Some Recent Developments in Oral Feedings for Optimal Nutrition in Burns

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THE NUMBER of survivors after severe thermal injury has increased in recent years because of more physiologic resuscitative measures, improved surgical techniques, and better control of infection. This increase in the number of survivors has re-emphasized the problems of convalescence. In some burn patients this period may last for several months, resulting in as much of a physiologic drain on the patient as the acute burn. Convalescence can be greatly shortened by increased attention to optimal nutrition.

Injury is followed by a period of negative nitrogen balance. This period of catabolism lasts for varying periods of time, depending upon the severity of the injury, the state of wound healing, and the nitrogen and caloric intake.

This presentation is concerned principally with the magnitude of protein losses, optimal levels of nutritional intake, and the achievement of optimal nutrition by oral supplemental protein feedings.

MAGNITUDE OF PROTEIN LOSSES

In an attempt to ascertain the magnitude of losses of a burned patient, complete metabolic balance studies were carried out on eight severely burned patients who were in a good nutritional state prior to their injury.[1] They had an average total burn of 40 per cent, 19 per cent of which was third degree. All of the patients in this group survived the study period. For the eight patients, the duration of negative nitrogen balance or the catabolic phase averaged 33 days.

The patients had an average daily intake of 95 grams of protein (15.2 grams of nitrogen) and 3000 calories. Throughout this period, these patients received a palatable, measured diet with an *ad libitum* intake. They were encouraged to take high protein feedings between meals and received the maximum intake of protein achievable without forced feeding through an intragastric tube. During the first week after injury, they could tolerate very little oral intake, but during the latter part of the study period the daily intake approached 200 grams of protein and 5000 calories.

During the 33 days of the catabolic phase, the daily nitrogen loss averaged 26.5 g, or 166 g of protein. The daily negative nitrogen balance averaged 10.4 g or 65 g of protein. The total losses for the catabolic period were most extensive. The total nitrogen loss per patient averaged 842 g. The weight loss in each patient averaged 29.5 g (13.4 kg) or almost one pound per day. This loss of 13.4 kg represented 917 kg of lean body mass and 3.7 kg of fat.

In spite of these extensive losses, wound healing did not seem to be impaired and skin grafts took well during the catabolic period. On the other hand, it is well known that burned patients who remain in negative nitrogen balance for prolonged periods of two months or more become depleted and fall into a state where the take of skin grafts and wound healing is impaired.

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OPTIMUM LEVELS OF NUTRITIONAL INTAKE IN BURNS

The optimal vitamin therapy after thermal injury has never been determined. On an empirical basis, it is common practice to administer several times the recommended normal daily requirements to patients in a condition of stress. In most instances, large amounts of all the known vitamins are probably not indicated.

Supplemental vitamin therapy is recommended for severely burned patients, but there does not appear to be any evidence to suggest that unusually large quantities of all vitamins are required. At least one or two grams of vitamin C should be given daily. In addition, the following daily doses are recommended: Thiamine hydrochloride 10 mg, riboflavin 10 mg, niacin amide 100 mg, pyridoxine hydrochloride 2 mg, calcium pantothenate 20 mg, folic acid 1.5 mg, and vitamin B_{12} 4 μg.[2]

During the days immediately following thermal injury, vitamins should be given by the parenteral route; later, oral intake is preferred. Two standard therapeutic vitamin tablets are sufficient, in addition to one or two grams of vitamin C.

The aims in protein therapy after thermal injury are (1) minimization of nitrogen depletion as soon as possible after injury, and (2) repletion of nitrogen during later convalescence. There has been abundant clinical evidence to show that the significantly burned patient requires about two to three grams of protein per kilogram of body weight and a total daily caloric intake of approximately 30 calories per gram of protein. This means that most burned patients should receive between 150 and 200 grams of protein, and between 4000 and 6000 calories daily, depending upon the extent of depletion and the severity of the injury.

The protein used should be of high biologic value; therefore, it should be either animal protein, or vegetable protein properly supplemented with animal protein. Whole natural foods are preferred to synthetic protein. When indicated, additional calories may be obtained by the use of a palatable fat emulsion. During the use of any high protein, high caloric formula, sufficient water must be supplied to insure adequate excretion of nitrogenous end products and excessive electrolytes.[3]

ACHIEVEMENT OF OPTIMAL NUTRITION BY ORAL SUPPLEMENTAL PROTEIN FEEDINGS

After severe thermal injury, the convalescent period extends over several weeks or even months (Figs. 1a, b, c, d, and e). Immediately after injury, an adequate intake cannot be expected because the patient is usually not able to take a full hospital tray. During this period, nitrogen depletion can be minimized by encouraging the patient to take a high protein liquid mixture. As his condition improves, he will probably consume more food from his hospital tray and, therefore, approach an optimum intake. However, he soon tires of hospital food. In spite of the most appetizing menus prepared by the best diet kitchens, burned patients rarely take an adequate amount of protein from the hospital tray for very long periods. The best method for minimizing protein depletion seems to be by the use of an acceptable high protein, between-meal liquid feeding. If such a mixture is palatable, patients will take it for prolonged periods of convalescence.

Large amounts of proteins can be given by intragastric nasal tube feedings. A small plastic tube can be inserted into the stomach and large quantities of proteins and calories can be given by this route. However, tubes are uncomfortable and unless there is evidence of impending severe depletion tube feedings are unnecessary. They should never be used in the immediate post-burn period because of the reflex gastrointestinal ileus that occurs during the first few days after an extensive burn. Likewise, they should never be used when the reflexes are depressed or when there is danger of aspiration.

If an adequate amount of supplemental protein can be given, tube feedings are usually unnecessary except in very extensively burned patients or patients that may become depleted. However, when it is obvious that an adequate nutritional intake is not being

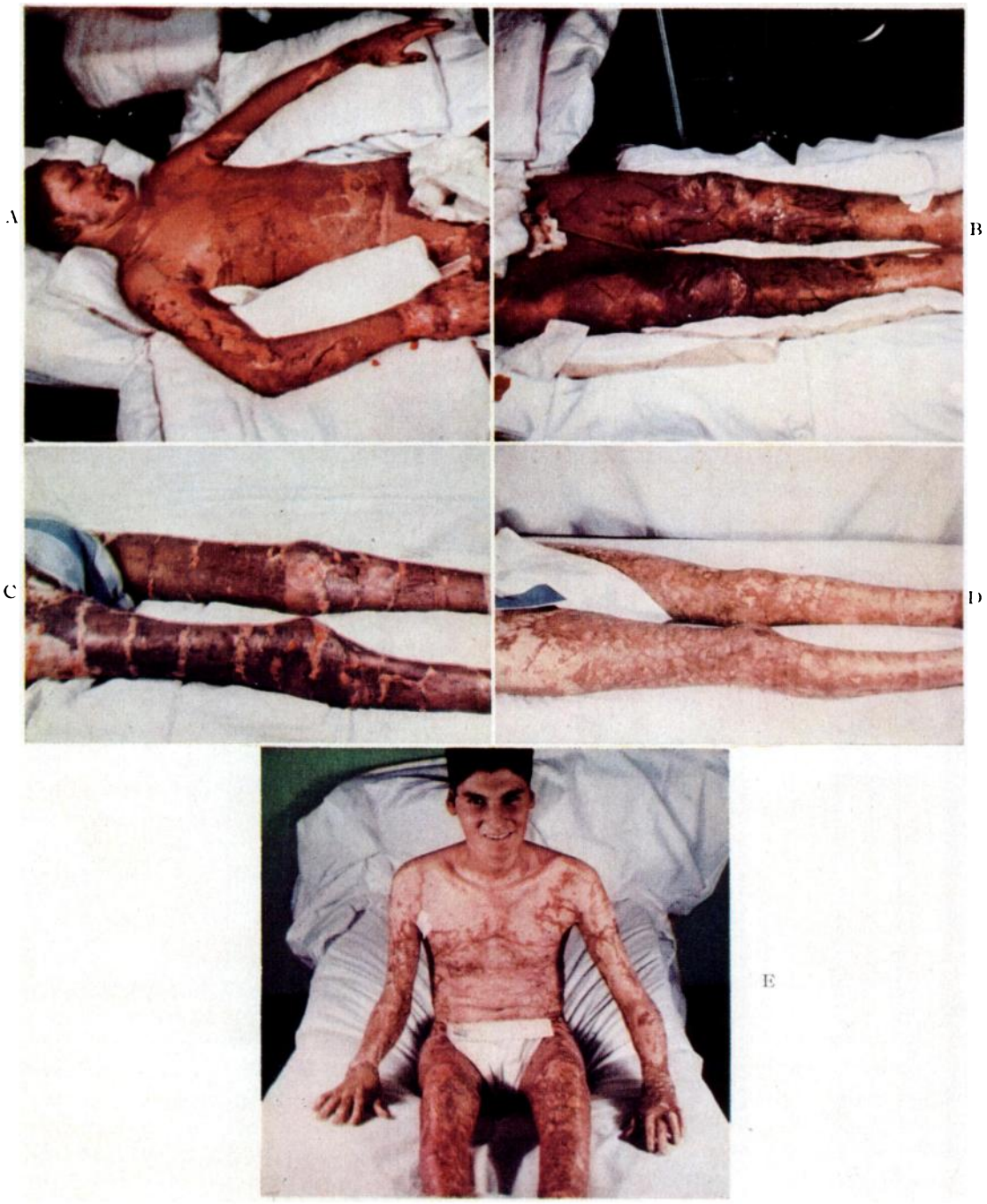

Figure 1

Fig. 1. A. This soldier sustained a 70 per cent burn, 43 per cent of which was third degree, when a shell exploded in a howitzer chamber. This photograph was taken 11 days after injury. There is partial healing of the face and a good protective crust has formed over the chest and arms. B. Eleven days after injury. There are deep circumferential burns of both legs and buttocks. C. Forty-eight days postburn. After removal of the deep eschar, the patient did not have an adequate amount of skin for covering the burn wound. Homografts from a recently deceased body were applied, and this photograph was taken after homografts had been in place 28 days. The homografts disappeared about 47 days after application. By that time the patient's general condition had improved and postage-stamp grafts taken under local anesthesia were applied. D. This photograph shows the patient at the time of discharge from the hospital when the wounds had healed. He was in a good nutritional state. Although he lost 50 pounds, he regained 30 pounds following the use of tube feedings and high protein between-meal supplemental feedings. E. Complete healing of the legs after the application of postage-stamp grafts.

Figure 2

Fig. 2. A. This pilot sustained a 27 per cent burn, 22 per cent of which was third degree, in an aircraft accident. This photograph shows second degree and third degree burn of the arm immediately after the injury. B. Deep second degree and third degree burns of the leg immediately after injury. C. Twenty-seven days postburn. The area is ready for grafting. The patient had received 1200 cc of high protein supplemental feeding daily. D. Twenty-seven days postburn. The leg is ready for grafting. The patient had lost approximately 15 pounds of weight. E. Eighty-three days postburn. The arm is completely healed and the patient weighs only five pounds less than his preburn weight. F. The left leg is completely healed and the patient is ready for discharge. The elastic bandage on the right leg is for support of a healed fracture of the tarsal bone. In spite of very extensive injuries this patient remained in a good state of nutrition throughout his entire hospital course. Complete healing of this extensive wound was accomplished in less than three months. Optimal nutrition was provided by large quantities of a palatable high protein supplemental feeding, which the patient consumed throughout his entire convalescence.

achieved and the patient is steadily becoming depleted, there is no substitute for tube feedings.

If special attention is paid to nutritional therapy as soon as the patient is admitted, a program can be outlined whereby an adequate intake will be maintained. It should be explained to the patient that the high protein, between-meal supplement is required for optimal convalescence. If this supplement is palatable and served to the patient three or four times a day, depletion will be minimized during the first few weeks after injury and later this added protein supplement will provide the necessary requirements for repletion of protein stores.

The desirable protein supplement should provide primarily proteins without a large number of calories. Increasing the caloric value of supplements frequently reduces the patient's appetite. In addition, when large quantities of carbohydrates and fats are used the supplement is not as palatable. Supplemental calories are usually provided by the intake from the hospital tray.

In the treatment of more than 600 burned patients hospitalized during the past four years, Provimalt* has been used extensively as an in-between-meal supplemental protein feeding and it has proved most efficacious (Figs. 2a, b, c, d, e, and f). Twenty-four grams (4 level tablespoons) of Provimalt powder are mixed with 227 ml of whole milk and flavored with 20 g of chocolate syrup. The resultant mixture (total volume 250 ml) contains the following: calories 296, protein 21.7 g, carbohydrate 28.6 g, and fat 9.3 g. When it is freshly prepared and served cold, patients find it very palatable and take it for many months. They may consume from 750 to 2000 cc of this mixture a day. Its chief advantage seems to be its palatability. Patients rarely tire of it and usually continue to take it throughout their entire convalescence.

* Provimalt is a high protein supplement powder supplied through the courtesy of Blake Snyder of Humanic Brands, Summit, N. J.

SUMMARY

Improved techniques in the management of burns have increased the number of survivors, which in turn has re-emphasized the problems of convalescence. Convalescence may be shortened by optimal nutrition.

Protein losses after burns are quite extensive. In eight patients on metabolic study, the average daily protein loss for the 33 days of the catabolic period was 166 grams. Although the patients were in negative nitrogen balance during this period, they were not severely depleted and wounds healed well.

The problem of nutrition in the severely burned patients seems to be prevention of protein depletion. Some type of high protein supplemental feedings is required because the patient is usually unable to take an adequate amount of protein from the hospital tray.

During the past four years Provimalt, a palatable high protein supplement, has been found to be most efficacious in the treatment of more than 600 burned patients. Its chief advantage is that patients accept it over the entire course of prolonged convalescence.

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