urgent need for blood transfusion has resulted in greater familiarity with the technique.

For many years past we have, in England at any rate, trusted to saline infusion to restore the balance after haemorrhage. So far as my experience goes, there is no comparison between the results of blood transfusion and saline infusion. The effects of blood transfusion are instantaneous and usually lasting; the effects of saline too often transitory—a flash in the pan—followed by greater collapse than before.

In civil practice, speaking generally, the occasions for transfusion are few; in military practice, in the forward line, the exsanguinated wounded man is regularly met with in the reception room.

The problems of shock and collapse are receiving every day greater attention. In every casualty clearing station there is a resuscitation ward with beds heated by hot air or electric light and with arrangements for giving hypertonic intravenous infusions, and so on. Here we endeavour to estimate the shock of battle, the shock that follows trauma or loss of blood, or the shock of toxæmia, to assess the proportionate damages to each, and to apply the appropriate remedy.

The methods of blood transfusion employed in the casualty clearing stations vary with the individual surgeon. Major Robertson has acquired great dexterity with the syringe method, and his results are correspondingly good.

Practice in team work is essential to success, and the two surgeons and the syringe orderly must drill together. Record syringes can be relied on for the purpose; others cannot.

The scope of blood transfusion is not limited to primary haemorrhage. It is of undoubted value for secondary haemorrhage, and we have used it successfully also as a sequel to venesection in two severe cases of carbon monoxide poisoning.

In the selection of a donor for blood transfusion, certain precautions should be taken when the circumstances of the case permit. At the front, particularly during the periods of heavy fighting, time does not permit of tests to eliminate syphilitic taint, nor, indeed, to ascertain if the blood of the donor is incompatible with that of the patient. Such risk as there is must be run if the urgent need of the patient is to be met promptly.

I have more than once seen alarming symptoms arise during transfusion. In one case the pupils dilated, the eyes were turned up, the pulse-rate increased, and the patient became pallid and unconscious, and died the same day. At the necropsy the blood was completely haemolysed. The condition of the wounds, however, showed that the chances of recovery were remote. In other instances I have noted transitory respiratory distress, sweating and precordial pain, followed subsequently by a varying amount of haemoglobinuria. The occurrence of rigors with a transitory rise of temperature are by no means uncommon after transfusion and are not an indication of incompatibility of bloods.

Too rapid transfusion may be followed by acute dilatation of the heart when the myocardium is exhausted and weakened by haemorrhage and shock. As Crile has pointed out, the work of the heart increases in geometric ratio to the volume of blood, and it is easy to realize the risk involved in suddenly producing a rapid increase in the volume of blood when the heart is already tired out. I have seen this exemplified in one case.

I feel confident that blood transfusion has become a permanent method, and that under the stimulus of war and the mass of material that war provides, our methods will steadily improve. The excellent results which Major Robertson has secured will, I hope, stimulate other surgeons to increased activity in the practice of this life-saving device.

WHEN delegates of the profession of the Republic of Uruguay recently visited France they were received at the Paris Faculty of Medicine on October 14th by Professor Gaucher, president of the General Medical Association of France, who recalled the fact that on the initiative of Professor Enrique Pouey of Montevideo the doctors of Uruguay had sent to the French fund for the medical victims of the war a sum of £1,360, contributed by 210 doctors in a country of not more than one million inhabitants. Professor Pouey himself had sent the whole of his salary.

C

DIRECT TRANSFUSION OF BLOOD.

BY

LIEUT.-COLONEL ALFRED J. HULL, F.R.C.S.,
ROYAL ARMY MEDICAL CORPS.

ALTHOUGH the advantages of direct transfusion are so apparent, this treatment does not appear to be in such frequent use as it merits.

Apart from its obvious indication in cases of severe haemorrhage, it would appear to be a valuable treatment for severe sepsis and shock. The provision of healthy blood to patients suffering from septicaemia must supply

FIG. 1.—The position of the arms. The donor's left hand grasps the patient's left arm well above the elbow, bringing the donor's radial artery almost into apposition with the patient's median basilic vein.

them with the bactericidal agents, bacteriolysins, antibodies, agglutinins, opsonins, leucocytes, and tryptic power which they are deficient in.

How far the alteration of the blood in cases of shock determines the result is at present uncertain, but the effect of healthy blood upon the tissues of such patients appears to be worthy of consideration.

Transfusion would appear to be a more scientific remedy than the empirical injection of antiseptics into the blood stream.

The difficulty of obtaining some one willing to submit to an operation entailing ligation of an artery is in my opinion the only bar to a much greater use of this treatment.

The operation is very simple and can be performed without the use of special apparatus. In fact, I consider the use of any apparatus most undesirable.

FIG. 2.—The preparation of the vessels. The radial artery has been cleaned for about an inch, divided, and drawn out of the wound. A traction suture has been tied on to the artery. The patient's vein has been exposed and lifted by two probes. By means of its needle the traction suture has been passed through the incision in the vein and out of the vein wall about an inch higher up the vessel.

To be efficient and certain in its results the operation should be performed by the direct transfusion of blood from artery to vein. It is only in this way that clotting, the one danger of transfusion, can be avoided with certainty. The only disadvantage of this method is that the amount of blood transfused cannot be measured, but this is outweighed by the safety and simplicity of the method, and moreover the amount of blood which flows before the donor becomes faint is fairly constant.

Position of the Patient and Donor.

The left hand of donor grasps the arm of the patient just above the elbow, bringing the donor's radial artery in close proximity to the patient's median basilic vein.

THE OPERATION.

An incision about 2 in. in length is made in the patient's arm over the median basilic vein.

The Preparation of the Artery.—A similar incision is made over the radial artery of the donor. The artery is cleaned for about an inch, the lower end of the artery in the wound is clipped, digital pressure is made over the brachial artery, and the radial is cut above the clip. The end of the radial artery is pulled out of the wound, and a traction suture is tied through the wall of the artery.

FIG. 3.—The insertion of the artery. The donor's and patient's arms have been rotated a short distance, bringing the wounds almost into apposition. Traction has been made upon the radial artery by means of the traction suture and the artery has been drawn into the vein. A ligature has been placed in the vein wall ready for tightening.

The Preparation of the Vein.—Two probes about an inch apart are passed under the vein for haemostatic purposes. A small cut is made into the vein (2 mm. in length); through this the needle bearing the traction ligature from the radial artery is passed. The needle emerges from the vein an inch above the incision. A second suture is now passed through the wound in the vein; this suture is used to close the vein when the artery has been inserted. By drawing upon the traction suture the artery is drawn into the vein, the vein suture is tied, and the probes and digital pressure removed.

The blood is allowed to flow until the donor feels faint. The artery is then clipped, pulled out, and ligatured. The whole procedure is carried out under local analgesia.

It may be objected that making use of the radial artery as a cannula involves a serious and avoidable mutilation of the donor. This is not the case; ligature of the radial artery must be performed in any case, and the excision of an inch or so of the vessel makes no difference. The elasticity of the artery renders its use as a cannula easy, and a considerable length of vessel becomes available through a comparative small wound.

A SIMPLE AND RAPID METHOD FOR THE SELECTION OF SUITABLE DONORS FOR TRANSFUSION BY THE DETERMINA- TION OF BLOOD GROUPS.

BY

ROGER I. LEE, MAJOR M.O.R.C., U.S.A.,
U.S. ARMY BASE HOSPITAL No. 5, B.E.F.

TRANSFUSION has now become a very valuable and widely accepted form of treatment in a large group of selected cases. With improved methods, and with increased skill and experience in the technique, there will probably be a very great increase in the number of transfusions performed.

There still exists a good deal of confusion as to the selection of the suitable donors. It has been a common experience that transfusion, without preliminary tests, may be performed in a considerable series of cases without detriment to the patient. On the other hand, promiscuous transfusions inevitably lead to disastrous results, which may be fatal.

It has long been known that all individuals are divided into four blood groups. These groups are not established at

birth, but become so in the first year of life. Apparently, the blood group of an individual follows the Mendelian law. Using the arbitrary classification of four groups, it is found that approximately:

8 per cent. of individuals fall in Group I.
Nearly 40 per cent. in Group II.
10 per cent. in Group III.
42 per cent. in Group IV.

This does not mean, however, that it is necessary that the donor and recipient should be in the same group. There is abundant laboratory and clinical evidence to show that the only important consideration is that the serum of the patient or recipient does not agglutinate or haemolyze the red corpuscles of the donor. The reason for this is that in the ordinary transfusion one adds from the donor only about one-fifth to one-twelfth of the total blood volume of the patient. The donor's serum is therefore diluted, and prevented from acting in a detrimental fashion. Furthermore, as has also been shown, the patient's cells are amply protected in that dilution by his own serum. Consequently, any transfusion between groups is permissible and harmless, provided the patient's serum does not agglutinate and haemolyze the donor's red corpuscles, although the donor's serum in the test may agglutinate and haemolyze the patient's red corpuscles. This is illustrated by the table, from which it will be seen that if a patient is in

		Serum of Group			
		I.	II.	III.	IV.
Cells of Group I	...	—	+	+	+
"	II	0	—	+	+
"	III	0	+	—	+
"	IV	0	0	0	—

+ = Agglutination and haemolysis.

0 = No agglutination and haemolysis.

Group I he can receive blood from any donor, because the serum of Group I will neither haemolyze nor agglutinate the red cells of any group. On the other hand, the cells of Group I are agglutinated and haemolyzed by all other serums except that of Group I (its own group). Fortunately this group is small. A Group I person is therefore known as the universal recipient. In contrast to Group I, we have Group IV, the largest group, whose cells are agglutinated and haemolyzed by no group, but whose serum will agglutinate and haemolyze the red corpuscles of all other groups. Group IV is known as the universal donor group, since the blood of Group IV can be transfused with safety into any patient. Furthermore, if the patient belongs to Group IV, he can only receive the blood of the same group.

One other factor which may prevent disaster is the variation in the strength of the agglutinating and haemolytic power of a given serum. It has been found that persons within the same group vary greatly in the potency of the agglutinating and haemolytic power of their serums. Thus a cross-transfusion may result in an immediate fatality in one instance, in complete destruction of the red blood corpuscles, haemoglobinuria, and marked jaundice, but without death, in another, and only mild symptoms in the third patient. I have seen an accidental cross-transfusion in a patient, with only mild symptoms, followed some weeks later by a second transfusion of the same amount from the same donor, with death. The explanation, of course, is the development of the agglutinins and haemolysins under the influence of the injection of the suitable protein.

In cases of dire necessity transfusion without tests is, of course, permissible, but it would seem to be almost unnecessary. The minimum procedure should consist of the establishment of the fact that the patient's serum does not agglutinate the donor's cells. This can readily be performed as follows:

A small amount of blood is collected from a patient (1 c.cm. from the ear or finger is sufficient), and allowed to clot. The serum is then obtained. One drop of this serum is placed upon a slide and mixed with a drop of a suspension of blood of the donor taken into 1.5 per cent. citrate solution. (A few drops of blood are taken into approximately ten times the amount of 1.5 citrate solution and shaken. It is very important that the blood be dropped directly in the citrate, and should not be partially coagulated.) The test will appear in a few moments,