Meetings

Blood Preservation and Blood Substitutes

A symposium of the Edward Mallinckrodt, Jr., Foundation on Blood Preservation and Blood Substitutes was held at Endicott House, Dedham, Massachusetts, on 11 and 12 December, with 28 participants. Shields Warren served as general chairman. The subjects and discussion leaders were as follows: "The physical properties of blood as a hydrodynamic fluid," John L. Oncley (Harvard Medical School); "Blood preservation by physical means," James L. Tullis (Protein Foundation); "Blood preservation by chemical means," Eugene P. Cronkite (Brookhaven National Laboratory); "Advantages and handicaps of presently available blood substitutes," Scott N. Swisher (University of Rochester School of Medicine); and "Desirable characteristics of blood substitutes," William H. Crosby (Walter Reed Army Institute of Research).

Recent advances in the knowledge of hemic osmotic pressure and viscosity were related to problems of the blood vascular system.

The key to the flow of blood lies in the size and type of capillary network through which it must pass. The flow through the capillaries has a fairly flat front, the blood moving largely as a unit with slippage along the walls. A normal sedimentation rate of red blood cells is important for smooth flow. The sedimentation rate tends to be increased by the presence of most long molecules, such as those of the plasma extenders.

The plasma proteins, in addition to maintaining proper osmotic balance and viscosity, act significantly as binding agents; for example, serum albumin binds one molecule of fatty acid strongly, and ten or more loosely. This action helps to maintain proper suspension of fats in the blood. Blood fats supply important nutrient material to vital organs, particularly the heart, which derives over 70 percent of its energy from fatty acids.

Of interest from the pharmaceutical standpoint is the fact that many drugs are bound by albumin, which helps to prevent their too rapid excretion. Hormones such as insulin and thyroglobulin are also bound by blood proteins.

Albumin also plays a role in the binding of ions. One albumin ion normally binds eight chloride ions. On the other

hand, albumin is a poor binder of calcium; the ratio is only one to one.

Because of recent interest in the use of cold for anesthesia and in other fields, the effects of lowered temperature on the blood were considered. The cryoglobulins do not contribute much to the total properties of blood, so a drop in temperature has relatively little effect on whole blood.

The normal viscosity of blood has an index of 3. In certain pathologic states this can go up to as high as 10. Fibrinogen is responsible for roughly 20 percent of the total viscosity of the blood. Deviation in viscosity can usually be readily handled by the homeostatic mechanisms of the blood.

Polyamino acids have potential value as a blood expander.

Reconstituted preserved plasma must be used rapidly, especially because the lipoprotein linkage has been broken down. In contrast to plasma, albumin can be frozen and thawed repeatedly without change. The major requirements in plasma expanders are freedom from antigenicity and homogenity of molecular size. Since a blood substitute must fulfill a number of functions, there is no single measurement that can be used to establish desirable criteria.

A much-discussed question was whether it is better, in order to obtain molecules of optimal size (about 35 angstroms) for use as blood substitutes, to split preexisting long molecules or to synthesize smaller molecules to a polymer.

Dextran is slightly antigenic. About 4 percent of normal persons react because of cross immunity. Dextran may slightly prolong bleeding time, but this is not serious or lasting. It rarely occurs if less than 1500 cubic centimeters of a 6-percent suspension are used. A greater disadvantage in the use of dextran is the difficulty of obtaining proper and uniform molecular size. Dextran is slowly metabolized, and the bulk is excreted in 2 to 4 weeks. Polyvinyl pyrrolidone is effective and cheap; however, it does persist in the liver. Because of the risk of serum hepatitis from whole-blood transfusions, it is quite possible that the use of whole blood is more dangerous than utilization of dextran or even polyvinyl pyrrolidone.

A number of plasma products are available. Four units of plasma are roughly equivalent to one unit of albumin. It was pointed out that despeciated bovine or equine plasma is used widely throughout the world.

There was extensive discussion of the preservation of blood by freezing, and of the role of glycerol in the protection of red blood cells during the freezing and thawing processes. The method developed by the Protein Foundation and the Chelsea Naval Hospital and utilized at the Naval Hospital has proved of great value. The mean period of survival of transfused washed red cells preserved by glycerol and freezing is over 30 days in the recipient's body. Glycerol is effective for successful freezing of washed red cells. Only 1 percent of the blood cells are lost with each successive freezing and thawing.

The plasma expanders are of very little use in civilian practice; their chief usefulness is in emergencies. One of the basic questions is, "Can one increase the supply and lower the cost of human albumin?"

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Forthcoming Events

March

5–9. Analytical Chemistry and Applied Spectroscopy, conf. and exposition of modern laboratory equipment, Pittsburgh, Pa. (C. F. Glick, Applied Research Laboratory, United States Steel Corp., Monroeville, Pa.)

5–16. United Nations Economic and