

Moderate exposures (20-30 mc h.) evoked an injury current from the irradiated region. At higher exposures, the threshold value of stimulus increased and the action current decreased in strength and duration, and ultimately disappeared at 70 millicurie-hours. Complete breakdown occurred at the highest doses.

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A Method of Human Plasmapheresis.* (19629)

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Although there has been considerable investigation of plasmapheresis in experimental animals(1) very little information is available concerning similar studies in humans. Co Tui *et al.*(2) in the course of investigating the problem of multiple blood donations during World War II, found that the ability of man to regenerate plasma proteins was virtually unlimited provided the red blood cells were returned to the donor. In the present study 16 liters[†] of plasma were removed from a patient with multiple myeloma over a period of 35 days. Since the cellular elements of his blood were restored, our patient experienced no ill effects from the procedure and the erythrocyte, hemoglobin, hematocrit and serum bilirubin remained essentially unchanged.

Method. The patient was bled daily in the

amount of 500 cc into a Transfuso-Vac bottle[‡] (closed system). The bottle was inverted and refrigerated at 4°C for 24 hours which permitted the red cells to settle into the upper portion and neck of the donor bottle. On removal from the refrigerator care was taken not to disturb the red cell layer and a recipient set was attached to the bottle after an 18-gauge needle had been inserted into the air-vent to insure release of any remaining vacuum. The erythrocytes were permitted to flow through the recipient set into an arm vein until only the plasma was left in the bottle. Cells remaining in the lower part of the system were then flushed through with small amounts of sterile physiological salt solution. In the event that adequate sedimentation of erythrocytes is not obtained after 24 hours the blood may be centrifuged at 1000 r.p.m. for 30 minutes in the inverted donor bottle. Prolonged centrifugation at high speed is to be avoided, since it may produce excessive packing of the red blood cells. Plasma proteins were determined on the plasma layer by electrophoresis and by a modification of the Howe sodium sulfate method. The patient was placed on a nitrogen balance program in the

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[†] 15 additional liters of plasma removed subsequently without detriment to the patient.

[‡] The transfusion apparatus is that prepared by Don Baxter & Co., Glendale, Calif.

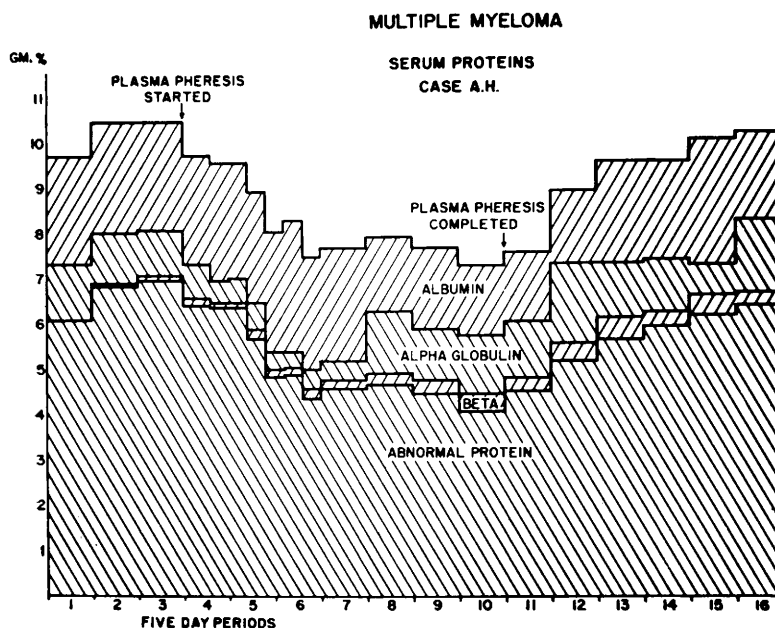


FIG. 1. Effect of removal of 16 liters of plasma on concentration of serum proteins in a patient with multiple myeloma. Note that the greatest change occurred in concentration of the abnormal protein.

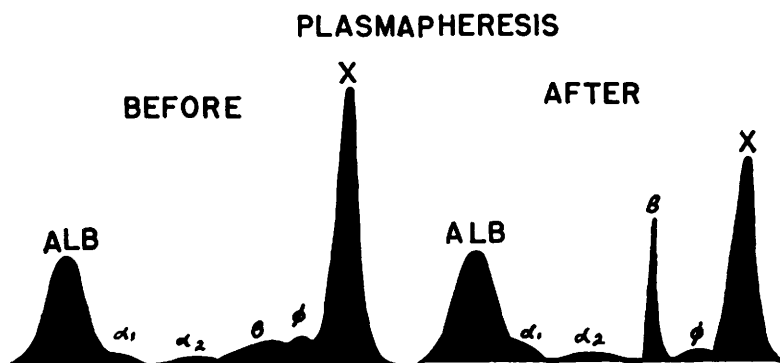


FIG. 2. Effect of removal of 16 liters of plasma on concentrations of plasma proteins as indicated by the descending electrophoretic patterns. The protein labeled "X" is an abnormal plasma protein occurring in this case of multiple myeloma. No significance is attached to the appearance of the "Beta Spike" after plasmapheresis.

conventional manner.

Results and discussion. The concentration of the abnormal plasma protein was slightly depressed whereas the concentrations of the other plasma proteins remained unchanged. (Fig. 1 and 2). On a diet composed of 85 g protein, 264 g CHO and 133 g fat (2500 calories) the patient was in slight positive nitrogen balance. When plasmapheresis was begun and the nitrogen of the protein removed by this procedure was included on the output

side of the ledger, the nitrogen balance was negative by an amount approximately equivalent to the nitrogen content of the plasma removed. However, as plasmapheresis was continued, there was a gradual reduction in the excretion of urinary nitrogen which, after 20 days was equal to the plasma nitrogen. Thus it is evident that the diet ingested during this phase of the study permitted the patient to maintain nitrogen equilibrium in spite of the continuous withdrawal of 30 g of plasma pro-

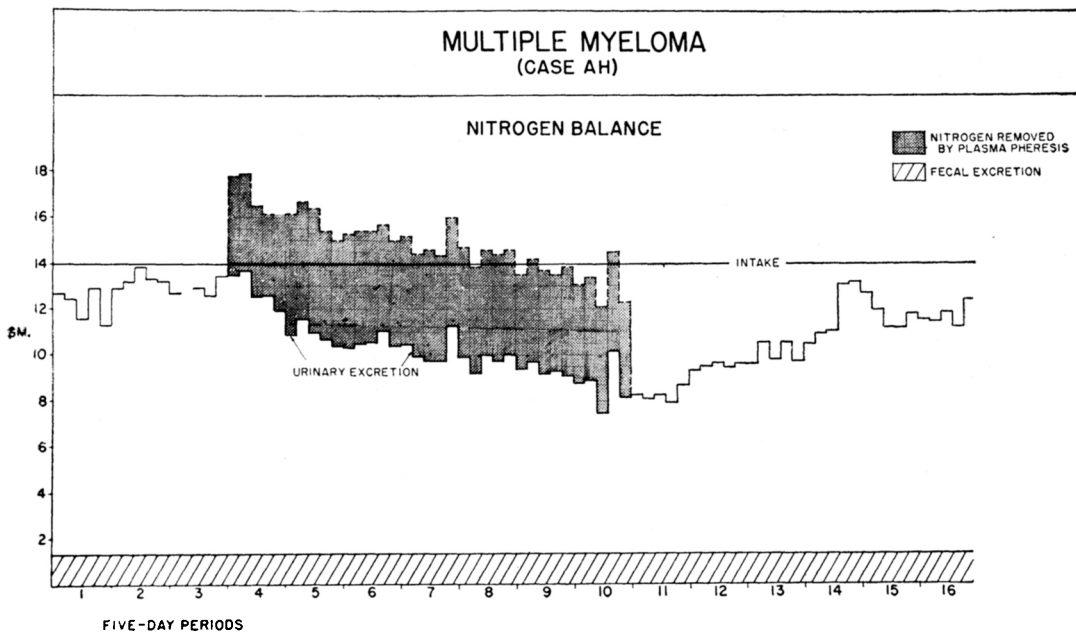


FIG. 3. Effect of plasmapheresis on nitrogen balance (see text). Dietary intake is represented as a straight line at a level of 14 g N/day. Nitrogen removed by plasmapheresis indicated by the stippled area. Cross-hatched area represents daily fecal loss of N. Daily urinary excretion of N is plotted from top of cross-hatched area to the irregular line; hence whenever this line exceeds dietary intake the patient is in negative N balance and whenever it falls below dietary line the patient is in positive N balance.

tein daily. When the plasmapheresis was discontinued at the end of 35 days the nitrogen balance became strongly positive (Fig. 3). Any initial depletion of body protein that may have occurred at the start of plasmapheresis was adequately compensated. If further study shows that the technic as outlined is a practical method for procuring large amounts of plasma from very small numbers of donors, this may well reduce the danger of transmitting viral hepatitis. In addition this suggests a method for readily obtaining large amounts of human convalescent serum.

Summary. A simple method for human

plasmapheresis is described. In a single patient with multiple myeloma it has been shown that the removal of 30 g of plasma protein daily can be continued without ill effect and without substantial decrease in the concentration of plasma protein for at least five weeks. Nitrogen equilibrium was maintained when the diet contained 85 g of protein per day and 2500 calories.

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