

Conclusions. The subcutaneous injection of hypertonic NaCl solution is followed by acute circulatory failure, which is associated with hemoconcentration and with an increase in the amount of sugar, non-protein nitrogen, and NaCl in the blood. Other hypertonic solutions, such as hypertonic glucose solution, when given subcutaneously, might be expected to produce somewhat similar results.

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Relative Significance of Water and of Protein Loss in Dehydration Shock.

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The importance of loss of fluid at the site of injury has been emphasized in shock due to trauma or burns and associated with hemoconcentration.^{1, 2} The chemical composition of this fluid is similar to that of blood plasma and its total protein is approximately 5.2 g per 100 cc.³ The present study was undertaken to determine the relative significance of loss of the protein fraction and of the aqueous fraction of the blood plasma in the production of acute circulatory failure associated with hemoconcentration.

Materials and Methods. Shock was induced in 6 dogs which had been anesthetized with sodium pentobarbital, by the subcutaneous introduction into the left leg of 25% sodium chloride solution, the dosage being 25 cc per kg of body weight. Details of this method have been published elsewhere.⁴ Determinations of the hemoglobin, hematocrit and erythrocytes were made upon blood withdrawn from the right femoral vein before and during the course of each experiment. After death each animal was bisected and the difference in weight between the halves of the body was determined. In estimating the amount of fluid lost at the site of injection, a correction was made by subtracting from the total weight the weight of the injected solution; 100 cc of 25% solution was found to weigh approximately 118.8 g, and the calculations were made upon this basis.

¹ Blalock, A., *Arch. Surg.*, 1930, **20**, 959.

² Parsons, E., and Phemister, D. B., *Surg., Gynec. and Obst.*, 1930, **51**, 196.

³ Harkins, H. N., and Harmon, P. H., *Ann. Surg.*, 1937, **106**, 1070.

⁴ Davis, H. A., *PROC. SOC. EXP. BIOL. AND MED.*, 1940, **43**, 354.

TABLE I.

| Dog wt, kg | Amt injection 25% NaCl sol., cc | Calc. plasma vol., cc | Reduction plasma vol. (calc. from hematocrit), cc | Corrected local fluid loss, cc | Local fluid loss, % body wt | Total protein in fluid, g % | Estimated total protein loss at site of injection in g |
|------------|---------------------------------|-----------------------|---|--------------------------------|-----------------------------|-----------------------------|--|
| 6.2 | 155 | 319 | 141 | 263 | 4.2 | 0.4 | 1.052 |
| 6.4 | 160 | 275.6 | 123 | 260 | 4.0 | 1.0 | 2.6 |
| 6.6 | 165 | 410.7 | 242 | 602 | 9.1 | 1.2 | 7.224 |

The fluid obtained at the site of injection was filtered and analyzed quantitatively for total protein.

Results. After correction, the amount of fluid lost at the site of injection varied from 4 to 9.1% of the body weights of the animals. The average loss of fluid was 5.9% of the body weight.

It is now necessary to consider to what extent these figures represent a loss of fluid from the blood stream. It is evident, from representative data shown in Table I, that the calculated reduction in the fluid portion of the blood is less than the amounts of fluid lost at the site of injection, these figures being based upon alterations of hematocrit, erythrocyte and hemoglobin readings. This would suggest that part of the fluid is lost from the interstitial tissue spaces.

The total protein content of the fluid lost at the site of injection varied from 0.4 to 1.7 g per 100 cc. The low protein content appears to indicate that the hemoconcentration is due not to a loss of whole plasma but rather to a loss of the aqueous fraction. One cannot exclude the possibility of slight damage to the capillary walls at the site of injection. Such an injury would permit the escape of whole plasma, but if it is present, the low protein content of the fluid suggests that it is apparently not significant. It has been shown that death will occur in dogs if whole plasma to the extent of 2.6 to 4.4% of the body weight is removed,^{5, 6, 7} which indicates that animals will tolerate the loss of large amounts of plasma protein before death takes place. In these experiments, however, 2 animals died (Table I) with local fluid losses amounting to only 4 and 4.2% of the body weight respectively. In both instances the fluid was almost entirely water and its protein content was very low.

Conclusions. Shock which follows the subcutaneous injection of hypertonic NaCl solution can be explained by a loss of fluid at the site of injection. This fluid contains only small amounts of protein, and it is suggested that it consists partly of water derived from the blood and partly of water derived from the interstitial tissue spaces. The presence of hemoconcentration is due to a loss of the aqueous fraction of the plasma rather than to a loss of whole plasma. Rapid loss of water from the blood is capable of producing acute circulatory failure.

⁵ Johnson, G. S., and Blalock, A., *Arch. Surg.*, 1931, **22**, 626.

⁶ Harkins, H. N., and Harmon, P. H., *Surgery*, 1937, **1**, 276.

⁷ Roome, N. W., Keith, W. S., and Phemister, D. B., *Surg., Gynec. and Obst.*, 1933, **56**, 161.