LETTERS TO THE EDITORS

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Dextran as a Substitute for Plasma

As is well known, we have in blood, plasma and serum adequate media for the treatment of shock, for example, in cases of serious loss of blood or contusions. During the present War, however, it has proved impossible completely to supply the large requirements of these materials. It is therefore natural that physiologists and chemists are seeking for substances the aqueous solutions of which can replace the expensive and delicate blood or plasma.

In the course of the War of 1914–18, Bayliss[1] attempted to employ solutions of gum arabic for purposes of infusion. Later, other substances such as gelatin, polyvinyl alcohol, pectin, polyvinylpyrrolidone and others were tested to this end. The infusion of these colloids has, however, been attended by certain difficulties. Some of the substances tested have antigenic properties, whereas others cannot be broken down by the organism, for which reason they are stored in the organs, especially in the liver.

The conditions to be fulfilled by a foreign colloid in order that it may exercise a therapeutic effect in cases of shock are, in brief, as follows:

In all cases of shock, both in bleeding and in contusions and burns, it is essential to increase the volume of the circulating blood by the infusion of a liquid. This cannot be done satisfactorily with solutions of crystalloids. The infused liquids must instead contain colloids that exert the same colloidal osmotic pressure as the plasma proteins, or 300–400 mm. water. A condition for the exertion of this pressure by the colloids is that they must be of such a molecular size that they cannot pass through the walls of the capillaries.

The colloid must be suited to repeated intravenous injection in large quantities. It must also be completely atoxic and devoid of antigenic properties.

The solutions must not have a high viscosity. The viscosity should preferably be of the same order as that of the blood.

Finally, the substance should be of such a nature that the body can gradually rid itself thereof, so that it does not remain long in the blood and is not stored in the organs.

A substance not previously tested for this purpose and apparently fulfilling the requirements listed above is the neutral polysaccharide dextran. Dextran is a water-soluble high-molecular carbohydrate which is formed in solutions of sugar infected with the bacterium *Leuconostoc mesenteroides*. It has been possible to show that the dextran molecule is built up of glucose units, linked together in long, more or less branched chains[2]. The molecular weight of dextran may be very high, of the order of magnitude of many millions[3,4,5]. By partial hydrolysis dextran preparations of lower molecular weight, for example, of the order of 100,000–200,000, can be made[6]. The partially hydrolysed dextran, like the original substance, is inhomogeneous with respect to molecular weight.

By well-controlled partial hydrolysis it is possible to prepare dextran solutions for purposes of infusion in which the solute has a suitable molecular weight and which do not give rise to injuries or reactions even after repeated large infusions. The sedimentation reaction, however, is increased after infusion (which has also been observed after infusion of, for example, gum arabic). The viscosity and colloidal osmotic pressure of the 6 per cent solutions employed (with 1–3 per cent sodium chloride) are of the same order as those of blood[6,7].

The solutions can be autoclaved and the preparation distributed in concentrated solutions or in the form of dry powder.

If a normal infusion dose is injected intravenously into a dog, the dextran concentration in the blood falls to zero in the course of three to four days. During the whole of this period dextran can be detected in the urine. The dextran ejected with the urine has a lower molecular weight than that originally injected. Even after repeated large infusions, no storage in the organs can be demonstrated histologically[6,7].

As dextran is broken down by the organism, glucose and relatively low-molecular fragments of dextran are presumably formed, which can pass the kidney filter and be expelled with the urine.

The therapeutic effect was investigated experimentally in cases of shock from bleeding, histamine shock and contusion shock developed artificially in rabbits and cats. Rapid and lasting effects on the blood pressure, heart action and respiration were always registered[6].

The experiments on animals giving favourable results, a clinical investigation was therefore commenced, at first on a limited scale. As the first clinical tests also gave promising results, and as there is reason for supposing that dextran is better suited as a plasma substitute than, for example, gum arabic, polyvinylpyrrolidone or pectin, it was considered justified to set in train a more thorough clinical investigation. An account of this will be submitted at a later stage.

We wish to thank Prof. Arne Tiselius for helpful advice and Profs. T. Svedberg and A. Westerlund for the provision of laboratory facilities. The research has been carried out with grants from A. B. Pharmacia, Stockholm, and Svenska Sockerfabriks A.B., Malmö.

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Reactivity of the Sulphur Linkage in Wool

WHEN a wool fibre is rubbed lengthways between finger and thumb, it migrates in the direction of the root end because the surface consists of a series of overlapping scales. Similarly, when a fabric containing wool fibres is rubbed in presence of aqueous media, the fibres migrate and cause the material to shrink. Such shrinkage is usually prevented by treating the fabric with compounds which are capable of forming a gelatinous degradation product of keratin on or under the scales of the fibres. A survey