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TOPICAL THERAPY OF BURNS (A Review)

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It has long been known that the major cause of death from burns is due to burn wound sepsis. The classic work of Teplitz (1964) defined burn wound sepsis as micro organisms growing in numbers exceeding 100,000 per gram of tissue and actively invading the adjacent unburned tissues. It has been demonstrated that in the burn population of a major burn centre burn wound sepsis accounted for 75% of the deaths and in 54% of them the bacterial infection was limited entirely to the burn wound (Moncrief 1964). Besides this, the burn wounds are ischaemic, because of confluent thrombosis of the arterioles, cappillaries and veins. Therefore systemic antibiotics are so ineffective in controlling burn wound sepsis. Inspite of their in vitro activity they cannot reach the burn wound in effective concentration to control local infection. It is quite logical that the antibacterial agents should be applied locally, and should be capable of active penetration into the tissues to effectively control infection. Other qualities of a topical agent should be a wide spectrum of antibacterial activity, lack of systemic toxicity, lack of development of resistant strains, ease of application and low in cost.

Cultures taken from the burn surface do not accurately reflect the infection in a burn wound. For a proper assessment ofburn wound infection, tissue biopsy is essential so as to identify the bacteria and also know their numbers. While colonisation of the burn wound usually starts within 24 hours, and the early invaders are the gram positive organisms, in a few days colonisation becomes more extensive, and penetration more active, and the gram negative organisms begin to predominate . If effective control is not established the bacteria begin to invade the adjacent unburned tissues.

Successful antibacterial therapy is able to control or reduce the number of micro-organisms present within the burn wound. While in established burn wound spesis the bacterial count in tissue biopsy may be as high as 10^8/gm of tissue, after topical chemotherapy the numbers may be reduced to 10^3-10^4/gm of tissue (Moncrief 1978). Thus topical antibacterial therapy does not completely eradicate the bacteria from the burn wound but effectively reduces the bacterial population to levels which the body can tolerate. Any laxity in the topical chemotherapy may result in a recurrence of burn wound sepsis.

From times immemorial man has used a number of agents for topical chemotherapy. At the present time, there are a few agents only which meet the criteria mentioned above and are being used successfully. Although most of these agents are effective in burn wound sepsis, each one of them has certain peculier characteristics and toxicities. Some of these agents like sulfamylon and gentamycin can penctrate the burn wound effectively and are therefore effective in controlling the bacteria in the depth of the burn, while others like silver nitrate and silver

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sulphadiazine have poor penctration and are not able to control deeper infection. Thus the later agents are preferably used in early burn wound infection before deeper penetration has taken 'place.

More recently a new approach in controlling burn wound sepsis has been introduced by Baxter et al (1973), in the form of subeschar antibiotics administered by subeschar claysis or infusion. This can be used in combination with topical therapy to yield superior results. The amount of antibiotics used should be the maximum tolerated dose.

The general characteristics of the four most commonly used antibacterial agents are given below.

Silver Nitrate

Half per cent solution of silver nitrate (Moyer and Manafo 1965) is effective in controlling the bacterial population in the burn wound. It has a wide spectrum of activity but tissue penctration is poor. It is therefore more useful in early stages before invasive infection has set in. It is cheap and readily available. Bacterial resistance, allergic reactions and argyria are extremely uncommon. Excretion is mainly through the kidneys.

It causes significant loss of electrolytes and may cause hyponatraemia, hypochloraemia, and hypokalaemia, Replacement by oral or intravenous sodium chloride in a doze of 25 to 30 gms is required daily and potassium in a doze of 40 to 120 m Eq/day.

The burn wound is covered by 8 to 10 thicknesses of gauze dressing which is soaked with silver nitrate solution every two hours, and the dressings changed at least once daily. Because of the precipitation of silver chloride the dressings and the clothing which come in contact are stained black.

Sulfamylon (Mafenide)

The German army used this agent in the second world war (Moncrief, 1928). It was introduced in USA by Lidbnerg in 1965. It has a wide bacterial spectrum, an excellent tissue penetration, is not inactivated in the tissue, does not develop resistance and is easy to use. It is particularly useful in established burn wound infection.

After absorption the drug is rapidly broken down by amine oxidase and the breakdown products are excreted by the kidney. The drug has strong carbonic anhydrase inhibiting properties. Because of the increased acid load a characteristic tachypnoea or hyperpnoea results.

Mafenide is applied locally over the burn with a gloved hand twice daily. Dressings are not required. The total amount of mafenide should not exceed $\frac{3}{4}$ lb per day.

Silver-Sulfadiazine

Silver sulfadiazine was introduced in recent years, with the hope that would have the theoretical advantages of both silver nitrate and silver sulfadiazine. In the tissue it dissociates into silver and sulfadiazine. Active penetration of the burn wound takes place by the sulfadizaine molecule only, 10% of which is absorbed systemically giving blood levels of 1.4-4 mgm percent. It has a wide spectrum of antibacterial activity which includes practically all the bacterial pathogens commonly seen in a burn wound. Bacterial resistance is not a serious problem. The eradication of staphylococci may not be as perfect as with sulfamylon. There is no pain

on application and toxicity is not seen except crystalluria on very rare occasions. Sulphonamide sensitivity has been reported.

To expand the usefullness of silver sulphadiazine a combination of silver sulphadiazine, zinc sulphadiazine and cerium sulphadiazine was used by Fox et al (1978). It has been reported that quicker healing follows zinc sulphadiazine and toxicity of cerium sulphadiazine is lowest. By combining all the three superior results were reported as compared to each one of them used separately (Fox et al 1978).

Gentamycin

This is used as a 0.1 percent cream or ointment applied without a dressing twice a day. Used selectively it is extremely effective against pseudomonas burn wound sepsis. It has a good penetration. Only with prolonged usage in high doses, nephrotoxic or ototoxic menifestations may appear. It should therefore be applied in small quantities to small areas of invasive infection only. It is painless on application. Superinfection with resistant bacterial strains will occur with protracted topical use (Monafo 1978).

Other Chemotherapeutic Agents

Furazolium chloride a nitrofuran derivative has a wide spectrum of activity against almost all the pathogens found in a burn wound. It is particularly effective against pseudomonas. It is used as a 0.231 percent solution Povidone Iodine has also been used in burn wounds. Although it effectively reduces the pseudomonas organisms, the effect on staphylococci was not very good. The results of long term use of this drug are not yet available.

A combination of several antibiotics such as chloramphenicol, neomycin, polymyxin and mystatin have also been used as a topical application every three hours (Collentine et al 1967) along with this massive systemic systemic antibiotics were also given. Although the technique is strongly advocated by the authors, it has not yet been used widely.

The control of burn wound sepsis by subeschar claysis of antibiotic solutions using long spinal needles has been found to be very successful (Baxter 1973). It is reserved for those cases in whom sepsis is already established on admission or the usual topical therapy has failed to control infection.

Conclusions

Topical therapy when used judiciously is highly effective in controlling burn wound sepsis. Although it markedly reduces the bacterial flora of the burn wound it does not sterilise it. This bsacterial control for a limited period of time provides the surgeon an opportunity to carry out vigorous burn wound debridement and convert an open wound to a closed on by skin grafting. Unless this is done expeditiously burn wound sepsis would escape from the tenuous control provided by topical chemotherapy, and continue to be constant threat to the survival of the patient.

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