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I.—Blood and Blood Products.

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Synopsis

The use of blood has greatly increased during the past 25 years. One of the most important advances during this period is related to the development of methods of isolating, concentrating and storing the individual components of blood for specific clinical requirements. Along with this, new problems in science and technology, blood-donor organisation and medical care and the recruitment and training of staff have emerged. The opinion is advanced, that in the future, the efficiency of blood transfusion lies in its establishment as a separate discipline.

Introduction

Over 300 years ago, on November 14, 1666, another Royal Society, then only 6 years old, held a meeting at Gresham College, London, which I believe must be the first Symposium on blood transfusion practice. Today's Symposium sponsored by the Royal Society of Edinburgh and the Royal College of Physicians of Edinburgh is in some ways no less historic to those of us associated with blood transfusion either as suppliers or users.

The meeting of 1666 could, I suppose, be regarded as setting the seal of respectability on blood transfusion, although it must be admitted that for most of the next 300 years its reputation suffered severe set-backs. Today's meeting will I hope, be regarded not only as recognition of blood transfusion practice as a science, but also as a major step towards its emergence as a viable discipline in its own right.

Blood transfusion owes much of its progress to a succession of wars and the period immediately following the Second World War provides a convenient starting-point for reviewing developments. By 1947, many important advances had been made. The main blood group systems had been identified and the related technology which has contributed so much to disciplines such as immunology and genetics, was rapidly expanding. The use of anticoagulant nutritive additives which led to the storage of blood and the system of blood banking which is still followed, had been introduced. The technology of large-scale plasma fractionation which will always be associated with the names of Professor E. J. Cohn in Boston and Professor R. A. Kekwick in London had also been established. Thus, although the emphasis and scope of blood transfusion has markedly changed, subsequent progress has been largely extensions of these earlier discoveries. Added to this, is the impact of clinical and scientific research, developments in technology, improved equipment and expanding clinical requirements.

For about a year after the Second World War, a period of relative quiet reigned. This was followed by an explosion in demand which has continued ever since. We must now ask ourselves; (i) Are we obtaining sufficient starting material? (ii) Do we know the nature and extent of the clinical requirement? (iii) Are we making the most of our existing resources?

The answers will provide an indication of our success, or lack of it and point the way to the future. In the short time available, it is possible to do no more than indicate some of the main lines along which developments are taking place.

1. *Cryobiology.* Scientists have provided us with a vast store of knowledge regarding the structure, biological function and physico-chemical properties of the cellular and non-cellular components of blood and of their behaviour under extracorporeal environmental conditions. It is now possible to isolate, concentrate and preserve many of these components at sub-zero temperatures for prolonged periods while still retaining their biological properties, an advance which enables us to stockpile otherwise labile components for clinical and laboratory use, and has added greatly to the safety, clinical efficiency and scope of transfusion practice. This in turn has led to the evolution of blood component therapy as the accepted form of blood utilisation, since all the clinically important components can, as a rule, be obtained from the same donations of blood, thus promoting significant economy in donor requirement and a more rational, safe and efficient use of our resources.

2. *Specific Immunotherapy.* One of the most important clinical applications of blood in recent years has been the use of the immunoglobulins (IgG) in preventative medicine, particularly those with a specific hyperimmune content. Immunoglobulin is provided in two ways:

(i) By concentrating the normal antibody content of blood plasma from large donor pools, in order to obtain a broad spectrum standard product (normal IgG).

(ii) By processing plasma with specific hyperimmune properties, obtainable from a limited number of highly selected donors who have been immunised naturally or following the deliberate injection of an appropriate antigen as in the production of anti-Rh immunoglobulin, an application of immunotherapy which has virtually eliminated fresh cases of haemolytic disease of the newborn related to the Rhesus factor.

3. *Prevention of Adverse Effects of Transfusion.* Advances in blood group serology, the development of techniques designed to identify disease carrier states in donor blood, improvements in the equipment for handling blood such as the introduction of closed-circuit disposable blood collecting and processing procedures and the use of blood components, have minimised the traditional risks of incompatibility and bacterial contamination. Nevertheless, these improvements are no more than relative since changes in blood transfusion practice have contributed others. For example, the diminishing risks of incompatibility from the presence of naturally occurring agglutinins have been offset by an increase in those of immune origin resulting from repetitive transfusion in a growing number of recipients. Steps to lessen this possibility by more precise donor-recipient matching, or even the auto-transfusion of blood stored often well in advance, are now practicable procedures.

4. *Automation and Computer Applications.* Blood group technology and donor screening systems for the detection of diseases transmissible by blood are on the whole well suited to automation, which is gradually replacing manual methods in both these situations. Computers are being introduced to facilitate donor organisation and blood stock control, to study the effects of transfusion and to promote optimal blood utilisation. Later in the Symposium you will hear a little about the application of the

computer in two rapidly expanding and important fields of blood transfusion namely, process control in the large-scale production of plasma protein fractions, and in relation to the selection and distribution of organs for transplantation.

5. *Donor Organisation.* All these developments are contributing to the creation of a new blood donor-service relationship. Many of the most valuable components of blood essential for clinical or laboratory use and derived from only a few highly selected individuals, can now be obtained in relatively large amounts by the technique of plasmapheresis. Volunteers are now asked not only to give blood in the conventional manner, but also, in special circumstances, to donate plasma only, at frequent intervals. In order to provide these substances they may also be asked to receive injections of antigenic material, which may carry additional risks and involve them in considerable personal inconvenience.

This approach to blood donation has created a new area of clinical, ethical and legal responsibility for medical staff in Transfusion Centres to which has been added the socio-medical problems resulting from the detection of carriers of transmissible viral diseases. For scientific and technical staff it means the acquisition of new expertise and for the blood withdrawal and donor organisation staff, new systems of blood withdrawal and the maintenance of not one, but several panels of highly selected donors.

The blood donor is now an essential member of a team concerned with patient care, a fact which is not always appreciated until a crisis in supply occurs. The importance of establishing and maintaining good public relations and above all public confidence in the service, grows with each new clinical application of blood and each technological and scientific development.

Blood transfusion, seen as an applied paraclinical discipline has reached a critical point in its history. Blood and its components are now readily available and are in many situations essential for patient care in hospital and general practice and in preventative medicine. Clinicians are not always aware of the progress already made, of the range of products available, when to administer them and how to control their use. The technical and scientific expertise used in modern blood transfusion is derived from many disciplines, such as biochemistry, immunology, genetics, haematology and microbiology and these are needed not only for the procurement and processing of blood, but also for the selection of the appropriate products for clinical use and for their quality control.

Along with the growing demand for greater product specificity and purity, we require more knowledge of the dangers inherent in the intensive use of potent therapeutic agents of biological origin. We need for example, to harness the growing mass of knowledge on immunology, which already points to the presence of substances in blood capable of potentiating or blocking a variety of immunological processes and which may have profound clinical applications. Dangerous infections, not controllable by antibiotics or chemotherapy or even resulting from their use, await the procurement and processing of specific immunoglobulins. We require still more information on the ultrastructure of the components of blood, their identification at molecular level, their biological properties and behaviour *in vivo* and in an extracorporeal environment.

Two factors are of paramount importance in developing the range and quality of service which medicine will in future demand of us:

1. The nature and extent of the requirement for the various components of blood. For this, collaborative clinical trials are essential, and the lecture dealing with the use of albumin shows just how informative and valuable such a trial can be.
2. The recruitment and training of staff for the special needs of blood transfusion practice. To obtain and retain the staff needed to meet the existing standard of medical science and the future clinical applications, we must provide them with competitive career prospects and satisfying work.

Can the breadth of interests and responsibilities which I have tried to indicate be centralised and applied under a national administrative structure and within the orbit of an integrated discipline, or should selected areas be divided among those disciplines which have more or less close functional relationships?

I have no doubt that in the best interests of patient care and scientific progress, the future of blood transfusion must lie in the development of a single functional discipline, designed to collaborate closely and directly with the users of blood as well as with related areas of laboratory medicine and capable of promoting the basic criteria for optimal blood utilisation, namely, adequate supply, ethical blood-donor management, safety and therapeutic efficiency. Only by strengthening the link between supply and use can these four objectives be reached and maintained.