E.1

DIRECTIONS.

For the use of the Blood Bank and Blood Transfusion Service.

The Blood Bank and Blood Transfusion Service were organized for the benefit of patients in hospital and the convenience of their medical attendants. Prior to the introduction of this service the medical attendant had not only to obtain donors and a sample of blood for grouping and crossmatching but also to take blood from the selected donor and administer it to the patient; pyrogenic reactions after transfusion were not infrequent owing to lack of trained staff and of apyrogenic distilled water to clean and prepare the transfusion sets; blood was not available in an emergency and the delay in obtaining blood, especially at night in case of emergency entailed serious consequences to the patient; there was no time to perform a Kahn test and there was always the risk of administering blood of the wrong group. (Statistics have shown that errors in grouping in an emergency are the cause of the majority of transfusion accidents resulting from administration of incompatible blood).

The risk of transmitting syphilis by transfusion is not inconsiderable. In the short time this blood bank has been open quite a few Kahn positive donors have been observed and it is conceivable that one or more of them might have been used to donate blood had the Blood Bank not been in operation.

A properly organized Blood Bank is a necessity in a hospital of any size and minimizes the risk of transfusion accidents, properly prepared transfusion sets are always available thus practically abolishing pyrogenic reactions, the risk of transfusing syphilis is abolished, blood is instantly available in case of emergency, the medical attendant is saved the time and labour necessary to take blood, the nursing staff are saved the labour of preparing transfusion sets, needles are always sharp and polished and the laboratory staff do not have to be called out at night.

A Blood Bank must be organized properly and run under definite rules and regulations if it is to carry out its functions adequately. Rules have been reduced to a minimum compatible with efficiency but it is necessary for medical officers, ward sisters and staff nurses to be acquainted with them and to abide by them if the work of the bank is to proceed smoothly and efficiently. It is for this reason these notes have been written and it is hoped they will be read carefully and kept for further refernce. The staff of the Bank are only too glad to assist and to advise when necessary and it is hoped reference will be made to them in case of doubt.

The Bank is organized on the same system as an ordinary commercial bank. Each ward in the hospital opens an account with it by sending two or more donors and for every two donors sent one "unit" (a bottle containing 500 c.c. of blood) is credited to that ward.

When blood is required for transfusion, send to the Bank -

(1) A requisition../...

(1) A requisition card (Form Med.98) properly filled in.

(2) Blood from the patient(3.0 c.c.).

(3) Receipt for a transfusion set signed by the Ward Sister.

After about half an hour the medical officer may come to the Bank and he will receive:-

(1) A bottle of compatible blood.

(2) The requisition and a reaction card (Form Med.99)

(3) A transfusion set.

Please note that blood will not be issued to a Sister, Medical Orderly or Nurse, only to a medical practitioner.

After the transfusion:-

(1) Fill the bottle with water.

(2) Run tap water through the transfusion set.

(3) Complete the requisition and reaction cards.

(4) Return all to the Bank within 24 hours.

Please do <u>not</u>

(1) Leave the bottle of blood standing in the ward before transfusion.

(2) Remove the cap of the bottle before transfusion.

(3) Dismantle the transfusion set.

(4) Discard the beads in the bottle.

(5) Fail to check the components of the set.

(6) Neglect to complete the cards.

<u>Components of Transfusion Set</u>.

(1) Bottle.

(2) Cap.

(3) Rubber washer in cap.

(4) Glass beads in bottle.

(5) Air inlet tube with glass filter tube at one end and long stainless steel needle at the other.

(6) Transfusion tubing with glass drip meter and short stainless steel needle at each end.

(7) Needle adaptor.

(8) Screw clip regulator.

<u>Donors</u>. ../...

Donors.

Donors are obtained from friends and relatives of the patient but it cannot be urged too strongly that they should be obtained before the transfusion is given, experience having shown that they are unwilling to come after the transfusion. It is recognized that this is not possible in case of an emergency but as a rule a patient so seriously ill as to require a transfusion will require further transfusions and donors can then be obtained. There are occasions when donors cannot be obtained. The patient may die after an accident in spite of a transfusion, he may be a visitor to the island or a pauper without friends and it is to provide a reserve of blood for such patients that it is necessary to require two donors per "unit" of blood issued, as well as to allow for wastage through outdated blood.

A useful source of blood may be found in patients who require venesection for therapeutic reasons. All such patients should be referred to the Blood Bank. If they are confined to bed arrangements may be made to take blood in the ward.

Donors should be sent to the Blood Bank not later than 1200 hours or between 1430 hours and 1600 hours on Monday, Tuesday, Thursday and Friday and before 1200 hours on Wednesday and Saturday, in the winter season. During the summer when Government offices close at 1330 hours they will be accepted up to 1200 hours daily except Sunday. The Blood Bank is closed on Public Holidays and donors cannot be accepted then. Should any unusual situation arise when the Bank is closed the Government Pathologist should be contacted (~~Telephone number 4181) or Miss Melahat (Telephone number 9/2988)~~).

When blood is issued it should be transfused immediately. At most, not more than half an hour should elapse before the transfusion is commenced. This is of particular importance during the hot summer months. Stored blood will haemolyse rapidly if warmed or left standing for any time at room temperature and transfusion of haemolysed blood will result in a severe reaction or even death of the patient.

To administer blood, the set is revmoved from the envelope, the long needle inserted to its full length through one of the openings in the cap of the bottle and the attached short portion of rubber tubing fastened to the base of the bottle by means of a strip of adhesive. See that the short portion of rubber tubing is not kinked; if it is, air cannot enter the bottle and the blood will not run freely. The short wider bore needle close to the "drip" is inserted through the other opening in the cap of the bottle, the bottle inverted and hung on the stand, blood allowed to fill the tubing so as to expel all the air, the clip tightened, needle inserted in the vein, fastened with plaster, the clip loosened and transfusion commenced. All these proceedings should be carried out with the strictest aseptic precautions.

The rate at.../....

The rate of which the blood is allowed to flow depends upon the condition of the patient. If loss of blood has been serious and the patient in danger from oligaemia it should be run in as rapidly as possible. If there is no urgency the transfusion should be slow. There is less risk of reaction or of circulatory overload if the transfusion is slow. Rate of flow may be increased by loosening the clip and/or raising the level of the bottle. Positive pressure by pumping air into the bottle is inadvisable. Fatal cases of air embolus have followed this practice.

The time taken to transfuse a bottle of blood can be estimated roughly from the following:-

40 drops a minute	4 hours
60 drops a minute	2½ hours
200 drops a minute	45 minutes.

Emergencies.

Some difficulty is experienced in maintaining an adequate stock of Group "O" blood for emergencies as only 35 per cent of the population in Cyprus belong to that group as compared with 48 to 58 per cent in the U.K. This difficutly should be borne in mind by all Medical Officers and the emergency stock used only for real and serious emergencies at times when the Bank is closed. It is regretted that owing to misuse of the emergency stock during the day it has been found necessary to lock the emergency refrigerator during working hours and to open it only when the Bank is closed. When the emergency refrigerator is locked application should be made to the Blood Bank.

When blood is taken from the emergency stock a requisition card should be filled in with the name of the patient, the number on the bottle, the nature of the emergency and other details. A transfusion set may be obtained from the Theatre Sister during the day or from the Night Sister during the night. The Sister who issues a set will note the name of the medical officer, the name of the patient and the ward in which it was used and send the information to the Bank not later than the following day. On receipt of this information another sterile set will be issued to the Sister responsible. The Ward Sister should return the used set, bottle, requisition and reaction cards to the Bank not later than the following day.

Operations.

Before every major operation donors must be obtained and 3.00 c.c. of the patient's blood sent to the Bank for grouping and crossmatching. When this is done a bottle or bottles of compatible blood will be prepared and set aside ready for instant use if required.

The practice of using emergency Group "O" blood during an operation cannot be condemned too strongly. Compatible blood crossmatched against the patient should always be used for transfusion and only in a serious emergency when time is not available and the risk of transfusion of unmatched blood is less than the risk to the patient if blood is not given, is this procedure justified.

Rh typing. .../...

Rh Typing.

It has not been found possible to maintain a stock of Rh negative blood owing to the small number of Rh negative inhabitants of Cyprus. Our figures up to the present show that only 2.5 per cent are Rh negative as compared with 18 per cent elsewhere. Nevertheless, the blood of every pregnant woman coming into hospital should be sent for grouping and typing and if she is Rh negative, her relatives should also be sent to ascertain which are suitable to act as donors should a transfusion be necessary. Full information should be sent to the Bank concerning the anticipated date of confinement, previous pregnancies, children, miscarriages, etc. Needless to say her husband should also be sent for typing.

Coombs' test.

As this test takes time to perform samples of blood should be submitted before 900 hours. Freshly taken blood is necessary for the Coombs' Test. If blood is kept standing for any time the results may be erratic and in consequence the sample should be sent to the Blood Bank Laboratory immediately after it is taken.

For the direct test a sample of unclotted blood in a blood bottle (red cap) is required. For the indirect test a sample of clotted blood (without anti-coagulant).

It should always be stated whether the direct, indirect or both tests are required.

Plasma.

Experience has shown that it is not possible to maintain a stock of plasma as was originally planned. If plasma is required notice should be given and a bottle will be prepared but it must be used immediately. In an emergency such as a serious case of burning, dextran may be used until plasma is available, but please note, a sample of blood for grouping and crossmatching should be taken before giving the dextran as it interferes with grouping and is not eliminated from the circulation for about a week.

Concentrated Red Cells.

This preparation is of value when it is of importance to introduce red blood cells into the circulation without unduly increasing the blood volume. As it must be prepared immediately before use, at least 24 hours notice should be given and it must be administered to the patient immediately. Neglect of this advice will involve serious risk to the patient.

REACTION../....

REACTION AND COMPLICATIONS OF BLOOD TRANSFUSION..

When a reaction develops during a transfusion two questions must be answered:-

(1) Is the reaction due to the primary disease or is it caused by the transfusion?

(2) If it is caused by the transfusion what is the type of the reaction?

There are, for example, many causes of anuria besides haemolysed blood and suppression of urine cannot be ascribed to a transfusion until evidence of haemolysis is obtained. A patient with pyelitis may have a chill and fever during or after a transfusion but not necessarily caused by it.

Pyrogenic reactions are characterized by chills and fever appearing during or a few minutes after transfusion persisting not more than a few hours. They are the most common complication of blood transfusion, their incidenne being 2 to 3 per cent and they must be differentiated from febrile manifestations of the disease of the recipient and from haemolytic reactions. The latter are excluded by testing a sample of blood from the recipient for haemoglobin and bilirubin immediately after the reaction.

Though this type of reaction may be uncomfortable it is not usually dangerous except in patients who are seriously ill from disease.

Treatment: During a transfusion the patient should be kept warm, in fact somewhat uncomfortably warm. It has been noted that reactions are less frequent in patients kept warm. The rate of transfusion should be slowed. Reactions are more liable to develop if transfusion is rapid. If the reaction is mild the transfusion may be continued but if severe it may have to be stopped.

Urticarial Reactions are usually considered to be an allergic manifestation and are the second most common type of reaction. The eruption lasts only a few hours but angioneurotic oedema with or without oedema of the glottis may supervene.

Treatment: Adrenaline or epinephrine 0.3 c.c. of 1/1,000 solution should be administered sub-cutaneously and if the eruption subsides the transfusion may be continued. If, however, angioneurotic oedema supervenes it is advisable to discontinue the transfusion.

Circulatory Overload: If the blood volume is excessively increased the left side of the heart dilates and may fail; pulmonary congestion and oedema develop and if the condition is not recognized at once and treated it is rapidly fatal. A smaller increase of blood volume will overload the circulation of a patient with cardiac failure or in haemorrhagic shock than in other conditions.

Circulatory overload is probably the most common cause of death from blood transfusion where proper precautions are taken to prevent incompatibility.

The ..../...

The circulation of a severely anaemic patient is easily overloaded. Trasfusion to these patients often produces a rise in the arterial pressure in spite of falling cardiac output but this is due to increasing peripheral resistance and not to improved circulation. Such patients should be transfused with the greatest caution. Small volumes of blood must be given but stopped if there is any increase in the venous pressure. A concentrated solution of erythrocytes is advisable for transfusion in cases of acute anaemia or in cardiac patients.

Signs and Symptoms of Circulatory Overload. Overloading produces a rise in the systemic venous pressure, an increase in the amount of blood in the pulmonary vessels and diminution of the vital capacity producing symptoms of fullness in the head, tightness in the chest, dyspnoea and often a dry cough. If these warning signs are neglected during transfusion plmonary oedema develops.

If dyspnoea develops during transfusion and the jugular venous pressure is found to be raised the transfusion must be stopped at once and if the patient is lying down he must be propped up. If this does not result in rapid improvement inject 1.0 mg. digoxin intravenously. Some authorities recommend withdrawing an amount of blood equal to that transfused and it may be necessary to resort to this in a serious case where the warning signs and symptoms have not been noticed.

A patient may show some or all of the signs of overloading during transfusion and apparently recover after appropriate measures have been taken but a few hours later pulmonary oedema and death ensue. Any sign of overloading appearing during transfusion must be treated seriously and even if the patient appears to improve he should be placed under special observation for the next twelve hours.

Success of the injection of fluids or blood intravenously depends upon adequate cardiac function. Plasma or whole blood should be administered sparingly and cautiously to patients with severe anaemia or with frank cardio-vascular disorders.

Haemolytic Reactions. A haemolytic transfusion reaction may be defined as the occurrence of an increased rate of destruction of the red cells of either the donor or the recipient following transfusion. Though incompatibility is the cause of most haemolytic transfusion reactions, transfusion of blood already haemolysed by over-heating or standing too long at room temperature can cause a similar clinical picture.

It is doubtful whether any large series of blood transfusions have ever been given without haemolytic complications. Although measures to ensure compatibility will prevent serious intravascular haemolysis most of the time they will not completely eliminate it.

Clininal Description. The interval between the beginning of the transfusion and the appearance of symptoms varies somewhat. Symptoms may appear when as little as 50 c.c. of blood has been given. Haemolysis due to Rh incompatibility is slower and may not appear until twelve hours after the transfusion is completed.

Early symptoms are severe pains in the loins, lumbar region and down the legs, sense of constriction in the substernal region quickly followed by violent chills, fever, rapid respiration. The systolic pressure may fall to 60 or even lower and there is great prostration. The patient rarely dies during this stage of primary shock. If the transfusion is given while the patient is under a general anaesthetic many of the early symptoms are masked.

Jaundice may develop, seldom sooner than twelve hours after the transfusion but it may be mild, transient or absent.

Many of the patients who exhibit the early symptoms continue to secrete urine satsifactorily and recover; a minority develop signs and symptoms of renal insufficiency.

Anuria is a well recognized sequel of severe haemolytic transfusion reactions but its onset seems to be determined to a considerable extent by the condition of the patient at the time of transfusion.

Transfusion of incompatible blood is sometimes held responsible for renal failure in cases where renal failure might well have occured had no transfusion been given. This is particularly the case in postpartum haemorrhage.

Treatment of Haemolytic Transfusion Reactions.

If the early signs and symptoms are recognised during the transfusion it should be stopped immediately. Many recover without sequelae if the condition is recognized early before much blood has been given.

Anuria. A patient with anuria suffers from the disadvantage that his ability to secrete water, electrolytes and metabolites is severely limited. Only one litre per day can be excreted via the lungs, faeces and skin, therefore, the first principle of treatment is to limit the fluid intake to that amount. The second principle is to provide a diet free from protein but sufficiently rich in calories to depress endogenous metabolism. Such a diet is nauseatinng but this difficulty has been overcome by administering the following mixture through a stomach tube:-

Dextrose	400 gm.
Peanut oil	100 gm.
Acacia q.s. to emulsify	
Water to	1 litre.

The mixture.../....

The mixture is administered at a steady drip rate throughout the 24 hours and maintained until the patient passes 1 litre of urine per day. If the patient vomits the vomit is collected, strained through lint and returned to the stomach to ensure that the fluid intake is accurate and there is no loss of electrolytes. When the patient starts to pass urine but it has not reached 1 litre per day the output must be measured and an equivalent amount of water added to the patient's intake for the day. As soon as urinary output has reached 1 litre per day the drip is discontinued and the patient started on a low protein diet.

Results of this treatment have been remarkably successful but it requires expert supervision and skilled attention.

Such drastic remedies as decapsulation of the kidney, splanchnic block, dialysis of the blood (artificial kidney) or massive exchange transfusion are unnecessary. Treatment by intravenous alkaline solutions and saline in an endeavour to clear the blocked tubules is more likely to accelerate the death of the patient as he is unable to excrete the fluid.

Air Embolism: It is easy to introduce air into a vein at the beginning of a transfusion or when changing from one bottle to another. This can be avoidedby making sure no air remains in the tubing before commencing the transfusion and by changing bottles before the first is quite empty to ensure the tubing remains full. Air can be sucked into the tubing or the drip chamber through small leaks if the clip is placed above the drip chamber. It should be placed as low down as possible near the delivery needle. Another cause of air embolism is a leaking adaptor close to the delivery neddle but the greatest danger from air embolism is when air is forced into the bottle to ensure rapid transfusion. Only in the gravest emergency should this be done, and then only under constant supervision.

When air enters a vein it is carried to the right auricle and thence to the right ventricle. If the volume is small it passes to the lungs and is absrobed, but when the volume is greater it is caught in the outlet of the right ventricle and blocks the flow of blood to the lungs resulting in anoxia, lowering of the arterial pressure and raising the venous pressure.

Clinically the patient develops sudden cyanosis and dyspnoea. If the amount of air is small the signs and symptoms subside, otherwise death supervenes rapidly.

Treatment: Transfusion should be discontinued and the patient placed on his left side so that the air will not block the right ventricular opening and kept in that position for some time while the air escapes gradually into the lungs.

Syphilis: Syphilis may be transmitted by blood transfusion and was onse a serious problem. Since the adoption of routine serological testing of all donors and storage of blood in a refrigerator it is no longer a problem.

Routine testing alone is not an adequate safeguard. Many cases of transmission of syphilis by blood transfusion have been reported in which routine testing had failed to disclose the infection. This is not surprising when it is remembered that some 35 per cent of cases of primary syphilis are serologically negative. The greatest safeguard is storage of blood in a refrigerator, it having been demonstrated conclusively that the spirochaete will not survive more than 48 to 72 hours under these conditions. This has to be emphasized as Medical Officers sometimes request fresh blood or send a donor requesting that blood taken from him be sent to transfuse a certain patient. Such requests are refused as blood is not issued until a Kahn test has been done and it has been stored for 72 hours in the refrigerator. Blood which is serologically positive is discarded.

Homologous Serum Jaundice is a form of hepatitis transmissible by human plasma or serum. It may be so mild as to cause only transient jaundice or it may be so severe as to produce fatal hepatic necrosis

The incidence of homologous serum hepatitis after blood transfusion is said to be 0.8 per cent but as the incubation period is 56 to 124 days it is probably greater as many cases may be missed or diagnosed as infective hepatitis. The only known method of prevention is for the blood bank to reject all donors who give a history of having had jaundice within the previous six months but this is not entirely effective for the disease may be so mild as to escape detection and there is evidence that there may be "carriers".

INDICATIONS FOR TRANSFUSION.

Haemorrhage may be postpartum, it may follow injuries and accidents, it may occur during operations or from rupture of a blood vessel in the gastro-intestinal tract.

The "faint" or "vaso-vagal attack" may be induced by an emotional upset as well as by loss of blood. It appears to be a hypothalamic response and is characterized by sweating, pallor, cold skin, slow pulse and low blood pressure. There may also be vomiting, involuntary defaecation and loss of consciousness with occasionally convulsions. Fainting commonly occurs in persons who have lost blood but it is important to recognize that an apparently grave clinical picture can be produced by emotion alone. Patients who show these signs and have not lost blood recover reapidly if laid down in a bed with the feet elevated.

Although sudden loss of blood frequently precipitates a vaso-vagal attack it does not necessarily always do so - e.g. a loss of 430 c.c. in four minutes as a rule produces trivial effects only. Usually there is no change in blood pressure or pulse rate though the venous pressure may fall slightly and take more than 30 minutes to regain its original level. This [illegible]

may be regarded as one of partial compensation in which the patient feels all right as long as he rests. The next grade of response is one in which blood pressure is not maintained even when the patient is lying down. Such patients are pale, cold, clammy, and may show air hunger-the classical picture of haemorrhage and wound shock associated with a reduced blood volume. Recovery from this phase of hypotension depends upon restoration of the blood volume either by transfusion or spontaneously.

After haemorrhage the plasma volume cannot be restored by administration of normal saline intravenously. Large amounts of saline only serve to increase the extravascular fluid and cause pulmonary oedema. Dextran is now much used as a plasma substitute and produces effects indistinguishable from a plasma transfusion after haemorrhage or burns. It remains in the circulation for about a week and as it causes rouleaux formation and difficulties in grouping it must be remembered to take a sample of blood for grouping from the patient before administration. If plasma is available it should be used but after an acute loss of blood either is only a temporary expedient to maintain the blood volume until blood is available.

If a patient has lost more than half his red cells new red cells are badly needed and these can be supplied only by a blood transfusion.

From the phase of low venous pressure and low cardiac output following haemorrhage the patient may pass into a third phase after the blood volume has been restored. He looks ill but the limbs are warm, venous pressure is raised and the cardiac output increased. In this condition he may pass into cardiac failure which may be precipitated by any considerable increase in venous pressure. In such cases, blood transfusion should be slow, limited to 500 c.c. or less and observation kept on the jugular venous pressure. Any indication of a rise in the jugular venous pressure is an indication for slowing or stopping the transfusion.

If a patient with a very low haemoglobin concentration has to be transfused, an initial transfusion of a concentrated suspension of red cells not exceeding 250 c.c. should be administered very slowly at a slow drip rate taking 4 to 6 hours but this should be stopped immediately if the venous pressure rises or there are signs of cardiac failure. If the transfusion is completed satisfactorily it may be repeated in twenty-four to forty-eight hours.

If an injured person whose blood pressure is low fails to respond to transfusion it may be due to one of three reasons:-

(a) The transfusion may have been given too late and he is in a condition of irreversible shock;

(b) The patient may still be losing blood and transfusion is not succeeding in restoring an adequate blood level;

(c) There may be infection.

If there is.../.....

If there is no response to transfusion of an adequate quantity of blood or plasma operation should not be delayed.

Acute Loss of Plasma. Although burning is the classical cause of acute loss of plasma from the circulation other conditions may be responsible. The most important of these is acute obstruction of the small intestine. In crushing injuries also there may be considerable local loss of plasma but treatment is that of oligaemia following severe injury. (Anuria following severe crushing injuries should be treated exactly the same as anuria following incompatible blood transfusion q.v.)

In severe burning there is an almost immediate reduction in plasma volume and subsequently there is a further loss for a period of about 24 hours. As in the acute reduction in blood volume due to haemorrhage there is an initial phase of compensation during which the blood pressure may be maintained though the pulse voluma is likely to be poor and the skin cold. After a few hours the blood pressure falls and the general condition deteriorates. It is therefore, very important to begin transfusion at the earliest possible moment before the blood pressure has fallen. The amount of plasma transfused must be determined by trial and error. Even if the initial plasma loss could be calculated correctly it is impossible to forecast how much more plasma will be lost subsequently.

In severe burns there is an appreciable loss of red cells and in consequence plasma transfusion should be followed by blood transfusion later.

Anaemia: As a general rule resort should be had to transfusion in treatment of anaemia only when it cannot be cured by treatment with iron, liver, etc. Hypochromic anaemia in itself only very rarely endagers life. In patients suffering from a chronic anaemia such as pernicious anaemia the haemoglobin may be as low as 3 g. per cent when the patient is admitted to hospital. There is often a temptation to give a blood transfusion to such patients but this must be avoided if possible as it may easily precipitate cardiac failure. The effect of treatment by liver, iron, etc., must be tried first.

Six main types of anaemia call for blood transfusion:

(1) Anaemia resulting from haemorrhage which is unlikely to recur;

(2) Haemolytic anaemias;

(3) Aplastic and refractory anaemias and leukaemias;

(4) Anaemia of sepsis;

(5) Any severe anaemia in a patient for operation;

(6) Anaemia in a pregnant woman near term.

As some.../....

As some persons take as long as 24 hours to re-adjust blood volume the amount of blood transfused in 24 hours must be limited to, say, 500 c.c. in really critical cases i.e. in those in whom the venous pressure is already raised. Thus, though massive drip transfusions are suitable for most cases of anaemia they are not safe in patients who are on the brink of cardiac failure. It is not sufficient in these cases, to limit the rate of transfusion, the amount must be limited also.

Patients who have developed anaemia as a result of repeated haemorrhages must be transfused, but such patients should not be allowed to become severly anaemic. A patient who has had a haematemesis and whose haemoglobin has fallen to 7 g. - 8 g. per cent, should be transfused. If the haemoglobin has fallen to 4 g. per cent it may be very dangerous to give a transfusion and it should be given only after serious consideration and with all precautions.

In Haemolytic Anaemias transfusion and splenectomy are the only known effective forms of treatment. Transfusion is never curative but when the patient's symptoms are due to a low haemoglobin concentration transfusion can bring about a temporary improvement. Its effect is greater when the patient suffers from a congenital form as the transfused erythrocytes, unlike the patient's own erythrocytes, survive normally in the circulation. In the acquired form the transfused erythrocytes are destroyed rapidly in the circulation and improvement is transient.

Transfusion is indicated in haemolytic anaemia when the patient's haemoglobin falls to 8 g. per cent but if he has a severe chronic anaemia it may be impossible to maintain the haemoglobin level at 8 g. per cent except by frequent transfusion and it is better to allow the haemoglobin to find its own level and reserve transfusion for emergencies. Repeated transfusions must be avoided where possible for this, not infrequently leads to formation of specific antibodies and increasing difficulty in finding compatible donors.

In the case of acquired haemolytic anaemia when the patient is being prepared for splenectomy it may be very difficult to raise the haemoglobin concentration of the blood to an adequate level. Twelve to twenty-four hours before operation a massive transfusion of concentrated red cells should be given which should raise the haemoglobin level sufficiently to enable the patient to withstand the operation.

In Aplastic Anaemia repeated transfusions may benecessary. Haemoglobin should be maintained at a level sufficient to allow the patient to indulge in moderate activity, i.e. not less than 11 g. per cent, but the difficulty is to find sufficient donors. About 500 c.c. of concentrated suspension of red cells every three to four weeks will be required to maintain an adequate haemoglobin level but may fail because:-

(a) Transfusion will not affect the platelet and white cell count; and,

(b) The patient may become sensitized to some factor and destroy the transfused cells.

In Chronic../.....

In Chronic Leukaemia there are often signs of mild haemolytic process and the time of survival of transfused erythrocytes is diminished. The larger the spleen the shorter the time of survival. Repeated transfusions present the same difficulties as in haemolytic anaemia or aplastic anaemia.

Pre-operative Transfusions. Patients should not be submitted to operation if their haemoglobin is less than 10 g. per cent. If the operation is not urgent is should be postponed and the anaemia treated. Only in case of urgency should a transfusion be given. It is completely unjustifiable to give a transfusion of emergency Group "O" blood during an operation unless it is a case of accident. Every patient has to be prepared for operation and part of the preparation should consist of sending blood to the Blood Bank for grouping and crossmatching so that a bottle or more of blood may be set aside should it be required during the operation. Group "O" blood should never be used unless the risk to the patient of the necessary delay for grouping and crossmatching is greater than that of giving unmatched blood.

Severe Anaemia in late pregnancy. Sudden haemorrhages are not uncommon during delivery and a woman who is already anaemic is less able to tolerate them. Adequate ante-natal care should ensure that the patient is not anaemic, but there are some anaemias which do not respond to treatment, e.g. in pyelitis of pregnancy. In such cases the patient should be transfused during the last few weeks. Women whose haemoglobin is less than 10 g. per cent should be considered anaemic.

Haemolytic Disease of the Newborn (Erythroblastosis) is commonly due to Rh incompatibility. Within the Rh system the great majority are due to anti-D incompatibility though cases due to anti-E, anti-e, anti-C and anti-C^W have also been described. Anti-Kell incompatibility has also been described on several occasions. Incompatibility within the ABO system as a cause of haemolytic disease of the newborn is less common than Rh anti-D but more common than that due to the rarer groups within the Rh system.

Of all the infants born with haemolytic disease, i.e. with a positive Coombs' test, about 1 in 4 die within 5 days in spite of treatment.

The severity of the disease is determined mainly by the rate of blood destruction and this is reflected by the haemoglobin concentration of the blood in the umbilical cord after birth. At the end of intra-uterine life deaths from haemolytic disease occur almost entirely among infants in whom the haemoglobin concentration of the cord blood is below 10 g. per cent. It should be noted that cord blood is necessary to determine whether or not the chance of recovery without treatment is so high that transfusion is not required. Fallacious information is obtained from capillary (skin prick) and also from venous blood. In newborn infants skin prick blood has a much higher concentration of haemoglobin than venous blood and both are higher than cord blood. If, therefore, erythroblastosis is suspected before birth arrangements should be made to take cord blood into a "blood bottle" (green cap) containing an anti-coagulant.

In a recent../...

In a recent number of the British Medical Journal (March 19th, 1955) an important article appeared entitled "Exchange Transfusion in Haemolytic Disease of the Newborn" by Walker, W., and Neligan, G.A., which should be read by all interested. The following is an abstract:-

Treatment should begin during pregnancy by grouping and typing both parents and testing the maternal serum for antibodies. As soon as the baby is born a Coombs test and Rh determination should be done on the cord blood.

At birth, the cord, is clamped about 15 cm. from the abdominal wall as soon as possible after delivery. Using a syringe, 10 c.c. of blood is collected from the umbilical vein on the maternal side of the clamp, 3 c.c. of the blood is transferred to a dry tube containing no anti-coagulant for serological tests, 5 c.c. is placed in a "blood bottle" (green cap) containing anti-coagulant for haematological tests and 2 c.c. into a "blood bottle" (red cap) for direct Coombs test.

If the baby is Rh-negative no further measures are necessary. If the Coombs test is positive and the haemoglobin content of the cord blood 14.8 g.per cent or less, exchange transfusion is indicated. If the haemoglobin level of the cord blood lies between 14.8 and 17.7 g. per cent, the bilirubin content of the cord blood should be estimated. If this is below 2.8 mg. transfusion is not necessary; if it is 2.8 mg. or over exchange transfusion is required. Exchange transfusion should be started within the first nine hours of life.

When neither the haemoglobin nor the bilirubin content of the cord blood is available as, for example, when the baby is born outside hospital, the onset of clinical signs and symptoms of haemolytic disease, e.g. jaundice, is an indication for exchange transfusion provided brain damage is not evident. Treatment is probably ineffective once neurological signs of kernicterus have developed.

For a baby weighing 8½ lbs. or less, two bottles of Rh-negative compatible blood are required. Overloading of the circulation is a very real danger and in consequence it is advisable to use concentrated red cells obtained by removing 200 c.c. of the plasma from each bottle. This will be done in the Blood Bank if requested.

During .../...

During the first six weeks of life haemoglobin estimations should be made repeatedly using blood from a skin prick, even after adequate exchange transfusion. A simple transfusion is indicated if the haemoglobin falls below 8.5 g. per 100 c.c.

If the infant is seen for the first time more than 24 hours after birth it is doubtful whether or not exchange transfusion is worth while but a simple transfusion of Rh-negative blood may be helpful if the condition is mild. If the infant is one week old, the only indication for transfusion is anaemia.

P.A.CLEARKIN,

M.O. Specialist, (Pathologist).

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In writing these notes considerable recourse has been had to two books - "Blood Transfusion in Clinical Medicine" by P.L. Mollison and "Blood Transfusion" by DeGowin, Hardin and Allgever.