INTRODUCTION DE SANG DANS LES VEINES - TRANSFUSION

By: O. HEYFELDER

A TRANSLATION BY PHIL LEAROYD

The section titled ‘Introduction of blood into the veins – Transfusion’ (pp. 302-314) written by Dr. Oscar Heyfelder (1828-1890) is contained within the monograph ‘Manuel de Chirurgie de Guerre’ [War Surgery Manual], translated by Dr. A. Rapp and published in Paris by Berger-Levrault in 1875, a copy of which can be read or downloaded from the following site:

https://gallica.bnf.fr/ark:/12148/bpt6k5851739w/f317.item

As the title identifies, this is an introduction and as such is a short description of blood transfusion that actually includes a surprising amount of detail regarding both human venous and animal arterial blood transfusion methods. Although Heyfelder provides details of both he stresses that human blood is preferable in that it gives a ‘more lasting’ effect and results in fewer and less severe post-transfusion effects, though he balances this by stating that animal blood is frequently used due to the difficulties in obtaining human donors.

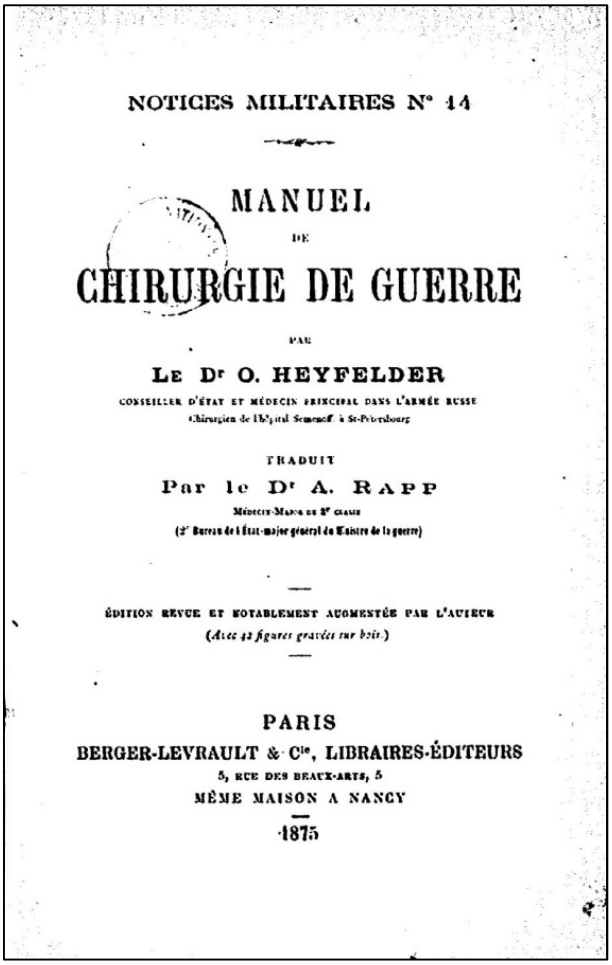
Venous human blood transfusion is described using Roussel’s (hermétique transfuser) equipment, which the author endorses, the use of which is described in a number of clear practical stages; including the need for an assistant, something that is not always identified. Animal arterial blood transfusion is described using the author’s own apparatus – essentially a modification of the tube used by the early researchers – which is also illustrated.

The effects / symptoms that ‘can be expected’ following giving the transfusion are clearly (and honestly) described with interesting detail, stressing that the more severe and longer lasting effects occur following a more rapid arterial blood transfusion – the author stressing the need to transfuse slowly so that the patient’s circulation is not overloaded.

The text provides a number of interesting practical insights into the performance and effects of a blood transfusion using both human and animal blood donors.

I have produced a translation of this section of the book ‘Manuel de Chirurgie de Guerre’ from French into English to enable its content to be appreciated by a wider audience. Whilst I am aware that instantaneous computer generated translation is available, this process struggles with accurately reading the original text and interpreting specialist terminology, as well as producing a ‘colloquial style’ not always representative of the original text. In addition, an ‘automatic translation’ may either purposely or inadvertently alter the wording to ‘make it read better’ but in doing so there has to be an element of interpretation involving something on the lines of ‘I believe that this is what the author is actually trying to say’. I want to avoid that as much as possible and try to present what the author actually wrote and as a result the reader may find that the English text does not ‘flow’ as well as it could. Although I have taken great care in accurately identifying the original text and producing a true representative translation of the author’s original wording I cannot guarantee that this work does not contain ‘translational errors’ and the reader is recommended to check specific details against the original text.

The paragraph settings and general layout of each part of this document has been maintained within the translation. The references in the original text are identified by numbers and placed at the bottom of the relevant pages where they occur. I have sequentially re-numbered these and placed them together at the end of the translation, reproduced as originally printed.



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DE
CHIRURGIE DE GUERRE

PAR

LE Dr O. HEYFELDER

CONSEILLER D'ÉTAT ET MÉDECIN PRINCIPAL DANS L'ARMÉE RUSSE
Chirurgien de l'hôpital Semenoff à St-Pétersbourg

TRADUIT

Par le Dr A. RAPP

Médecin-Major de 2e classe
(2e Bureau de l'État-major général du Ministère de la guerre)

ÉDITION REVUE ET NOTABLEMENT AUGMENTÉE PAR L'AUTEUR
(*Avec 42 figures gravées sur bois.*)

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MÊME MAISON A NANCY
1875

Title page: Manuel de Chirurgie de Guerre.
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OSCAR HEYFELDER

Dr. Oscar Heyfelder was born in 1828 in Trier, Germany, the son of Johann Ferdinand Heyfelder. He studied at the Universities of Heidelberg and then Erlangen, where he received his degree in 1851. For a number of years he was chief of the surgical and ophthalmological clinic at Erlangen. He was a member of the German Medical Society of Paris, becoming a military doctor and a staff surgeon in St. Petersburg. He died in Tschardschai, Russia, in 1890.

INTRODUCTION OF BLOOD INTO THE VEINS - TRANSFUSION

Since 1873, thanks to the simultaneous efforts of Albini, from Naples (1); of Roussel, from Geneva (2); of Hasse, of Nordhausen (3); of Heyfelder, in St. Petersburg (4) and of a number of French and German doctors, the direct transfusion of human or animal blood introduced in substance into the circulatory network, is an operation reinstated in its rights of citizenship in surgery. Numerous experiments, numerous operations carried out on living things, have demonstrated that lamb's blood is not incompatible with the economy of the human body, and that the blood of all animals whose globules are smaller than those of the human blood, can be introduced there without mechanical disturbance and that the operation itself is relatively easy and harmless.

Directions. - Anaemia resulting from haemorrhages, starvation, chronic diseases; according to some authors, too, pyaemia, tuberculosis and other chronic internal diseases. For us, this practice is especially valuable in cases of war wounds, as a result of abundant blood loss, or as a result of a long stay in hospitals, both as a revivification process and as a preparatory measure for major operations. If, in 1870 and 1871, I had known the curative value and ease of execution of direct transfusion of lamb's blood, I would have infused new blood into most of the starving and weakening patients who came to me from Metz, which would have allowed me to carry out major operations.

Times of the operation. - At the dressing station, as soon as possible; in hospitals, for further practice.

Operation. - We essentially distinguish between the transfusion of human blood, which is much preferable, and the transfusion of animal blood, to which we give second place. Until now, we have mainly transfused human venous blood with the Roussel apparatus and arterial animal blood with the Denis, Hasse and Heyfelder apparatus. As the apparatus is subordinate to the method, we will describe the former while dealing with the latter.

Venous transfusion. - The transfusion of venous blood, usually carried out with human blood, is carried out in the absence of any *vis a tergo* capable of causing the blood stream to gush out with sufficient force, by means of an apparatus including a pump. The best apparatus known to date is that of Roussel.

The *Roussel hermétique transfuser* consists of a system of tubes, 50 centimetres long, made of rubber or gutta-percha, into which no nozzle of any other composition enters. The tube carries at one of its ends a suction cup which is armed with a lancet intended to open the vein of the subject which supplies the blood; at the other end, it is fitted with a curved cannula used to introduce blood into the vein of the subject who is to receive it. In the middle part of the tube, there is a fusiform bulb, the pump, which, under the influence of the compression exerted by the hand of the operator, fulfils the function of the propelling organ, the heart, and which, when relaxed, draws blood from the vein. The pump, each time it is completely emptied, transfuses 10 grams of blood. It is therefore possible to measure the quantities of blood introduced and to regulate the pace of the transfusion. In order to prevent the blood sucked in by the rubber tube from being discharged back into the vein from which it originates, when pressure is exerted on the elastic pump, valves, built on the model of venous valves, are located inside the tube. Near the suction cup is a tube communicating with a rubber balloon intended to create a vacuum in the suction cup, then a second tube ending in a nozzle allowing hot water to be sucked into the interior of the device. The anastomosis of this second tube into the main tube is provided with a tap. The handle of the lancet is engaged in the suction cup, like a stopper in the neck of a bottle blocked with emery. Simply press your finger more or less on the top of the handle to push the blade more or less deeply into the vein.

Operative procedure. - First stage: The apparatus is filled with hot alkalized water, the arm of the subject who is to supply the blood is surrounded by a bandage as for bleeding and the application of the suction cup is tried on the chosen vein (median or basilic), then the lancet is fixed in such a way as to have the desired depth and to take an oblique direction with respect to the axis of the vein.

Second stage: During these preparations, a second operator exposed the vein intended to receive the blood; he stands ready to open it with small, fine scissors.

Third stage: The first operator definitively places the suction cup on the vein of the subject who is to supply the blood and who is placed nearby, he opens the vein under water and operates the pump; the water is then driven out of the apparatus by the blood that flows in.

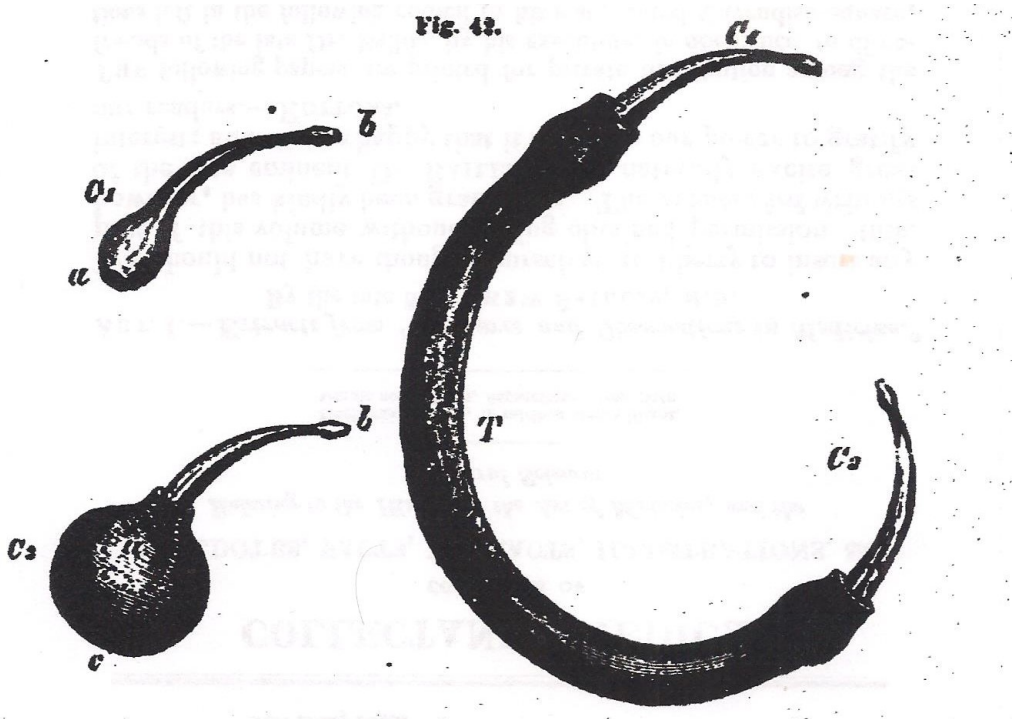
Fourth stage: As soon as the first jet of pure blood comes out of the terminal cannula, the second operator will have opened the vein which is to receive the blood and will engage the cannula in it, then the first operator will operate the pump, not by compressing it with the full hand, but by exerting moderate pressure with three fingers. The blood is thus pushed back into the recipient vein, which swells with each pressure imparted to the pump, and collapses each time the bulb is released.

The pump must be emptied by a very low pressure, and fill itself as soon as the pressure is released. When the first of these conditions is not met, that is to say, if the inflated bulb resists the moderate pressure, it is due to the fact that the blood has coagulated in it or that a mechanical obstacle opposes the exit of the blood through the cannula or its progression into the vein to be injected. In all these cases, we must be very careful not to try to overcome resistance by the use of force; there is only one thing to do: disassemble the device, inspect it and look for the cause of the resistance. In the second case, that is to say, when, the pressure being interrupted, the blood does not flow sufficiently abundantly into the pump, it is because the donor vein is not sufficiently open (in this case an attempt will be made to make the blade work a second time), or it is because the individual will have become frightened and will find himself at the beginning of a syncope, or finally it is that the suction cup will have moved. In this case, we remove the device and apply it again.

Fifth stage: once the operation is complete, one of the operators removes the cannula from the vein and presses his finger on the opening until dressing. The device is emptied under hot water and then inspected so that no clots remain in it. The subject who has supplied the blood is dressed as after bleeding.

Arterial transfusion. - Arterial blood transfusion is preferably done with lamb's blood, exceptionally with human blood (Küster). It does not require such complicated instrumentation, since it is the cardiac contractions that are responsible for propelling the blood through the apparatus and the vein to the recipient heart.

Fig. 42.



Heyfelder apparatus (5). - This apparatus is an improvement of the devices of Denis and Hasse. It consists (fig. 42) of a rubber tube, T, 34 centimetres in length, walls 2 millimetres thick and 4 millimetres in calibre, and in two semicircular glass cannulas, C_1 and C_2, the upper end, *a*, is rounded or balled, while the lower end, *b*, ends at a point. However, the end of the tip is not sharp, but has a small olivary bulge, intended to facilitate the application of a link. For the occlusion of the rubber tube, I use strong fine-clamps; for the cannula to be introduced into the vein, I use a small rubber balloon which, with the small glass balloon, constitutes an easy-to-fill suction pump.

Operating procedure of the Heyfelder method. - Preparations: This process requires fairly long and careful preparations, which can however be shortened when two operators work on it simultaneously. It is not difficult to have livestock in the countryside. Lambs and calves are best suited; however, adult oxen and sheep can also be used. A young animal of two to three months can be used for three or even four transfusions performed one after another. But we can no longer use an animal once it has convalesced, as the blood is no longer normal. The animal which must provide the arterial blood is attached to an oval board, pierced with six holes intended to provide passage for the ties which fix the subject at the level of the head, shoulders and pelvis. This board can be replaced, without much inconvenience, by the first board that comes along, by a table, or a bench. Care has been taken to wrap the head of the animal beforehand with a piece of bandage or scarf, so as to cover the eyes, to leave the mouth uncovered, and to cushion the pressure of the cephalic link. These preparations, as well as the manoeuvres of the first stage of the operation, should be carried out in a room far from the patient, who would be too strongly impressed by the sight of all these preparations.

First stage: The carotid artery or crural artery of the animal is exposed over a length of 1 to 2 inches; two threads are passed under the artery, all prepared for ligation, and two strong fine-clamps are used to reapply the skin to the prepared region, in order to prevent any coagulation.

Second stage: When the operator has completed the first stage (or while an assistant is performing it), he discovers, over a length of 1 inch, one of the patient's veins, usually one of the veins in the elbow crease or the saphenous vein. When the veins are small, or the subject is bloodless, it is not always easy to find the vessel; in any case, it is necessary to act with caution and a certain skill, so as not to injure him. When a collateral branch has been injured and the bleeding does not stop immediately, it must be ligated. In impressionable or pusillanimous people, I have recourse, for this part of the operation, to anaesthesia with chloroform, taking care to let the patient come back to his senses before performing the transfusion. Local anaesthesia should be rejected because it makes the skin rigid and preparation of the vein difficult. During this time, an assistant has prepared lukewarm, almost hot water in a vase, in which the two cannulas with their rubber lining, both filled with a sodium solution and closed with fine clamps, were completely immersed.

Third stage: It is then that the vein is opened and the glass cannula is inserted in it, the tip turned towards the heart, and is secured with a thread. This cannula, the rubber balloon, is surrounded by a piece of flannel soaked in hot water and sprayed, along with the wound, with hot water by means of an irrigator or teapot. Afterwards, or even while this is being done, the artery of the animal is likewise opened between two fine clamps, the glass cannula is engaged in the buttonhole of the vessel, the tip turned towards the heart and fastened in this position. This done, the blood of the animal is allowed to flow freely for a moment, the rubber balloon is removed from the other cannula and the latter is promptly capped with the rubber tube which is already fixed on the arterial cannula; to do this, the board on which the animal is attached must be brought closer to the desired distance. By means of a seconds watch, the quantity of blood transfused was calculated, which could amount to 160 to 200 grams. The long length which, unlike the other operators, I have given to the rubber tube makes the operation much easier. At the same time, this modification makes it possible, by means of cadenced constrictions which are exerted on the tube, to slow down the speed of the blood flow. Now this practice enables the heart to make itself more easily master of the mass of blood which is brought to it, and it avoids those alarming and stormy phenomena

which are observed during the operation, as well as the haematuria which follows it. The duration of the operation can be 2 or 3 minutes. Before removing the apparatus, the flow of blood is first stopped by means of a strong clamp, then the cannula engaged in the patient's vein is removed, then that which has passed through the animal's artery. This artery is bound and the skin is sutured. As for the vein, it is not bound, for fear of causing phlebitis; the skin is simply joined together by means of one, two or three Carlsbad pins and sufficient pressure is thus exerted on the vascular wound.

The same apparatus and the same method may be used to transfuse human arterial blood into the vein, or, as Küster has practiced, into the artery of the patient.

Effects of transfusion

Immediate effect. As soon as 4 or 5 seconds have elapsed after the transfusion of a small number of drams of blood, the pulse, originally small, weak, threadlike, becomes very sensitive and beats with force; at the same time the patient feels a pleasant sensation of warmth throughout his whole arm. After another small number of seconds, the face becomes coloured and the temperature of the extremities rises; again after five seconds, there is a little oppression, a certain feeling of heaviness in the kidneys; the pulse becomes fuller and fuller and the temperature continues to rise, then sweat appears; the dyspnoea increases more and more, the sensation of pressure from the kidney spreads to the rectum, the bladder, and, in women, the uterus; the malaise becomes general, the patient experiences nausea, the face and hands become red, then blue; the pulse becomes hard enough to rupture the vessel; the dyspnoea, the anxiety, become unbearable, and then comes the moment when it is necessary to postpone any new intromission of blood. If we continued, we would have to fear asphyxiation, the rupture of small vessels, and the effusion of blood into the organs. Immediately after the transfusion, even during the operation, the patient feels excited, revived and strengthened. The symptoms of blood congestion which we have just described persist for some time, then diminish and finally disappear. They are much less stormy when the injection of blood is carried out slowly or when human blood is used for the transfusion. We constantly observe, at the end of a quarter of an hour or half an hour, a violent shudder, which lasts from ten minutes to an hour, and which is followed by heat, sweating, and finally a restful sleep from which the patient wakes up with appetite. Haematuria sometimes occurs in copious transfusions or transfusions that are too quickly performed; it is also more common in animal blood transfusions. The more slowly or gently, the more blood can be injected; with these precautions, a minimum of 60 or a maximum of 250 grams of blood can be given.

Results. - Some patients who have been operated on enter into full recovery almost immediately, sometimes as early as six to eight hours; others remain under the influence of the shock for several days. But soon afterwards healing occurs and with it all the signs of a return to well-being.

The therapeutic effect of human blood is more lasting than that of animal blood. On the other hand, animal blood is more easily obtained.

The transfusion carried out with the arterial blood of man was performed twice by me on the living with good results (6). Just as uncomplicated in its execution, it is less stormy in its momentary effects and more lasting in its curative effects than the infusion of lamb's blood. However, unless absolutely necessary this method is contraindicated, because of the relative dangers to which the person supplying the blood is exposed and who must undergo the ligation of a large arterial trunk (the humeral before its bifurcation at the bend of the elbow). The left arm is preferred in the preparation of the vein, the greatest care should be taken and the aim should be to obtain immediate reunion.

Practiced according to my method or that of Roussel, I consider transfusion to be harmless. Among thirty-two observations of my own, I had no disturbing accident. A delicate lady had a fainting spell after she had received 90 to 120 grams of blood and before the onset of congestive disorders.

Of the 100 cases of immediate transfusion that are recorded in science, there were only two in which death was the result of the operation: one patient suffering from myelitis (Hasse) and one from pyaemia (Hoepner).

1. Giuseppe Alblni, Relazione sulla trasfusione diretta di sangue d'agnello, etc. *Reseconto d. R, Acad. se. fislche e ma*t. Dicemb. 1812. - Nuora cannula per la trasfusione dir. di sangue, etc. di Dr G. Albini; Napoli, 30 nov. 1873.
2. *Gazette des hôpitauy de Paris*, sept. 1865.
3. La Transfusion du sang d'agneau à l'homme.
4. *Deutsche Zeitschrift fur Chirurgie*. Vol. IV, fasc. 5 et 6.
5. L'appareil est construit chez M. Gerber, fabricant d'instruments de chirurgie â Saint-Pétersbourg.
6. Cfr.: *Deutsche Zeitschrift fur Chirurgie*; t. IV., fasc. 4, 5, 6 *et seq*.