

INTRODUCTORY NOTES

The book 'Blood Transfusion' edited by Elmer L. DeGowin, Robert C. Hardin and John B. Alsever was originally published by W.B. Saunders Company, Philadelphia & London in 1949. The first chapter of this book (pages 1-6 inclusive) written by Elmer L. DeGowin is titled 'Historical Perspective' and provides information on a number of aspects relating to the history of transfusion.

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Whilst this version of the history of blood transfusion, written by USA-based authors, provides a brief history "of the first 275 years" its main focus is on "the last 50 years", i.e. the first half of the twentieth century. As such this alone provides an interesting viewpoint. As well as sections titled the 'discovery of the four blood groups', the 'introduction of sodium citrate' and the 'Rh Factor', it also provides historical information regarding the importance of the discovery of pyrogens and the use of blood plasma. The article identifies that it attempts to evaluate the various advances of the previous 50 years "in the light of their effect in making transfusion available to the average patient".

HISTORICAL PERSPECTIVE

By Elmer L. DeGowin

From 'Blood Transfusion' by Elmer L. DeGowin, Robert C. Hardin and John B. Alsever, published by W.B. Saunders Co. 1949.

THE FIRST 275 YEARS

THE LAST 50 YEARS

The detailed history of blood transfusion is a fascinating subject for physician or layman but the reader frequently finds difficulty in bringing many events into proper perspective. DeBakely¹ has written an excellent summary of the salient discoveries in the field up to 1915. It is rather the purpose of this discussion to attempt an evaluation of the various advances in the light of their effect in making transfusion available to the average patient.

THE FIRST 275 YEARS THE PERIOD OF EXPLORATION

William Harvey first announced his observations on the circulation of the blood in his lectures in 1616, the year of Shakespeare's death. They were published in 1628 in his famous monograph.² It is probable that Richard Lower, the English physiologist, performed the first successful transfusion in animals in 1665.³ The first well-documented transfusion to man was probably performed by Jean Baptiste Denis in

1667,⁴ who transfused the blood of a lamb into a youth. The operation was performed but rarely for the next 150 years. There was no consensus as to the indications, and many disappointments were encountered because of the fantastic results expected. About 1818 James Blundell, the English physiologist and obstetrician, revived the procedure and advocated its use in the treatment of acute hemorrhage.⁵ He also insisted that human blood was more effective than that of animal origin. His writing probably introduced the subject to the American profession.

But in spite of centuries of discussion, the procedure was so impractical that Landois⁶ in 1875 was able to collect reports of only 347 transfusions from literature of the world up to that time. The operation was crude and difficult. Transfusion was performed either by artery-to-vein anastomosis or by some modification of the syringe method. There was no effective way of preventing coagulation of blood. Probably about 40 per cent of transfusion resulted in intravascular hemolysis, with a high mortality.

THE LAST 50 YEARS THE PERIOD OF APPLICATION

The Discovery of the Four Blood Groups

In 1900 Landsteiner⁷ announced his discovery of various patterns of agglutinogens and agglutinins in human individuals and reported three blood groups, some of which were mutually incompatible in blood transfusion. Decastello and Sturli⁸ described the fourth blood group two years later. Ottenberg⁹ and his associates were the first to apply this knowledge to human transfusion. In 1907 Jansky¹⁰ reported his numerical classification of the four groups in a Bohemian journal which attracted little notice at the time. In the United States, Moss¹¹ announced a somewhat similar nomenclature independently in 1910.

During the first decade of the twentieth century interest was again greatly stimulated in blood transfusion because the major cause of fatalities had been discovered and the methods of prevention had been demonstrated. Many attempts were made to improve the mechanics of the procedure. These resulted in the techniques of Carrel, of Crile and of Bernheim in artery-to-vein anastomosis, and the paraffin tube method of Kimpton and Brown. But again, these advances did not affect the average patient who needed a transfusion. The techniques were still so difficult as to require the services of highly skilled persons in an operating room. The vessels of the donor and recipient were usually ligated. It is safe to state that only a few transfusions were performed in comparison with the need.

Introduction of Sodium Citrate

Perhaps next in importance to the discovery of the four blood groups was the introduction of sodium citrate as an anticoagulant in 1914 by Hustin¹² in Belgium, Agote¹³ in Argentina, and Lewisohn¹⁴ and Weil¹⁵ in the United States. This advance made possible the addition of a simple, inexpensive, relative nontoxic chemical substance to the blood which permitted a much-needed simplification of the procedure of transfusion. The collection of blood could be separated from its injection by minutes or hours. The presence of the donor was not required in the same room with the recipient. This permitted for the first time, what we have termed 'delayed transfusion'. The technique of blood transfusion was immediately simplified so that the operation was within the skill of anyone who could insert a needle into a vein.

The procedure immediately became popular and was employed quite extensively in the treatment of the wounded in World War I. Its use has steadily grown ever since in civilian practice.

Discovery of Pyrogens

This landmark in parenteral therapy has never received just recognition of its importance. In 1923 Florence Seibert¹⁶ announced the discovery of heat-stable products from bacteria growing in distilled water. By taking certain precautions against the contamination of fluids with pyrogens, injections of solutions of blood can be given to human beings with a minimal incidence of chills and fever. This finally allayed the doubts as to the innocuousness of sodium citrate, so that the delayed method of transfusion became more widely employed. Another result was the commercial production of solutions for parenteral therapy and preservative mixtures for blood, which has contributed materially to the increased use of blood transfusions in the United States

Preservation of Blood

Within two years after the introduction of sodium citrate as an anticoagulant, Rous and Turner of the Rockefeller Institute published the pioneer studies¹⁷ on the preservation of blood for transfusion. Almost immediately the results were applied by Robertson who conceived and operated the first blood bank. He collected stores of blood in casualty clearing stations of the British Army and transfused wounded soldiers. His report was published in 1918.¹⁸

The principle of the blood bank was temporarily forgotten after World War I, to receive a revival in Russia by Yudin who used cadaver blood in 1933.¹⁹ The first blood bank in the United States was organised in 1936 in Cook County Hospital in Chicago;²⁰ since then, the idea has spread with great rapidity in this country and elsewhere. In almost every institution in which a bank has been established the number of blood transfusions has been greatly increased so that this development has resulted in more nearly supplying the needs of the patients for transfusion than ever before in the history of medicine.

In World War II the use of preserved blood was greatly accelerated. In Great Britain blood banks were organised for the treatment of civilians injured in air raids. The British Army Blood Transfusion Service furnished preserved blood for the troops in combat in Europe and Africa. Later, the Army of the United States operated transfusion services in the European Theatre of Operations and the Mediterranean Theatre. Approximately a third of a million transfusions of preserved whole blood were given in the ETOUSA alone. Almost half of this amount was flown from continental United States. The United States Navy operated a transfusion service which transported blood by airplane from the United States to the Pacific Ocean Areas.

The experience of wartime had a profound effect on blood transfusion in civilian practice. Many physicians who served in the armed services acquired knowledge and skill in the practice which they carried back to civilian life. In Great Britain a national transfusion service was organised to serve civilian needs. At the present writing, the American National Red Cross is initiating a programme to provide preserved blood to communities where it is needed.

Blood Plasma

Blood serum and plasma had been used therapeutically in the United States for many years, probably as an outgrowth of the "serum centre" in which convalescent serum was processed. As early as 1936 John Elliott²¹ reported the use of blood plasma, and Strumia²² stated that his experience with it began in 1927. When blood banks developed with the consequent supply of plasma as a byproduct from outdated blood, interest in the clinical use of plasma increased. Most of the pioneer work was done in 1939. Preliminary experiments and observations seemed to indicate that hemorrhagic shock could be treated successfully with transfusions of plasma. A short-lived wave of enthusiasm for plasma therapy ensued in the United States which was dampened about 1943-1944 by the extensive experience of the

armed forces in the treatment of wounded men. Gradually the clinical and experimental evidence became overwhelming to indicate that plasma transfusions were principally of value as a first-aid measure in the treatment of hemorrhagic shock, and that plasma would not supplant transfusions of whole blood. The treatment of chronic hypoproteinemia with plasma had also proved disappointing.

Plasma Fractions

An outgrowth of the processing of plasma on a huge scale for the armed forces was the physicochemical fractionation of human plasma in large quantities for therapeutic use. This was done primarily by Cohn and his coworkers²³ under the auspices of the National Research Council and the Office of Scientific Research and Development. The clinical evaluation of the plasma fractions is still under way as a project of the American National Red Cross.

The Rh Factor

The discovery of the Rh antigens by Landsteiner and Wiener²⁴ in 1940 and the demonstration of their relation to erythroblastosis fetalis by Levine and his colleagues²⁵ have opened up a new field of immunology closely related to blood transfusion. The knowledge of isosensitization has led to new techniques for testing blood compatibility before transfusion and in the diagnosis and treatment of haemolytic disease of the newborn. Although the overall safety of blood transfusion has been increased but little by these discoveries, a new vista of research in immunology and genetics has been opened which may have widespread effects on the understanding of some disease processes.

Summary

The clinical experience of over 300 years has led to the conclusion that the great majority of patients who need blood require the erythrocyte particularly. The simplest method of supplying these is by whole blood transfusion. The procedures are now known and practical to supply most patients in the country with transfusions of safe blood.

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