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OBSERVATIONS ON TRANSFUSION OF BLOOD.

By DR. BLUNDELL.

*With a Description of his Gravitator.**

STATES of the body really requiring the infusion of blood into the veins are probably rare; yet we sometimes meet with cases in which the patient must die unless such operation can be performed; and still more frequently with cases which seem to require a supply of blood, in order to prevent the ill health which usually arises from large losses of the vital fluid, even when they do not prove fatal.

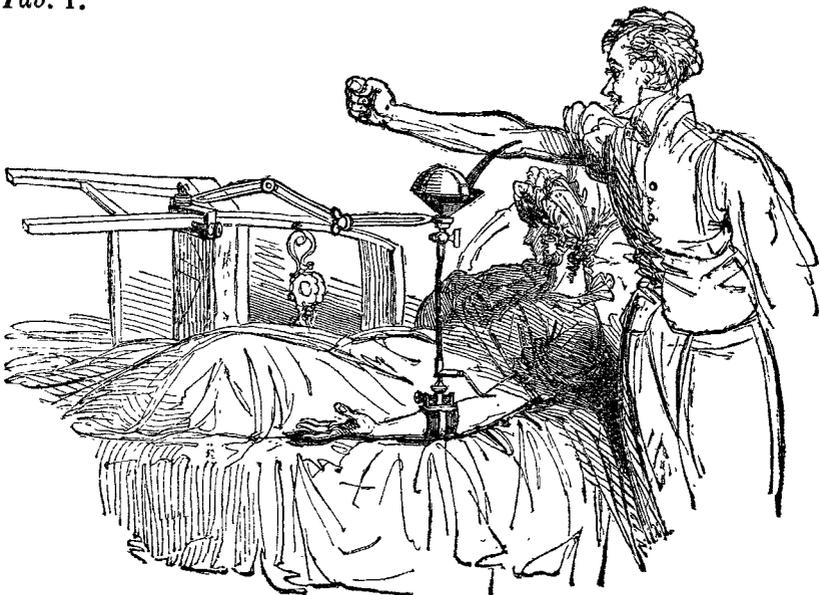
* The instrument is manufactured by Messrs. Maw, 55, Aldermanbury.

In the present state of our knowledge respecting the operation, although it has not been clearly shown to have proved fatal in any one instance, yet not to mention possible, though unknown risks, inflammation of the arm has certainly been produced by it on one or two occasions; and therefore it seems right, as the operation now stands, to confine transfusion to the first class of cases only, namely, those in which there seems to be no hope for the patient, unless blood can be thrown into the veins.

The object of the Gravitator is, to give help in this last extremity, by transmitting the blood in a regulated stream from one individual to another, with as little exposure as may be to air, cold, and inanimate surface; ordinary venesection being the only operation performed on the person who emits the blood; and the insertion of a small tube into the vein usually laid open in bleeding, being all the operation which it is necessary to execute on the person who receives it.

The following plate represents the whole apparatus connected for use and in action:—

Tab. I.



When the apparatus has been put together for use, the following points of management require the attention of the operator:—

First, an ounce or more of clean water (better if milk-warm) is to be poured into the coniform blood receiver, the stop-cock being at the same time shut. Secondly, the vein of the patient who is to receive blood is to be distinctly exposed to the extent of half an inch, or more, the integuments and cellular web being laid open by the scalpel; an operation which may be performed by those who are dexterous at a single stroke of the knife. Thirdly, the venous tubule, see Table 2, Fig. *a*, being plugged into the angular tube which terminates the flexible canula, the operator ought to arrange the apparatus so as to place the tube immediately over the vein of the patient, and then laying hold of the tubes moveably suspended above the vein, he ought to bear down and adjust the flexible arm support, Table 2, Fig. *e*, until the venous tubule is brought into *light* contact with the vein, so that the horizontal extremity of the tube may lie externally along the course of the vessel to the extent of half an inch. This tubule, it should be observed, is of very pure silver, and flexible, and may, therefore, if necessary, be altered a little in its curves, so as to adapt it with nicety to any accidental variation in the direction of the vessel which receives it; but the less tampering with the silver the better. Of course the point of the tubule ought to be directed towards the heart, and its whole length ought to be adjusted to the direction of the vein with great exactness, so that the extremity of the tube may lie within the cavity of the vessel, without straining or otherwise injuring it; indeed, throughout the whole of the operation, the vein must be spared as much as possible.

These preliminary measures taken, the operator, moving the arm a little aside, ought next to lay open the vein with a lancet, to such an extent (say the tenth of an inch) as may ensure the easy entrance of the pipe; and if any blood issues, a small probe may be slid transversely underneath the vein, between the venous orifice and the inferior extremity of the cutaneous wound, so as to enable the operator to close the vein at pleasure, by gently pressing it down upon the probe.

The arm being prepared in this manner, the bracelet, or spring clasp, Table 2, Fig. *i*, (its cup resting rather behind the middle of the screw which supports it, say at point *x*, Table 2,) ought now to be put upon the arm of the patient, to which it will cling, and then the ball and cap, Table 2, Fig. *h*, being adjusted to the cup, but rather lightly, that they may be easily separated again, the

operator, taking a firm hold, right and left, of the two springs which form the clasp of the bracelet, he opens them a little, when he may easily advance or retract the clasp along the arm, so as to bring the silver tubule (disarranged by these previous operations) to its just bearings and light contact with the vein externally as before. At this time the nuts of the flexible arm-support, Table 2, Fig. *d*, ought, if necessary, to be screwed tight, so as to give stability to the whole apparatus, and preserve the adjustment.

This accomplished, the operator ought now to open the ball and socket-joint by separating the cap and cup, and laying hold of the apparatus at this part, he should, *with all gentleness*, pass and re-pass the silver tubule (moveable because suspended by the flexible canula) into the cavity of the vein, so as to satisfy himself that it really does enter the vessel, and that it is not unawares inserted between the vein and its sheath of cellular web, an accident which may easily occur, not without a risk of frustrating the whole operation. After this, again withdrawing the tubule from the cavity of the vein, he may open the stop-cock, when the water in the coniform receiver above will gravitate through the tubes, and being suffered to run for two or three seconds, will completely expel the whole of the air; after which the stop-cock being again closed, the tubes will remain full, (if this part of the operation has been well performed,) a small quantity only of water lodging in the point of the receiver, part of which may be removed, if necessary, by means of a piece of *clean* sponge, a convenience which should always be at hand.

The operation being brought to this point, the venous tubule may now be easily deposited in the cavity of the vessel; when, by turning the screw, Table 2, Fig. *e*, the small cup may be made to pass backward and forward, in the direction of the venous orifice, until it is brought exactly under the cap and ball, to which it is to be afterwards screwed down, care being taken not to derange the vein or venous tubule, neither of which are, on any account, to be disturbed.

The tubule being now retained in the vein at the proper degree of obliquity, the cap may be screwed home upon the cup; and if it be thought necessary to advance or withdraw the tubule a little, as it lies within the cavity of the vessel, this of course may be easily effected by the action of the screw support, Table 2, Fig. *e*, as before.

The hood, Table 2, Fig. *k*, being now mounted upon the receiver, Tab. 2, Fig. *f*, a vein should be opened in the arm of the person who emits the blood, and this arm ought then to be held over the receiver in the usual manner, so that the blood may

flow into it, when the cock may be turned, and the transfusion will immediately begin; the blood flowing along the tube directly from the arm of the person who emits the blood, to the arm of the person who receives it. In this mode of operating, the small quantity of water which fills the tubes will, as a matter of course, enter the veins along with the blood; but though this is certainly undesirable, it does not appear to cause any obvious hurt.

As the operation proceeds, if the blood flow freely, it ought to be collected in the receiver; if it dribble down the arm, it is better not to make use of it. If the pipes become clogged in consequence of the inspissation of the blood, the operation will be arrested: the stoppage of the operation, when this accident occurs, is an excellence of the instrument, not a defect. To clear the apparatus, a syringe is provided, fitting the opening of the stop-cock, by means of which warm water may be forced through the tubes before the blood hardens in them.

In the progress of the operation watch the countenance; if the features are slightly convulsed, the flow of blood should be checked: and if the attack is severe, the operation must be suspended altogether. On the other hand, so long as no spasmodic twitchings of the features, or other alarming symptoms are observed, we may then proceed without fear.

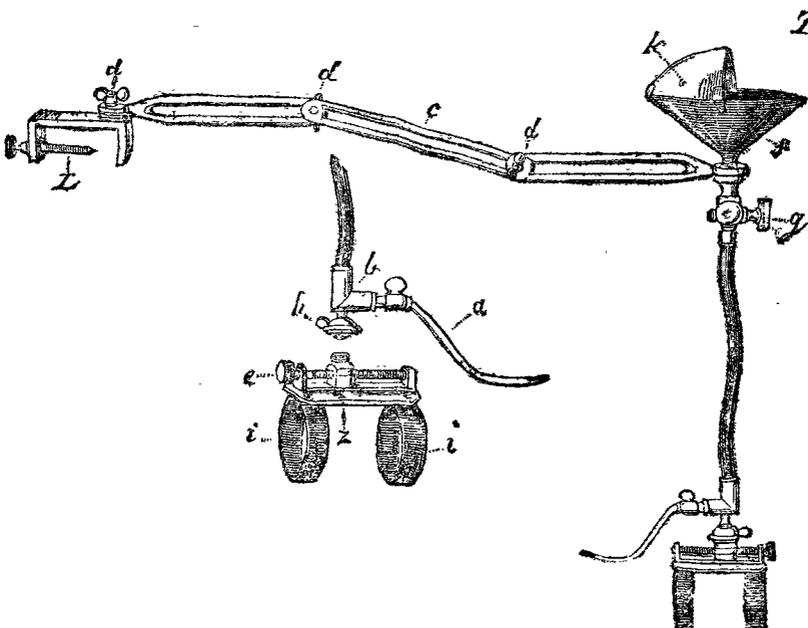
If there be occasion to suspend the operation, all the blood which lies in the apparatus, during the interruption, ought to be cleared away, and warm water being passed through the tubes, the transfusion ought to be commenced afresh.

Throughout the whole process, only a small quantity of blood should be allowed to collect in the receiver at once, nor should its level ever rise above the line drawn around its interior. This line indicates the measure of two fluid ounces.

If the blood collect in the receiver too fast, this may be easily remedied, either by placing a finger below the orifice in the arm of the person who supplies it, so as to check the stream; or else, by requesting him to withdraw his arm, so that the blood may no longer reach the receiver.

In cases requiring transfusion, the heart and vascular system being feeble, there is reason to believe that their action might be arrested by too rapid an influx, and that sudden death might, in that manner, be produced. It is necessary to guard against this accident with care; and it is to be recollected, that by means of the flexible arm-support, the receiver may be placed at any level above the arm of the patient, and that the rapidity of the influx may thereby be increased or retarded accordingly. It should too be observed, the force of the stream may be diminished at pleasure, by means of a partial closure of the stop-cock: and although this tends to produce a slight suction, yet it may, notwithstanding, be the best mode of regulating the impetus of the stream. The force of the stream may also be ascertained, by pouring water into the receiver before the operation is begun, and the elevation of the receiver, or the turn of the cock, may be adjusted accordingly before the operation begins.

The following plate represents the several parts of the apparatus referred to as Table 2:—



Although the description of the instrument must appear complex, its use is simple; in truth, when the transfusion is once begun, the operator has little to do; his principal cares are—first, to see that the cup never empties itself entirely, otherwise air might be carried down along with the blood. Secondly, to make sure that blood which issues by dribbling, from the arm of the person who supplies it, may not be admitted into the receiver, as its fitness for use is doubtful. Thirdly, to watch the accumulation of blood in the receiver, and to prevent its rise above the prescribed level; and, lastly, to observe with attention the countenance of the patient, and to guard, as before stated, against an overcharge of the heart. *This latter cause is of great importance.*

C is the flexible arm, which acts as a support to the rest of the apparatus (excepting the spring clasp, which embraces the arm of the patient): this part of the apparatus is furnished, at one end, with a strong clamp, or vice, Fig. L, for the purpose of attaching it to a chair, (a piece of furniture always at hand, and well adapted for the purpose,) and this is placed on the bed beyond the patient, in the manner represented, Table 1. At the other extremity of this flexible arm is a ring, into which is screwed the stop-cock, Fig. g, which consists of a flexible canula, having at one end a stop-cock, and at the other an angular brass tube, Fig. b, furnished with a ball and loose cap; which ball and cap serve to connect it with the part. Below is the spring clasp, or armet, intended to cling to the arm of the patient. Upon this clasp is mounted a screw and cup, upon which the cap of the ball is screwed, so as to complete the ball and socket joint, a kind of juncture, giving the universal motion, but capable of being rendered immoveable by firmly screwing home the cap, and enabling the operator to fix the angular end of the canula at any necessary degree of inclination or obliquity. There are two venous tubules, the curvature of one having a bias in the opposite direction to that of the other, so as to suit either arm. These tubules being of pure and very soft silver, are capable of being accurately adapted to the course of the vessel into which they are to be inserted. The coniform blood-receiver f, and its hood or partial covering h, are contrived to intercept the stream from the supplying vein, and preclude its passing over the receiver; in the apex of the receiver is a triangular partition, which has the effect of preventing that rotary motion and hollow surface sometimes assumed by fluids when passing through a funnel-shaped aperture. The receiver having its hood fitted upon its rim, is then firmly plugged into the opening made to receive it on the

top of the stop-cock. A syringe, scalpel, lancet, and silver probe are connected with the apparatus, the uses of which are described above.

FOREIGN DEPARTMENT.

TRANSFUSION AND INFUSION.

THE following extract, from a recently published work of Dr. Dieffenbach, of Berlin (of which already some mention has been made in THE LANCET) contains an abrégé of the experiments on the above subject, which have been made in France, during the last twenty-five years.

Nysten's experiments on the injection of different kinds of air into the vessels are very interesting. Large quantities of atmospheric air invariably caused death, under extreme distention of the right ventricle; if, however, by the division of the subclavian vein an exit was given to the air, the experiments hardly ever had a fatal result. He never found any air in the arterial vessels, provided the injection had been made into a vein. A small quantity of atmospheric air, injected into the carotid, had no effect whatever; a large quantity caused general paralysis, but seemed to have no direct influence on respiration and circulation, which were, for a considerable time, regularly performed. Oxygen injected in large quantity, into the veins, proved fatal; a small portion of it had no effect. The injection of nitrogen, even in small quantities, and after the division of the subclavian vein, was invariably followed by death; the arterial blood in such cases was found to be of a brown colour. Nitrous oxyd was rapidly absorbed by the blood, and large quantities of it were injected without any ill effect. Carbonic acid was also absorbed by the blood, and small portions of it were easily borne; in greater quantities, however, it appeared to cause pain over the whole body, and eventually death. Carburetted hydrogen, injected into the carotids, caused almost immediate death; the injection of small doses of hydrogen was also followed by death, without any struggle; while the injection of phosphoretted, or sulphuretted hydrogen, caused death, under violent convulsions; the latter gas was quickly absorbed by the blood. Nitrous gas, ammonia, and chlorine appeared to act only by their chemical properties. Nysten concluded, from numerous experiments, that part of the injected gas is thrown off by the lungs during expiration, the greater portion of it being retained in the vascular system. Dogs, which were made to respire nitrogen,