

tion tests demonstrating the degree of protection afforded by the serum of 3 patients who had acute attacks of encephalitis in the summer of 1933 against the virus of the 1937 outbreak.

Virus neutralization tests were carried out on the sera of these same patients during 1935 and 1936 against the 1933 virus. These tests are included for comparison with the present tests.

The results are summarized in Table I.

The significance of these results is to indicate the identity of the virus causing the 1937 summer outbreak of encephalitis with that which caused the epidemic of 1933. It also points to the existence of an endemic focus of this infection in the St. Louis area.

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Concentration of Serum Protein Following a Single Severe Hemorrhage in the Fasting Dog.

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Numerous observations have been made on the fall in serum protein immediately following hemorrhage (particularly plasmapheresis), and its subsequent rise. According to one view, this rise is ascribed to regeneration of new serum protein, presumably from amino-acids which were absorbed from the intestinal tract or mobilized from various tissues, notably the liver and muscle. According to another view, the rise of serum protein is due to the direct entrance of protein from a "body store". This "body store" is apparently different from that contained in the various tissue fluids and lymph which furnish a ready source of fluid, but contain only 1% of protein, which is but one-seventh of its concentration in normal blood plasma.

There is general agreement regarding the fall in serum protein which follows a severe hemorrhage. Accompanied as it is by a fall in the red cell count, the process is obviously one of dilution whereby the fluid stores of the body, poor in protein, enter the blood stream in the attempt to restore blood volume back to normal. Once this dilution has occurred, further increases in serum protein concentration are presumably due to the regeneration of new protein or the direct entrance of new protein from some immediately available source, as

mentioned above. However, no inferences regarding the concentration of serum protein should overlook the influence of changes in plasma volume, which occur particularly after severe hemorrhage. Such blood volume changes are due to the fact that the vasomotor system is especially active after severe hemorrhage, resulting in rapid, and often marked, changes in the size of the blood bed. Thus, actual protein may enter the blood stream and yet be masked as far as its concentration is concerned by a coincident vasodilation; conversely, a vasoconstriction may diminish blood volume and result in an increase in the concentration of serum protein, which, in fact, is unchanged as far as the total amount circulating in the plasma is concerned. In reviewing previous observations on the subject, there is some diversity as regards the behavior of serum protein for several hours after the hemorrhage, although there is universal agreement that definite increases occur after 24 hours, particularly when an adequate diet is ingested. Many observers, however, have found evidence of a marked increase of the serum protein concentration even within a few hours following bleeding. Doubtless much of the variation is referable to differences in procedure and the type of animal used; of great importance, too, is the presence or absence of food from which amino-acids may be absorbed. Prominent among these observations are those of Morawitz,¹ Kerr, Hurwitz and Whipple,² Smith, Belt and Whipple,³ Neumann,⁴ Stanbury, Warweg and Amberson,⁵ and Cutting and Cutter.⁶

The present observations, in contrast to many of those cited above, reveal little or no increase in the serum protein concentration (after the initial drop) for 24 hours following a single severe hemorrhage. After 24 hours, definite increases were found. In each of the experiments, 3.5% of the dog's body weight was bled and the same amount immediately replaced by Ringer's solution. One-half hour was then allowed to elapse for readjustment to take place before the second sample of blood was taken. All dogs were starved not only during the experiment, but for 48 to 72 hours previously, although water was allowed *ad lib*. Serum protein was determined by macro-Kjeldahl titrations and checked on duplicate determinations

¹ Morawitz, P., *Beit. z. chem. physiol. u. path.*, 1906, **7**, 153.

² Kerr, W. J., Hurwitz, S. H., and Whipple, G. H., *Am. J. Physiol.*, 1918, **47**, 356.

³ Smith, H. P., Belt, A. E., and Whipple, G. H., *Am. J. Physiol.*, 1920, **52**, 54.

⁴ Neumann, B., *Arch. f. Klin. Chir.*, 1932, **172**, 529.

⁵ Stanbury, J. B., Warweg, E., and Amberson, W. R., *Am. J. Physiol.*, 1936, **117**, 230.

⁶ Cutting, W. C., and Cutter, R. D., *Am. J. Physiol.*, 1935, **114**, 204.

to within 2%. The observations are summarized in Fig. 1. These observations confirm those reported by the author in these PROCEEDINGS,⁷ in which similar experiments were carried out except

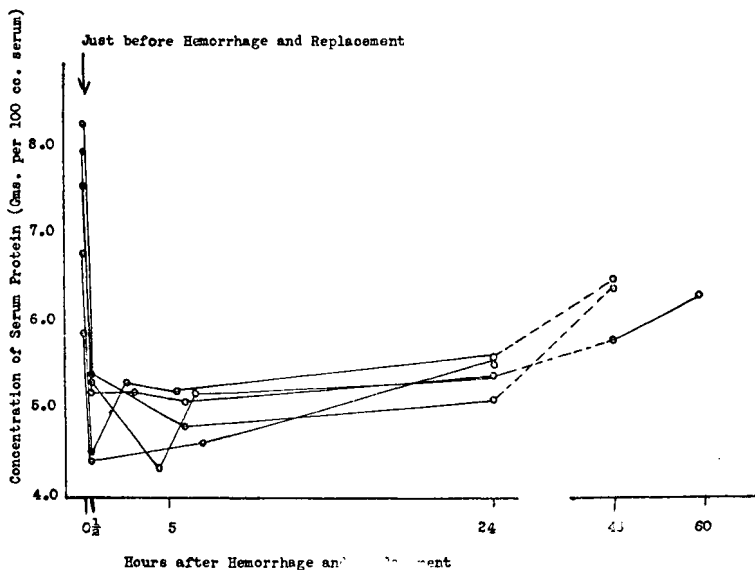


FIG. 1.

Curve of serum protein concentration following a single bleeding of 3.5% of the body weight of the dog, followed by immediate replacement of the same volume of Ringers Solution. Second sample taken at 1/2 hour.

for the administration of additional fluid following the hemorrhage and replacement. In these experiments there was actually a decrease of 0.09 gm. % in 6 hours with an increase of but 0.15 gm. % in 24 hours following the hemorrhage and replacement. It is of interest to note that Kerr, Hurwitz and Whipple² in 1918 made similar observations after plasmapheresis in fasting dogs. They state "Regeneration is a slow and difficult matter requiring many days. . . . It seems that the body can produce serum proteins only in small amounts even in an emergency."

Conclusion. In fasting dogs bled 3.5% of their body weight, with immediate replacement of the same volume with Ringer's solution, very little increase in the serum protein concentration occurred beginning one-half hour up to 24 hours after replacement. After 24 hours, definite increases were noted.

⁷ Elman, R., PROC. SOC. EXP. BIOL. AND MED., 1937, **36**, 867.