swabs produce qualitative data.
- Advantages
- Disadvantages

CONTACT PLATES:

- It involves the contact of the culture media with area of the wound to be studied.
- Contact plates provide quantitative information and when selective media are used, can produce qualitative information as well.
- The use of contact plates as quantitative test for bacterial assay of burn wound is limited because of the confluent growth of the bacteria on it after its application to moist burn areas. Furthermore contact plates take more time to give results and do not sample the subeschar space.



WOUND BIOPSY:

The most reliable and accurate means for monitoring the microbial proliferation of burn wound and diagnosing the incidence of infection is biopsy sampling.



HISTOLOGICAL STUDY:

At the time of biopsy, tissue should be dissected and one half should be sent to the pathology laboratory where it is processed and examined while the other half is sent for quantitative wound culture.



Histological Signs of infection

- **Presence of microorganisms in unburned subeschar tissue at viable/nonviable tissue interface.**
- **Hemorrhage present in unburned subcutaneous tissue.**
- **Exaggeration of the normally mild inflammatory response present in viable tissue immediately adjacent to the burn.**
- **Microbial invasion of the small vessels of the specimen.**
- **Peripheral and perilymphatic proliferation of organisms.**

GRADING:

- G1: Surface contamination of low number of M/O .**
- G2: Dense microbial proliferation on surface of wound.**
- G3: Variable penetration of eschar.**
- G4: Microbial penetration of full thickness of eschar.**
- G5: Proliferation of microorganisms in subeschar space i.e.nonviable/viable tissue interface.**
- G6: Microbial invasion of unburned tissue**
 - Focal micro invasion (early stage)**
 - Deep extension into viable tissue (advanced stage)**
 - Micro vascular or lymphatic invasion.**



Control of infection in Burns

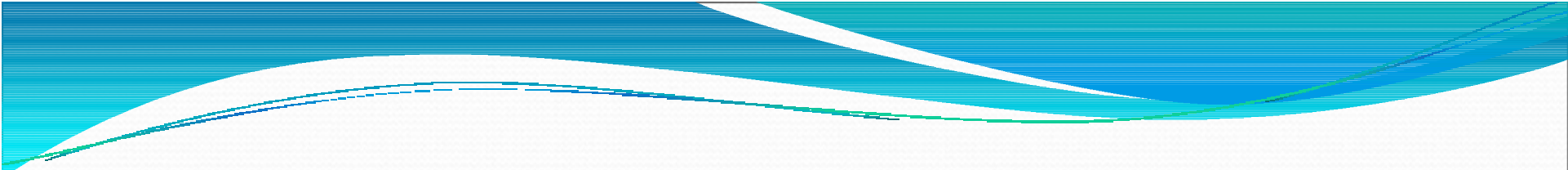
can be divided into five measures.

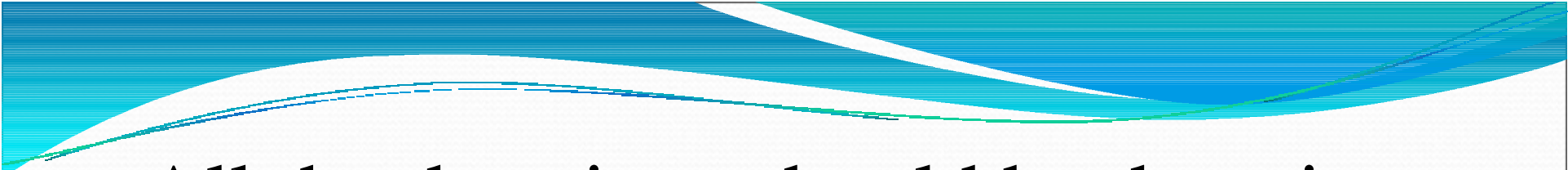
- Environmental control.
- Adequate nutrition.
- Immunoprophylaxis.
- Early excision and debridement of wound.
- Topical chemoprophylaxis.

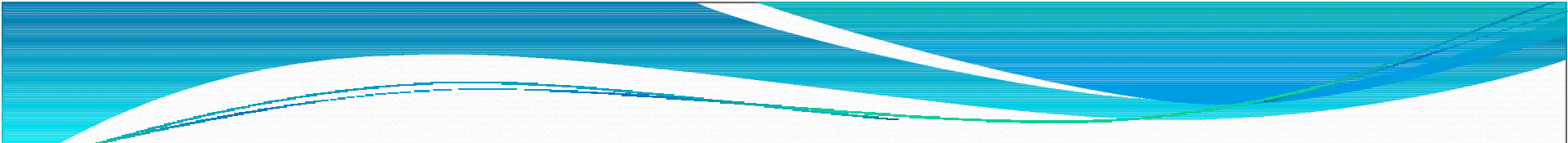


ENVIRONMENTAL CONTROL

Environmental control is directed to prevent nosocomial infection. Even with strict environmental control, endogenous infections from patients themselves develop and nowadays all over the world isolation techniques and bacterial control units have limited value. It does not mean that we shun all precautions to prevent exogenous infection and bacterial resistance.

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- Access to patient care area should be limited to those personnel concerned with the care of patients.**
 - All persons visiting the unit should wear plastic apron, cap and mask.**
 - Hands must be washed any time contact is made with the patients environment and disposable gloves must be worn any time contact is made with the patient.**
 - Sterile gloves are to replace disposable gloves when wounds are to be treated.**

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- All the dressings should be done in operating room observing all OT attire .
 - All the removed dressings and material should be double bagged, taped and disposed.

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- Frequent disinfections of supporting equipments such as respirators and nebulizers, hydrotherapy equipments etc. should be done.**
 - All the intravenous cannulas, urinary catheters should be changed after every 48 to 72 hours.**
 - All patients should have chest therapy.**
 - All patients with streptococcus B-hemolyticus group A infection, staphylococcus resistant to methicillin, anaerobic bacterial spore (tetanus and gas gangrene), viral infections and immunosuppressive states are indications for complete isolation.**

ADEQUATE NUTRITION

- A non-specific aid to the depressed host defense appears to be adequate nutrition. Researchers have found reversal of anergy to common antigens when the burn patient remains in positive nitrogen balance. An adequate amount seems to be 25 kcal per kg of body weight plus 40 kcal per percentage body surface area of the burn for adult patient. This frequently must be delivered by continuous pump tube feedings.**

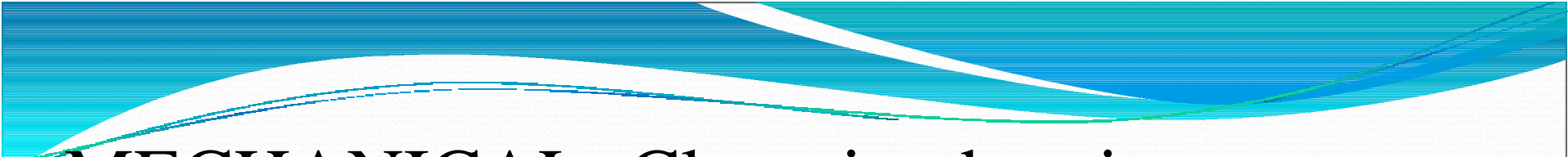
IMMUNOPROPHYLAXIS:

- It consists of prophylaxis against tetanus by antitetanic serum and tetanus toxoid.
- Active and passive vaccines against Pseudomonas infections are very beneficial in the sort of facilities that we have got.
- Administration of immunoglobulin as such is not proved to be able to control or prevent burn wound infection. They are given intramuscularly in a dose of 1 ml/kg body weight on 1st, 3rd and 5th post burn day.



WOUND DEBRIDEMENT:

- Wound debridement is the removal of dead tissue and its purpose is to prepare the wound for closure. Debridement may be conservative or aggressive (excisional).**
- CONSERVATIVE DEBRIDEMENT:**
- Conservative debridement may be mechanical or enzymatic.**

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- MECHANICAL:** Cleansing by vigorous sponging or hydrotherapy and multiple dressings may be used. During either of these, picking, pulling, scraping, or excision of loose particles is performed. Debridement may take place in the dressing room or in the treatment room or in the operating room. Usually no anesthesia is required. Debridement should be done with proper aseptic techniques.
 - Spontaneous separation of eschar is a natural consequence within three weeks.

ENZYMATIC:

- **Enzyme preparations are applied over wounds involving not more than 15% TBS area at any one time. The application is followed by wet dressings and reapplied eight hourly.**
- **Some of the enzymes that have been used are:**
- **Sutilans [Travase ointment]**
- **Bromelans [Ananase]**
- **Collegenase [Santyl ointment]**
- **Papain [Panafil ointment]**
- **Fibrinolysin-desoxyribonuclease [Elase ointment]**
- **Neomycin palmitate – trypsin chymotrypsin [Biozyme ointment]**



ADVANTAGES:

The advantages of this method are:

- It decreases time for spontaneous separation of eschar.**
- Blood loss is minimized.**
- Operative and manual hours are conserved.**



DISADVANTAGES:

- Drawbacks of enzymatic debridement may be listed as follows:**
- This method increases the risk of bacterial invasion of tissue and consequently of septicemia.**
- Some agents are over active and damage normal tissue and cause bleeding and fluid loss from the wound.**
- Some agents leave a thin layer of necrotic tissue on the wound on which skin graft will not take.**



AGGRESSIVE DEBRIDEMENT:

- Aggressive debridement is the excision or avulsion of devitalized tissue superficial to structures capable of supporting a skin graft.
- Excision of devitalized tissue can be divided into three varieties:
 - Simple excision.
 - Sequential excision.
 - Tangential excision.



SIMPLE EXCISION:

- It involves scalpel or scissors excision of all dead tissue down to viable tissues at one sitting and is done in the operating room, usually under general anesthesia.**
- Major objection to this line of action is the possibility of sacrifices of viable tissues during this procedure.**



SEQUENTIAL EXCISION:

- This method involves daily removal of loose debris during hydrotherapy, coupled with repeated sharp excision of eschar with guarded skin graft knives once or twice weekly. Ketamine anesthesia is sufficient for major sessions.**
- This method may supplement conservative/enzymatic approach and is suitable for burns of face palms, sole and perineum and burns on other parts of the body whose depth is uncertain.**
- The main advantage .**
- Disadvantages**



TANGENTIAL EXCISION:

- Definition:**
- How it is done**
- Disadvantages**
- Advantages.**

INDICATIONS

Burns of the dorsum of the hand that by clinical estimate will not heal within three weeks are ideally handled by this technique. Chances of early functional recovery are enhanced.

- Full thickness burns of limited extent i.e. upto 5% of TBS area treated by this method shorten hospital stay and lead to early return to preburn functional status.**
- In patients with massive burn injury this method helps reduce the burn size to a total body surface area, which is more compatible with survival.**

CONTRAINDICATION OF TANGENTIAL EXCISION:

Patients still not fully resuscitated and stable.

- Burn wounds involving the face and neck.**
- The presence of massive burn wound infection for fear of inducing invasive sepsis.**
- Unavailability of autograft, homograft or heterograft skin for wound closure.**
- Extremes of age.**
- Debilitating constitutional disease.**
- Unavailability of blood.**
- Unavailability of supporting facilities including peri-operative environmental control and competent personnel.**



USE OF TOPICAL PROPHYLAXIS:

- The aim of topical prophylaxis is to keep curtailed the bacterial count to level of less than 10^5 organisms per gram of tissue. Wide variety of topical antibiotics are in use with their advantages and disadvantages and their uses vary from one center to another.

SILVER SULFADIAZINE:

- Chemically, it is a combination of silver ion and sulfadiazine in 1% water-soluble cream .**
- Mode of action.**
- effective against Pseudomonas, E.coli and Candida. Less effective against Staphylococcus aureus and some strains of Klebsiella.**
- Antibacterial potency has been demonstrated for upto 24 hours. The presence of thick creamy exudates on the wound is common since the silver binds with protein and resultant material looks like pus.**
- ADVANTAGES:**
- DISADVANTAGES:**

SILVER NITRATE:

- Moyer introduced it in 1965. He showed that in 0.05% concentration, silver nitrate does not injure regenerating epithelium in the burn wound and is effectively bacteriostatic against staphylococcus, aureus, E.coli and Pseudomonas aeruginosa.**
- The usual method of application of silver nitrate dressings is to use thick layers of gauze saturated with the solution. The dressings are wetted at 2-hour intervals and changed twice a day.**
- ADVANTAGES;**
- DISADVANTAGES:**

MEFENIDE ACETATE:

- It is available in a 10% water-soluble cream or a 5% solution . It is effective ,especially against all strains of *Pseudomonas aeruginosa*. The water-soluble cream is applied to the wound like “butter”. The region is left exposed for maximal antibacterial efficiency. The cream is applied twice daily and replaced if it is rubbed off between treatments.
- The 5% solution is applied in a saturated gauze dressing and changed every eight hours.
- ADVANTAGES:
- DISADVANTAGES:



GENTAMYCIN:

- It is available in 0.1% water-soluble cream and has broad-spectrum antibacterial activity against *Pseudomonas aeruginosa*.
- It can be applied for use in either closed or open methods.
- ADVANTAGES:
- DISADVANTAGES:



POVIDONE IODINE OINTMENT (BETADINE):

- It has broad spectrum of antibacterial and antifungal activities . It is available as 10% ointment or as an aerosol spray. Its active antibacterial ingredient is Iodine. Betadine ointment can be used effectively in both the open and closed techniques. Robson (1979) has shown that it is most effective when applied 6 hourly.**
- DISADVANTAGES:**
- Causes pain on application (but less as compared to mafenide)**
- It may be absorbed systemically and can lead to metabolic acidosis and renal failure and also suppress normal lymphocyte response.**

POLYMYXIN B – BACITRACIN (POLYFAX)

This ointment contains 10,000 units per gram polymyxin B and 500 units per gram of bacitracin.

ADVANTAGES:

- Painless application. No systemic absorption.**
- Wide range of antibacterial effect due to synergistic effect of two antibacterials.**

DISADVANTAGES:

- The base of ointment in which the antibacterial are contained somewhat inhibits their effectiveness against the bacteria present on the surface of the wound.**
- Polyfax is widely used for treatment of minor and superficial burns but cannot be relied upon in large deep burns .**



SUBESCHAR ANTIBIOTICS:

- This process has limited value. Wounds that are superficial and involve less than 10% of the total body surface area are eligible for treatment by this method. The antibiotics used by this route are semisynthetic penicillins and gentamycin. A solution of 10 gm of antibiotic in 150 ml of saline is injected twice a day in subcutaneous tissue beneath each infected area using a No.20 spinal puncture needle to keep the number of injection site to a minimum.**
- The effectiveness of bacterial control is modified by serial full thickness wound biopsies taken from representative sites at two-day intervals .**



PROPERTIES OF AN IDEAL TOPICAL AGENT:

Agent must

- Have broad spectrum of antibacterial activity.**
- Discourage development of resistant organisms.**
- Possess low toxicity.**
- Actively penetrate wound.**

USE OF SYSTEMIC ANTIBIOTICS:

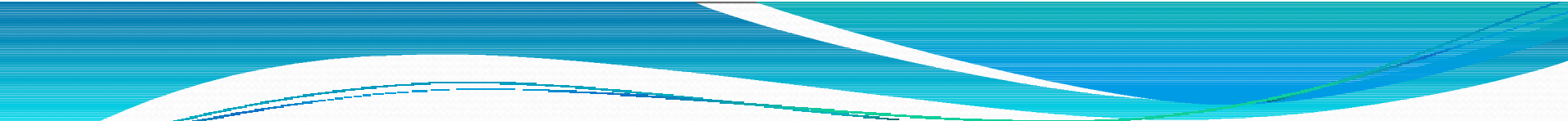
Systemic antibiotics are indicated when clinically sepsis is suspected and is confirmed by lab aids.

- Always identification of m/o is tried.**
- Keep a weekly/monthly record of your unit's flora and the most effective antimicrobial for each organism.**
- If the systemic signs suggest sepsis, after obtaining relevant samples one may begin an appropriate drug as determined by monthly records.**
- If response is positive and confirmed by lab tests, continue for 5 days or for a day or so after signs subside.**
- If response is positive but not confirmed by lab tests, one may still continue antibiotic but for a shorter time.**
- If response is negative, await results of tests and proceed accordingly.**



— USE OF PROPHYLACTIC ANTIBIOTICS AND STEROIDS:

- The concept of prophylactic antibiotics is very controversial, it is used in some burn centers and not in others.**
- The initial danger to burn patient is from B-hemolytic streptococcus that forms the major part of the transient flora of the skin and is present in almost all patients.**
- The rich vascularity of the inflammatory phase of the early injury, edema & neutralization of the bactericidal defense mechanism of sebum all render the burn wound particularly prone to streptococcal infection.**



Although there is ample evidence that systemic antibiotics fail to reach burn wound, it is documented that streptococcal infection can be prevented by penicillin administration. It should be continued for period of 48-72 hours and then stopped to reduce the chances of emergence of resistant organisms.

Later in the clinical course systemic antibiotics are of little use to burn wound as the vascular changes of full thickness burn and with the local occlusion of small blood vessels prevent the adequate delivery of potent systemic antibiotics to the foci of bacterial growth.



Thank you