a small transfusion of the father's blood (Rh-positive) was given—60 c.cm. (This case occurred early in the series.) The transfusion increased the jaundice; the blood picture, although immediately improved, was reduced to the original level in 36 hours. A second transfusion, of Rh-negative blood this time, was given, and a normal blood picture was thereafter maintained. Grave doubts were held as to the mentality of the patient from his 14th day of life, from which time he lay in marked opisthotonos and stared vacantly. No spasticity was noticed until the fifth month. The condition was thought to be due to nuclear jaundice. He died in Oct., 1942, of bronchopneumonia.

Rustin McIntosh (1941) quoted a kernicterus incidence of 10% in cases of erythroblastosis foetalis. In view of the fact that Fitzgerald, Greenfield, and Kounine (1939) state that it manifests itself within 24 hours of the jaundice, it is unlikely that this dreaded sequel can be avoided.

Recommendations

1. Blood transfusion with rhesus-negative blood free of agglutinins should be employed for the treatment of cases of haemolytic disease of the newborn. A relatively large transfusion is advocated when necessary, as no haemolytic reaction need be anticipated. The general condition of the infant is thus rapidly improved; a stay of only 24 hours in hospital with further out-patient observation can be allowed, and a minimum number of transfusions will be necessary.

2. A store of rhesus-negative blood free of agglutinins should be easily available to all paediatric units and maternity hospitals.

3. Pregnant women who have previously borne an infant thought to be affected with haemolytic disease should be tested for the rhesus factor. If Rh-negative, she should be delivered in a maternity institution where Rh-negative blood is available.

4. For an infant born jaundiced, with a strong family history of haemolytic disease, immediate transfusion with Rh-negative blood free of agglutinins should be given, no matter what the erythrocyte and haemoglobin levels.

Summary

Nineteen consecutive cases of haemolytic disease of the newborn have been treated and investigated with reference to the isoimmunization theory of causation. Eighteen of these were transfused. Clinical comparison has been attempted between the effectiveness of rhesus-negative blood free of agglutinins and rhesus-positive blood. All these patients regained a normal blood picture with at most two Rh-negative transfusions.

These results are encouraging, and although the number of cases studied is small it would seem that if an infant with haemolytic disease of the newborn lives long enough to reach hospital there is a good chance of its survival.

Dr. Mollison and his co-workers at the Sutton Blood Transfusion Unit have done all the testing for the rhesus factor and supplied us with the Rh-negative blood used in the series. I should like here to thank him. My thanks are also due to the staff of the Hospital for Sick Children, Great Ormond Street, for their co-operation.

REFERENCES

- Boorman, K. E., Dodd, B. E., and Mollison, P. L. (1942). *British Medical Journal*, **2**, 535, 569.
Fitzgerald, G. M., Greenfield, J. G., and Kounine, B. (1939). *Brain*, **62**, 292.
Hawksley, J. C., and Lightwood, R. (1934). *Quart. J. Med.*, **27**, 155.
Landsteiner, K., and Wiener, A. S. (1941). *J. exp. Med.*, **74**, 309.
Levine, P., Burnham, L., Katzin, E. M., and Vogel, P. (1941a). *Amer. J. Obstet. Gynec.*, **42**, 925.
—, Katzin, E. M., and Burnham, L. (1941b). *J. Amer. med. Ass.*, **116**, 825.
McIntosh, Rustin (1941). *Canad. med. Ass. J.*, **45**, 488.
Parsons, L. G., Hawksley, J. C., and Gittins, R. (1933). *Arch. Dis. Childh.*, **8**, 159.

OCCURRENCE OF THE Rh ANTIGEN IN THE POPULATION

NOTES ON 5 CASES OF ERYTHROBLASTOSIS FOETALIS

BY

EDWARD D. HOARE, M.D.

Department of Pathology, Welsh National School of Medicine

In a recent paper Boorman, Dodd, and Mollison (1942) gave a full account of our present knowledge of the Rh factor in the blood. The following is a record of its incidence in 1,122 unselected blood donors in South Wales.* A study of 5 cases of erythroblastosis foetalis is also included.

Technique

The test serum was obtained by immunizing guinea-pigs with rhesus monkey blood as described by Landsteiner and Wiener (1941). Only 3 out of 10 guinea-pigs yielded satisfactory results, but from the three sera were obtained which gave a clear-cut distinction between Rh-positive and Rh-negative bloods at dilutions up to 1:60—a titre high enough to avoid confusion from any anti-A or anti-B agglutinins that might be present. It should be stated that the serum was kindly tested by Dr. Mollison, who confirmed the presence of Rh antibodies, but considered their titre somewhat low and apt to permit of false negatives. Dr. Mollison, however, in testing the serum, used equal volumes of cell suspension with 1:60 serum dilutions, whereas in testing the donors' bloods 1 volume of cell suspension with 2 volumes of serum was always used, so that a greater antibody concentration was obtained. Results were read according to the "sediment pattern" after standing at room temperature, and after microscopical examination of the resuspended sediment (Landsteiner and Wiener, 1941). At a later stage in the work the serum and cells were allowed to stand at room temperature for 1/2 to 1 hour and were shaken and spun at 500 to 1,000 r.p.m. for 1 to 2 minutes; the deposit was then examined for agglutinates by gently tapping the tube. The results obtained by this method agreed with those given by the "sediment pattern" method.

Table showing Distribution of the Rh Antigen in 1,122 Unselected Blood Donors

Group:	AB	A	B	O	Total
Rh-positive ..	27	349	90	483	949 (84.6%)
Rh-negative ..	3	64	14	92	173 (15.4%)

The results correspond closely with those of Wiener (1942), who found 85.6% Rh-positive out of 777 persons of all groups, and of Boorman, Dodd, and Mollison (1942), who found 85.15% Rh-positive of 1,610 persons of Groups A and O.

Erythroblastosis Foetalis

Various observations by Levine and Stetson (1939) and Levine, Katzin, and Burnham (1941) have shown that an Rh-negative mother carrying an Rh-positive foetus (by an Rh-positive father) may become immunized to the Rh factor in the foetus and produce antibodies which destroy the foetal erythrocytes. A haemolytic anaemia results in the foetus, and is manifest in the newborn infant in the condition known as erythroblastosis foetalis. Five such cases have come under my notice in the course of this investigation.

Case 1.—Child aged 19 days; jaundiced since birth; severe anaemia. R.B.C. 1.25 millions per c.mm.; Hb 24%; moderate numbers of erythroblasts and normoblasts. Despite blood transfusion the child died. Father, Group A Rh-positive; mother, Group O Rh-negative; child, Group O Rh-positive. The mother's serum, taken 3 weeks after her delivery, reacted against 2 Rh-positive Group O bloods. There was no reaction with 3 Rh-negative Group O bloods. The Rh antibodies were apparently of the cold type, and were detectable in the undiluted serum at room temperature and to a titre of 1:4 at 0° C.

Case 2.—Child aged 2½ weeks; jaundiced since birth; moderately severe hyperchromic anaemia. R.B.C. 2.02 millions per c.mm.;

* Samples of blood were kindly supplied by Dr. Drummond of the Welsh Board of Health Blood Transfusion Service.

Mr. Herbert Morrison foresees the Prison Medical Service of the future as an integral part of a new comprehensive health and medical service, but providing more opportunities for studying the mental aspects of crime. The Home Secretary, who was speaking to the Prison Medical Officers' Association, said that study of this kind was developing well until stopped by the war, but it had been found possible to resume it on a limited scale at Wormwood Scrubs. The number of prisoners in Britain had risen from 10,236 in 1939 to 12,400 in 1942, due largely to wartime offences. The incidence of certain diseases, especially venereal disease, had increased, but thanks to the efforts of the prison medical staff prisoners generally were healthier at the end of their sentence than when admitted.

Hb 50%; erythroblasts and normoblasts present in moderate numbers. The child was treated by blood transfusion and recovered. Father abroad; mother, Group A Rh-negative; child, Group A Rh-positive. The mother's serum, taken 3 weeks after her delivery, reacted against 3 Rh-positive Group A bloods and gave no reaction against 3 Rh-negative Group O bloods. The titre of the antibodies was not determined.

Case 3.—Child aged 2 days; jaundiced since birth; moderately severe hyperchromic anaemia. R.B.C. 2.15 millions per c.mm.; Hb 48%; moderate numbers of erythroblasts and normoblasts. Blood transfusion was given, but the child died. Father, Group O Rh-positive; mother, Group A Rh-negative; child, Group A Rh-positive. The mother's serum, tested 4 weeks after her delivery, reacted against 11 Rh-positive bloods (2 Group A, 9 Group O), but gave no reaction with 9 Rh-negative bloods (2 Group A, 7 Group O). When titrated against 3 Rh-positive Group O bloods the serum reacted in dilutions up to 1:32.

Case 4.—Child aged 3 weeks; jaundiced since birth; moderately severe anaemia. Small numbers of erythroblasts and normoblasts were present in the blood film. The child died before any treatment could be given. Father, Group A Rh-positive; mother, Group A Rh-negative; child, Group A Rh-positive. The mother's serum, 2 weeks after her delivery, reacted against 14 Rh-positive Group O bloods—to a titre of 1:32 with two of them and 1:8 with one. There was no reaction with 2 Rh-negative Group O bloods.

Case 5.—Child aged 10 days; jaundiced since birth; very severe hyperchromic anaemia. R.B.C. 830,000 per c.mm.; Hb 27%; large numbers of erythroblasts and normoblasts seen. The child received blood transfusion, but died. Father, Group O Rh-positive; mother, Group A Rh-negative; child, Group O Rh-positive. The mother's serum, 2½ weeks after delivery, reacted against 6 Rh-positive bloods (2 Group A, 4 Group O). There was no reaction with 3 Rh-negative bloods (1 Group A, 2 Group O). The titre was 1:16 when tested against 3 Rh-positive Group O bloods.

In all the five cases described above the father and child were Rh-positive while the mother was Rh-negative. In all cases the mother's serum contained Rh antibodies, and in four of the cases its titre ranged from 1:1 to 1:32. Case 4 was of interest in that the titre was 1:8 with some bloods and 1:32 with others used for test purposes. Both the "sediment pattern" and the centrifuge method were used in the determination of the titre. They gave the same reading. In one case only was the antibody of the cold type.

I should add that at the time these cases occurred the reports that Rh-negative blood often survived longer in the circulation of cases of erythroblastosis foetalis than Rh-positive blood had not appeared, and as there was no theoretical reason against the use of Rh-positive blood, the Rh grouping of the transfused blood was not determined. A-B-O grouping and careful cross-matching tests were of course done.

My thanks are due to Dr. MacCallum of the Wellcome Bureau of Scientific Research, who kindly supplied me with rhesus monkey blood.

REFERENCES

- Boorman, K. E., Dodd, B. E., and Mollison, P. L. (1942). *British Medical Journal*, 2, 535, 569.
Landsteiner, K., and Wiener, A. S. (1941). *J. exp. Med.*, 74, 309.
Levine, P., and Stetson, R. E. (1939). *J. Amer. med. Ass.*, 113, 126.
— Katzin, E. M., and Burnham, L. (1941). *Ibid.*, 116, 825.
Wiener, A. S. (1942). *Amer. J. clin. Path.*, 12, 302.

A NOTE ON THE REHABILITATION OF HEART PATIENTS

BY

BASIL PARSONS-SMITH, M.D., F.R.C.P.

Physician to the National Heart Hospital

As with all other branches of medicine, the aim of rehabilitation in heart disease is restoration of function and physical capacity to the fullest possible extent. For the achievement of such an objective it is essential that the general programme of treatment in cardiac patients shall include all such remedial measures as are likely to ensure the use of their physical capacity to the best advantage.

Fortunately the trend of modern opinion entirely reverses the long-accepted teaching which doomed patients with heart affections to a life of inactivity and permanent invalidism. We recognize in broad principle the varying degrees of debility

which cardiovascular diseases involve, but equally also we appreciate the fact that in such conditions the circulatory reserve may be relatively well maintained. The practical demonstration of circulatory reserve or compensation is not far to seek, for it is common knowledge that organic disease is frequently recognized during the casual examination of normally active individuals, and it quite often happens that patients with well-defined heart disease continue in strenuous employments and survive long professional careers of average duration. As expected, the records of such cases have provoked considerable interest, for they show conclusively that cardiac disease need not signify total incapacity and they adduce prima facie evidence that an efficient circulation can be maintained, under favourable circumstances, in patients suffering from structural heart affections.

The significance of the term "cardiac reserve" has become increasingly apparent, and it is recognized nowadays as the essential pivot on which revolves the whole process of circulatory compensation, incidentally also all the problems of rehabilitation. Suitable preparations for their ultimate rehabilitation should be included automatically when formulating schemes of treatment for patients with circulatory affections, and there is good reason to assume that under favourable circumstances they may be permitted ultimately to enjoy all the economic advantages of appropriate employment.

Accepting these principles, the wide scope of our duty in regard to the management of cardiac cases becomes amply defined. We must not only be prepared to prescribe all the essential remedies that may be required by our patients during the initial stages of their illnesses but we must also assume full responsibility for their convalescence. We must envisage the time when they will be able to resume their original employment or, alternatively, we must be prepared to recommend educational training for some suitable occupation, our assessment in this respect depending upon the extent of such physical defects as may be present, the patient's age, temperament, and social circumstances. The intervention of Nature both in the cure and in the readjustment of cardiac patients cannot be too strongly emphasized. Assuming an average level of general health, we are justified in expecting that Nature, *per se*, will limit cardiovascular disease, that it will determine adequate compensation, and that, in general terms, it will promote a favourable prognosis.

Preludes to Rehabilitation

The natural development of compensation is obviously an essential prelude to rehabilitation, and the latter depends more particularly on the physiological capabilities of the myocardium. As the result of experimental research and clinical investigation we know that the pulse rate and the stroke volume increase during exercise and that the venous return to the heart is proportionately accelerated. These changes materially improve the range of the myocardial efficiency, it being a well-established axiom that, within limits, the greater the initial length of the heart-muscle fibres at the beginning of systole the more forcible is the subsequent contraction. Such considerations are of outstanding importance in the rehabilitation of patients convalescent from heart affections, the rational deduction being that in appropriate cases exercise and occupation promote the efficiency of both the cardiac and the circulatory functions.

It may be inferred from the above that heart patients require suitable exercise to maintain their general resistance and that, according to their degree of compensation, their circumstances, inclinations, etc., some form of regular employment is, in all cases, a most desirable prescription.

A further and important factor in rehabilitation therapy is reassurance, the value of which cannot be over-emphasized. All classes of heart patients, particularly children, are naturally impressionable, and if encouraged in adequate fashion during the whole course of their illness they may be relied upon to assist materially their curative treatment and future prospects. Bedside discussions concerning the gravity of any particular condition, its response or otherwise to treatment, the question of prognosis, and the possibility of complications should be avoided as a general rule. The heart-disease atmosphere should be obviated so far as is possible, and frequent examinations