LA TRANSFUSION DU SANG APPLIQUÉE AU TRAITEMENT DES BLESSÉS
MÉMOIRE PRÉSENTÉ À SON EXCELLENCE LE MINISTRE DE LA GUERRE

By: Dr. L. DE BELINA (1870)

A TRANSLATION BY PHIL LEAROYD

A copy of the monograph: The transfusion of blood applied to the treatment of the wounded, memoir presented to his Excellency the Minister of War, by Dr. L. de Belina, published in Paris by V. Masson & Son in 1870, can be viewed or downloaded from:

https://gallica.bnf.fr/ark:/12148/bpt6k56136637.r=La%20transfusion%20du%20sang%20appliquee%20au%20traitement%20des%20blesses%20%20%201870?rk=21459;2

Dr. L de Belina is described on the title page as being the 'Former Head of Clinic, Former Associate Professor at the Faculty of Medicine in Heidelberg'.

Note: Although the author's name is given on the title page of this monograph as being Dr. L. de Belina, the *Gallica.bnf* site states that the author's name is Dr Wladyslaw Świątkowski Belina. His name has been given various interpretations by different authors, including Ladislao de Belina and L. Belina-Kwiatkowski, whilst the name given on the title-page of his book published in 1869 is Dr L. von Belina-Swiontkowski. His work is frequently referred to in other publications as being simply 'L. Belina'.

I have translated this 15 page monograph from the original French into English in the hope that the content may be appreciated by a wider audience. Whilst I am obviously aware that instantaneous computer-generated translation is possible, this process struggles with specialist terminology and also produces a 'colloquial style' not always representative of the original text. The use of italics by the author within the text has been reproduced in this translation. Although I have taken great care not to knowingly misrepresent the author's original meaning I cannot guarantee that this work does not contain 'translational errors' and the reader is recommended to check specific details against the original French text.

The sub-title (i.e. Memoir presented to his Excellency the Minister of War) as well as much of the content obviously identifies this document as being essentially a 'sales pitch' presumably relating to the possibility of Belina's transfusion equipment being used by the military. This document appears therefore to be very similar to the publication method used by Joseph Roussel in 1882[1].

Belina mainly describes the constituent parts and operating method of his transfusion equipment pointing out its various advantages as well as at the same time identifying the need to use defibrinated blood 'of the same species'. The text illustrates the realisation regarding the potential adverse effects of the clotting of non-defibrinated blood prior to transfusion, a fact that many other researchers of the same period were blatantly ignoring, resulting in the stated subsequent possibility of the transfusion of blood clots. The initial content is also of historical interest in that Belina discusses the need to use blood transfusion as a treatment method (after the ligation of the injured vessels) for the 'anaemia resulting from the haemorrhage'

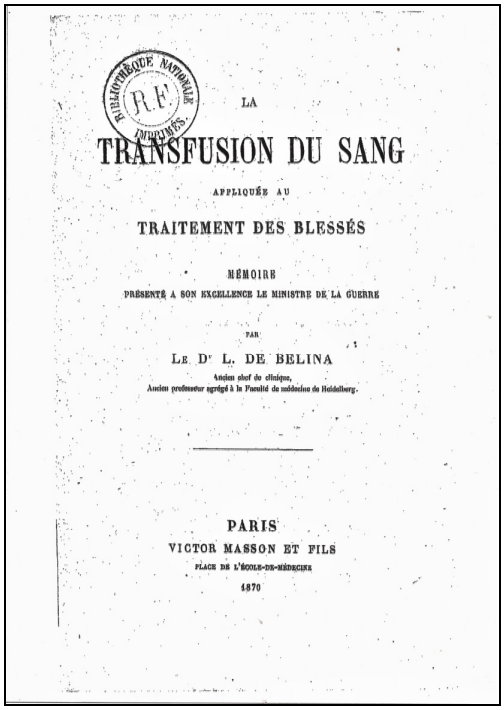
incurred as a consequence of battle wounds; many authors having previously ignored this valuable life saving role based on antiquated medical views.

In addition, Belina, in describing his transfusion equipment also emphasises the need for four essential requirements, i.e. cleanliness of the equipment, the need to avoid transfusing air, keeping the blood at a desired temperature and ensuring that a known amount of blood is transfused at a constant and not too rapid infusion rate. This is however essentially a repetition of the information associated with a description of an earlier version of his transfusion equipment, illustrated in his book 'Die transfusion des blutes in physiologischer und medicinischer beziehung' published in 1869[2] (see page 123). Whilst identifying these requirements, Belina also takes the opportunity to criticise the use of a simple syringe methodology and the transfusion equipment devised by Mr. Mathieu.

Interestingly, though not surprisingly, Belina provides little information regarding the difficulties associated with producing a large volume of defibrinated blood, which he simply states is produced 'using twisted glass rods'.

Having described his equipment and how it is used, Belina then includes documentation purporting to support his claims, which relate to experiments performed on dogs as well as the transfusion of two people, the first in 1868 on a woman suffering from 'puerperal eclampsia in an asphyxiated state' (transfused with blood obtained from a colleague) and the second in 1869 on a newborn baby 'asphyxiated by the constriction of the cord', stated to have been transfused with blood 'taken from the placenta of the mother'.

1. Roussel, J. (1882) Transfusion directe du sang vivant. [Extrait de la *Gazette des Hôpitaux* du 18 février 1882]. Paris: Asselin. https://wellcomecollection.org/works/jm7e7mka
2. Belina-Swiontkowski, L. von (1869) Die transfusion des blutes in physiologischer und medicinischer beziehung. Heidelberg: Carl Winter Universitätsbuchhandlung. https://wellcomecollection.org/works/xyaxdznu



Title page: La transfusion du sang appliquée au treatment des blesses – Dr. L. de Belina
(Image credit: gallica.bnf)

THE TRANSFUSION OF BLOOD APPLIED TO THE TREATMENT OF THE WOUNDED

Conclusive experiments, both on man and on animals, have established that the blood of an individual injected into the circulation of another individual of the same species functions like normal blood and absolutely replaces it.

Moreover, by experiments on man described in the *Proceedings of the Academy of Sciences* (4 October 1869), as well as by other experiments on animals made before a commission of the Academy of Medicine of Paris, I have proved that the operation of transfusion has become very simple and less dangerous.

It is thus obvious that we have in this process a powerful remedy which one can especially have the occasion to employ in time of war in cases even appearing hopeless.

Many of the injured die of anaemia resulting from the haemorrhage; the direct replacement of the lost blood, after ligation of the injured vessels, seems to be the most logical remedy.

In addition, it often happens that post-haemorrhagic anaemia makes it impossible for the injured person to undergo a necessary operation, such as an amputation. It is in these circumstances that a transfusion, performed before or after the operation, can restore to the patient the strength necessary to resist it; and it is even, in certain cases, the only means which can save life.

The main causes of the failure of blood transfusion, and, consequently, of the discredit into which this system has fallen in France, are: the use of non-defibrinated blood, the failure to measure the quantity of blood to be used, the too hasty injection, and finally the imperfection of the instruments and of the operative procedures.

The use of non-defibrinated blood can lead to two things: either the blood coagulates in the tubes of the device and the clot which forms makes transfusion impossible by preventing the passage of the liquid; or, the clot formed is expelled from the device and enters the vein, which makes the operation dangerous and even fatal.

When the clots are too large, they inevitably lead to obstruction of the pulmonary artery, and sudden death; if death is not immediate, it may be produced by an embolism resulting from the deposit of clots in any part of the circulation.

Fibrin is not an essential part of the blood and can be removed from it without inconvenience. Moreover, the preparation to which the blood is subjected in order to defibrinate it has the advantage of saturating it with oxygen and of freeing it from carbonic acid.

As to the quantity, we have often employed either too much blood, or too much at the same time, or we have introduced it too quickly or in an irregular manner; thence flow to the heart, consequent paralysis, or at least dangerous congestions in different regions of the body.

To carry out the transfusion of blood, different syringes have so far been used which only imperfectly meet the physiological conditions of this operation, namely:

1° That the device can be kept in a state of perfect cleanliness;
2° That its capacity is sufficient to contain the necessary quantity of blood and that it can be handled easily and with precision;
3° That it is possible to keep the blood at the desired temperature;
4° That the introduction of air bubbles into the vein is rendered impossible.

The syringes ordinarily employed for transfusion consist of a glass cylinder fitted with accessory parts of metal or rubber, and a plunger covered with greased leather. By attaching the accessory parts to the cylinder, there were always grooves between these parts. Into these grooves are always introduced dust, small pieces of mastic,

and above all blood, which it is very difficult to remove completely; this blood decomposes and can infect blood that will be used for a second transfusion.

The pistons are also, in the long run, very difficult to keep in a state of absolute cleanliness. Leather always absorbs some blood; the grease becomes rancid, and from the leather of the piston come off foreign matter which easily alters the blood and produces in the lungs various pathological lesions such as embolisms and abscesses. Several physiologists claim that the introduction of foreign bodies into the circulation could even be the starting point for the formation of tubercles.

Mr. Mathieu's apparatus with its perforated piston and gray vulcanized rubber capillary tube, of too thin a calibre, is even more difficult to clean well than most other syringes. Then, the rubber incessantly loses particles of sulphur which come to corrupt the blood. In addition, it is impossible to keep it at the desired temperature. And even if it is defibrinated blood, which does not coagulate, it cools on the wide surface of the funnel, passing through the pump, the hollow piston rod, the rubber tube and the too thin nozzle; then it coagulates by its low temperature the blood of the vein and causes the serious accidents which result from the entry of the clots into the circulation. It is thus that all the operations performed with Mr. Mathieu's apparatus have had no other results than the death of the patients.

I believe I have avoided all the disadvantages I point out in the other devices by constructing the following which consists of:

1° An inverted cylindrical glass bottle, 25 centimetres high by 5 and a half centimetres in diameter. This bottle ends at the bottom with a neck 4 millimetres in diameter. Below the upper part there is a hole *b* 1.5 centimetres in diameter. This vial is constructed to hold 250 grams of blood from zero to 250 degrees; above 250 degrees, a chamber remains which will contain air.

2° A compressed air pump composed of two rubber balloons joined together and terminating in a tube also of rubber. The first balloon *p*, about 5 centimetres in diameter by 7 in length, is closed on the exterior side at *r* by a valve which opens from outside inwards, and, on the interior side at *o*, corresponding to the second balloon *s*, it is closed by a valve opening in the opposite direction. The second valve serves as communication between the first and the second balloon; this one, in the state of rest, presents a length of 7 centimetres and a diameter of 3 centimetres, which can acquire that of the first balloon. It is surrounded by a net intended to limit the degree of distension. The tube *m*, also of rubber, which terminates the second balloon, is 27 centimetres long by 4 millimetres in diameter.

3° A trocar composed of two silver tubes and a stylet. The first pipe *f'n*, 2 centimetres long, discharges at almost a right angle, with a slight inclination, into the other pipe *hh'*, 5 centimetres long. The diameter of the two pipes is approximately 2 millimetres. The ii' stylus, furnished with a small handle in the shape of a button, fits with gentle friction with the pipe. The tip, of triangular shape, protrudes by 5 millimetres from the opening of the said pipe. Near *k* there is a spring which, when the stylet is withdrawn, expands in a groove located on its stem, and in this way prevents it from being withdrawn any further.

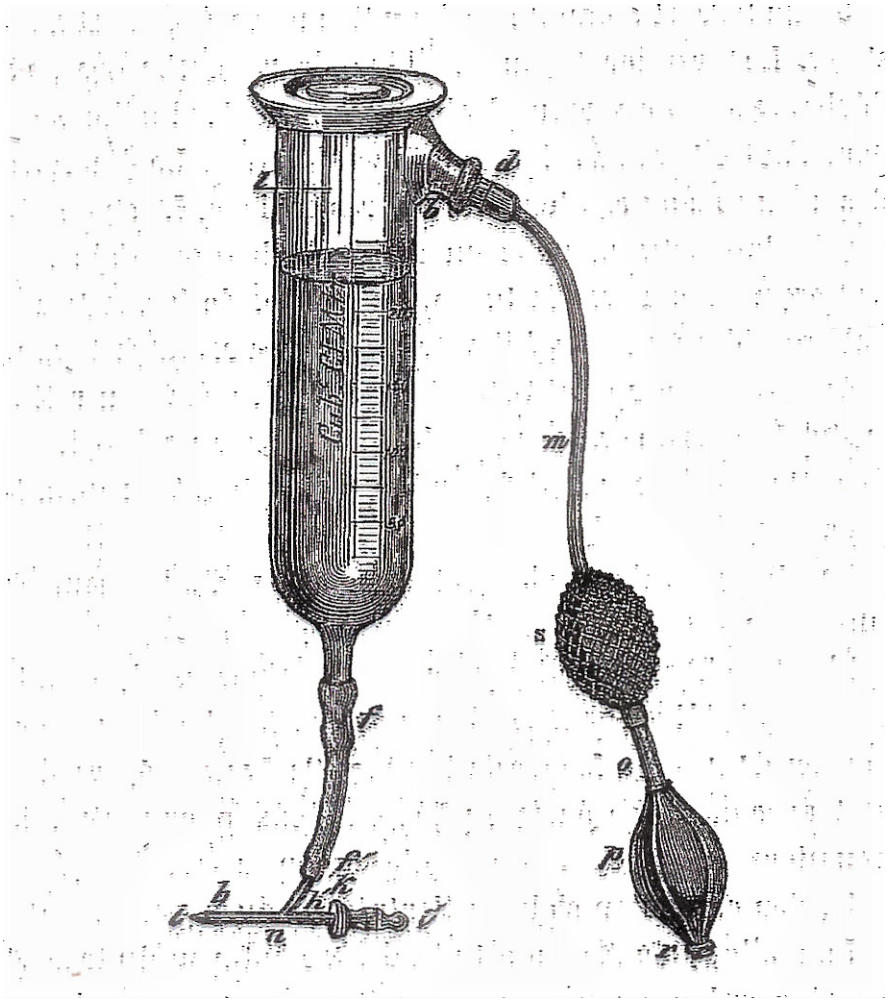
The three parts fit together as follows:

Orifice *b* is filled with a perforated rubber stopper which itself contains an ivory cannula sticking out in the shape of a button. This button is covered with thick gauze folded in half to stop dust and airborne organic germs. On this button adjusts the end of the pipe *m*.

The neck *f* of the bottle is joined with the tube of the trocar terminated in a button *f'* by a black rubber tube *ff'*, 12 centimetres long by 4 centimetres in diameter.

In order to avoid too great a variation in the temperature of the blood, especially if one is obliged to inject very slowly, and if the temperature of the patient's room is not very high, the bottle may be provided with a woollen blanket; an indentation has been

made in it which allows the quantity of blood supplied to the patient to be seen on the metric scale engraved on the bottle.



This device is located at Luer, in Paris, at 19 Place de l'Ecole-de-medecine
(Image credit: gallica-bnf)

The description of the apparatus finished, here is how one will operate the transfusion: one begins by defibrinating the blood, using twisted glass rods; then, it is filtered through a thick cloth, and introduced through opening *b* with a glass funnel into the flask. The opening *b* is closed with a black rubber stopper, and the bottle is placed in a water bath heated to 40 degrees.

After bandaging the patient's arm, as for bleeding, the median vein is uncovered by making an incision 1 centimetre long. Remove the bottle from the water, dry it; then, holding the collar down, pull the rubber stopper and introduce the compression pump.

The stylet is then withdrawn up to *n*, and the blood expels all the air contained in the tube of the trocar in the direction of the communication *f' n i*, which is restored in this way. When you are sure of this, on seeing the blood flow through the opening of the tube, you must replace the stylet, wipe the trocar, have the bottle held by an assistant, and, after having fixed the vein with the left hand, insert the trocar, then withdraw the stylet.

The band is then removed from the arm; the trocar is maintained by the assistant; then taking the bottle with the left hand, one handles the compression pump with the right. Each pressure on the balloon *p* brings about 20 to 30 grams of air into the space *l*; the air is compressed inside and presses on the blood. By handling this

balloon in a continuous way and by regulating the flow of the blood by the introduction of the stylet, which can be used here as a tap, we will succeed in making the blood flow in the vein in a sure and uniform way.

Many surgeons are of the opinion that all the special and complicated devices are superfluous, that a scalpel, tweezers and an enema syringe, which are found everywhere, are sufficient for carrying out the transfusion. This tendency towards primitive simplicity is deplorable.

To solve such a big problem, appropriate means are needed. Blood transfusion is a physiological operation par excellence; it therefore requires a device that meets the physiological requirements.

The human body is very complex. All the materials that arrive in the blood pass through a whole system of filters; the very air we breathe enters through a channel whose hairs and pituitary membrane remove dust, at the same time that the air from the nasal cavities warms the one we breathe in.

If, then, we wish to replace the blood of one individual by the blood of another, this blood must pass through a medium suitable to the physiological state.

The time when we wanted to do everything with a scalpel and tweezers has passed for surgery. There are operations which, while being perfected, become more complicated; and if some surgeons complain of minute apparatus and procedures, many patients owe their salvation to them.

The improvement, if it is real and indisputable, if it saves even a single patient out of a hundred, is a sufficient reason to have the new apparatus adopted and to reserve the enema syringes for their usual use.

Paris. 21 July 1870

SUPPORTING DOCUMENTS

1° EXPERIENCES

To demonstrate how to use the apparatus, I made, on 27 March 1870, in the laboratory of Mr. *Longet*, in the presence of Messrs. *Béclard* and *Broca*, the following experiment. I opened the femoral artery of a little dog, and let its blood flow until the heart stopped beating and the convulsions appeared. A minute later, I introduced through the jugular vein; using my apparatus, 150 grams of defibrinated and filtered blood from another dog. The animal straightened up immediately, and, a few moments after the operation, it was running as if nothing had been done to it.

To prove that one can make use of transfusion in asphyxia, I have also done, in the laboratory of Mr. *Longet*, on 19 March 1870; with the assistance of Messrs. *Carville*, *Landowski* and *Zebrowski*, the following experiment. Two dogs of equal size and strength were placed in a tank filled with illuminating gas. After fifteen minutes they gave hardly any sign of life; breathing had ceased completely, and the beating of the heart was barely perceptible. Removing them then and leaving one to himself, I practiced on the other a transfusion of 200 grams of defibrinated and filtered blood taken from a third dog. The first succumbed, while the second revived and remains in perfect condition.

I repeated this experiment, with the same result, before Messrs. *Béclard* and *Broca*, 27 March 1870.

I have twice employed the transfusion on man, and always with the most complete success. The first case (1868) was puerperal eclampsia in an asphyxiated state. The patient had had 33 attacks before and after delivery, and had not been able to take food or medicine for 36 hours because of trismus. I made a depletion of

420 grams, and I introduced, with the assistance of Professor *Lange*, 210 grams of defibrinated and filtered blood taken from a colleague, Dr. *Vietz*. After the operation, the seizures ceased, the patient regained consciousness, and after 3 weeks left the hospital perfectly recovered.

The second case arose last year. I practiced the transfusion on a newborn, asphyxiated by the constriction of the cord. After having transfused 30 grams of defibrinated and filtered blood taken from the placenta of the mother, I obtained a sudden and lasting revivification of the child.

These two observations are recounted in detail in the *Paris Medical Gazette*, 1870, No. 2, p. 17.

To convince myself of the success of deplethoric transfusion in pyohemia, puerperal fever and diphtheria, I experimented in the laboratory of Mr. *Helmholtz*, on animals which I had previously put in an analogous morbid state by artificial putrid infection, and I obtained favourable results by means of repeated deplethoric transfusions.

I have described these experiments in the *Archives de physiologie*, 1870, No. 1, p. 43.

2° LETTER FROM Mr. H. HELMHOLTZ, PROFESSOR OF PHYSIOLOGY AT THE UNIVERSITY OF HEIDELBERG, TO Mr. A. WURTZ, DEAN OF THE FACULTY OF MEDICINE IN PARIS.

Dear Sir and Honourable Colleague,

A young Polish physician, Doctor de Belina, who for a long time occupied himself in my laboratory with the question of blood transfusion; and who, as I believe, has essentially perfected the method by replacing the coarse syringes of the manufacturers of surgical instruments by an apparatus suitable for all physiological requirements, has asked me to serve as his introducer to you, and I can certify here that he pursued his scientific goal with great ardour, and that his efforts were crowned with the greatest success.

Perhaps you can recommend him to the competent medical authorities, so that he may be given the opportunity, in a hospital in Paris, to demonstrate his method and to put it into practice.

Please accept, sir, the expression of my sincere sentiments.

Signed H. HELMHOLTZ.

Heidelberg, 20 January 1869.

3° CERTIFICATE FROM THE COMMISSION OF THE PARIS ACADEMY OF MEDICINE

IMPERIAL ACADEMY OF MEDICINE OF PARIS

The undersigned, members of the Academy of Medicine, certify that they have attended, as a committee of the Academy, the blood transfusion experiments carried out by Dr. de Belina, using the device of which he is the inventor; that these experiments have been perfectly successful, and that the apparatus appears to us to

be of a nature to render service in the treatment of anaemia consecutive to haemorrhages.

Signed P. BROCA, Jules BÉGLARD

Paris, 18 July 1870.

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