SYMPOSIUM ON BURNS

Recent and Current Trends in Burn Research and Treatment

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Most clinicians will agree that a severe burn is not a "case"; it is almost a surgical career. Because of the many facets of the "burn problem", there is, with the possible exception of cancer, no field in which research is more active than in burns. If only the major medical journals of the English-speaking world are examined, at least 70 papers each year will be found that deal with this subject. It is impossible to review all such research in a short presentation, particularly animal experiments, but certain aspects of the general problem have, perhaps, attracted more attention than others and in these positive progress may have been made. Those subjects are: (1) toxicity in burns, (2) fluid loss by evaporation in burns, and (3) the use of plastic material as artificial skin.

1. Toxicity

For years the question has arisen whether burned skin liberates a specific toxic substance or whether the toxic changes seen in burns are due to infection.1 The question was reopened when in 1958, at the International Congress on Blood Transfusion, Fedorov and Skurkovich2 of Russia reported that they had obtained favourable results in burned patients by the intravenous administration of serum collected from those convalescing from burns. Their hypothesis was that this convalescent serum contained antibodies which had been produced in the burned patient in response to the challenge of specific tissue antigens liberated from the burned skin. In support of this hypothesis, they described anaphylactic reactions in healthy guinea pigs that had been injected with either burned skin extracts or serum from experimentally burned animals. This Russian report attracted much attention and attempts were made to obtain comparable results in clinical trials and by animal experiments, both in the United Kingdom and North America. The clinical reports of these studies so far available cover only a limited number of cases, and it is the opinion of their authors that the results have been far from conclusive.3 Perhaps in view of the difficulties of standardization and control in clinical practice, it is not surprising that a dramatic effect cannot be demonstrated. Bailey,4 however, following his study of a carefully standardized series of rats with experimental burns, believes that the rat can develop active immunity following scalding, and that convalescent serum from previously scalded rats has a protective influence on other scalded rats. He found that toxic though not lethal effects are produced by injection of burned skin extract from severely burned rats into normal rats. Other animal experiments have failed to confirm this.

In addition to the search for a burn toxin, research workers are showing increasing interest in serum enzyme levels following burning.4 The extensive changes in serum enzymes shortly after burning are sufficient to influence morbidity and mortality in experimental animals, and it has been suggested that these changes result from the combined effects of hemolysis and acute tissue damage.4 There is a rise in serum...

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ornithyl carbamyl transferase, which is a specific sign of acute liver damage, and also an increase in serum glutamic oxaloacetic transaminase and serum glutamic pyruvic transaminase, indicating general tissue damage. The level of these enzymes is at a maximum on the second or third post-burn day. Lorthoir in Belgium has conducted an extensive trial of the agent trasylol in experimental burns in rats. Trasylol is an enzyme antagonist which has been reported to be useful in the treatment of acute pancreatitis. He reported that the drug has a favourable effect in burned rats, reducing the mortality rate from 76% at 48 hours post-burn to 4%. He also reported that the drug was useful in clinical practice. In our own laboratory we are evaluating this drug in experimental burns but have, so far, been unable to reproduce the dramatic results reported by the Belgian workers. Preliminary reports from Vancouver also have failed to sustain the claims made for trasylol.

In summary, it remains to be proved whether an antigenic burn toxin is produced during the breakdown of burned tissue and while there is an increase in circulating proteolytic enzymes in burns, their role in morbidity and mortality has not yet been established.

Following reports of the successful use of serum from convalescent burn patients, it was suggested that these beneficial effects resulted from the high level of antibacterial antibodies found in this serum, more particularly those against pyocyanus infection.

The importance of Pseudomonas pyocyaneus infection in burn wound has been carefully assessed by several workers recently. Verdoglobinuria, the "green urine syndrome", was described in 15 patients dying of Pseudomonas septicemia. The presence of the pigment may be detected several days before it is visible to the naked eye in daylight by exposure to ultraviolet light and this maneuver is a valuable test of Pseudomonas septicemia. Goldfarb and Margraf observed that the Pseudomonas can produce hydrogen cyanide both in vitro and in vivo and suggested that the lethal effect of severe Pseudomonas infection may be due to the cyanide produced by the organisms. Because the titres against Staphylococcus aureus and Pseudomonas are much higher in the serum of convalescent burn patients, Feller and his associates at Ann Arbor prepared a vaccine of heat-killed phenol-preserved Pseudomonas which was given with 250 c.c of hyperimmune plasma daily. In the year in which this combined active and passive immunity has been used clinically, they reported no cases of Pseudomonas septicemia in their unit. More recently the use of an old antiseptic, silver nitrate, has been revived to combat Pseudomonas aeruginosa and other burn infections, Moyer and his group have used a ½% solution applied daily, as a wet dressing, and report that this reduces infection and gives rapid debridement of burned areas. Our own limited experience with this method seems to confirm this. A new antibiotic, gentamicin sulfate, has also been reported to be beneficial in this situation.

2. Fluid and Electrolyte Loss

Large and unappreciated losses of water may occur from extensive burns, even those covered by an apparently dry eschar. Moser, Robinson and Schloerb found that radioactive normal saline solutions pass freely through burn granulations, and Harrison et al. found that in large burns during the second week after burning, the loss by evaporation from the burned area may require a compensatory fluid intake of up to 10 litres per day. They stress also the caloric needs required to keep pace with this. In a similar study on two patients with 50% burns in which they used a sensitive hydraulic bed scale, Roe and Kinney showed a loss by evaporation of between 2 and 4 l. per day in one burn, and 4 to 8 l. per day in the other. They point out that the evaporation of 5 l. per day requires an obligatory expenditure of 2900 calories per day if a stable body temperature is to be maintained. It is clear from these studies that we may easily underestimate the amount of fluid required to preserve water balance after the initial treatment of shock, and before skin cover is obtained. The studies also emphasize the need of a high caloric diet.

3. Artificial Skin

The plastic sponge material "Ivalon" has been suggested as an artificial skin. The need for such substitutes becomes obvious when one considers the difficulties in covering extensive burns when only a relatively small donor area is available and must be used over and over again. The use of homografts goes only part way in meeting this problem. Therefore, the use of Ivalon as a temporary substitute for skin in extensive burns is quite attractive. Workers in several centres have described its use and found that it aids in the control of infection and the maintenance of nutrition. Chardack et al. described the use of such sponges in four children with burns of between 30 and 50% of the body surface. After debridement and when a clean granulating wound had been obtained, sheets of open cellular formalin-sterilized poly-
vinyl sponge were applied. The material adheres because the granulation tissue grows into the sponge which is left in place for weeks or months, and is removed bit by bit and replaced by autografts as they become available. The sponge did not interfere with the take of autografts because a satisfactory bed was left after the Ivalon was removed. Protein loss from these burns was much less than from similar-sized areas covered with non-adherent conventional dressings. However, before the sponge is applied, meticulous debridement must be carried out; otherwise the sponge will adhere poorly and infection may become established beneath it.

In this brief review, only a few of the many aspects of burn research and current innovations in treatment could be mentioned. Many concepts and treatments have come and gone over the years, each one of which has been hailed as a panacea, and for this reason a somewhat skeptical attitude to new developments is appropriate until their efficacy is proved. Because the ultimate criterion of burn treatment is the mortality rate, it is depressing to report that in several large series of burns reported from major centres there has been no significant change in mortality in the last 10 years as compared with the previous decade. Patients with serious burns no longer die in shock, and with adequate and early treatment they seldom die of renal failure. The two most valuable improvements in burn therapy would be a topical debriding agent that would remove necrotic tissue within a few days before extensive bacterial contamination occurs, and a skin bank that would allow us to put a permanent skin cover over the wound almost at once.

Summary Some current trends in burn research and treatment are reviewed, particularly concerning the toxemia of burns and the use of convalescent serum in its therapy. Experimental work with proteolytic enzymes is also described. The importance of Pseudomonas septicemia is again stressed and the use of a vaccine against massive Pseudomonas infection is described. Only recently has it been realized that large losses of water may occur from burned surfaces even when covered by a dry eschar. The use of a plastic sponge as synthetic skin is also briefly commented upon.

Résumé L'auteur passe en revue quelques récents travaux de recherches dans le domaine des brûlures, et insiste particulièrement sur le problème de la toxémie des brûlures et l'emploi de sérum de convalescent. Il rappelle aussi le travail expérimental effectué avec des enzymes protéolytiques. Il saisit l'occasion de souligner l'importance de la septicémie à Pseudomonas et l'emploi d'un vaccin contre l'infection à Pseudomonas accablante. Ce n'est que dernièrement qu'on s'est rendu compte qu'une perte d'eau considérable survient au niveau des surfaces brûlées, même quand elles sont recouvertes d'une escarre sèche. En terminant l'auteur décrit brièvement l'emploi d'une éponge de plastique, à titre de peau synthétique.

References