

ON
TRANSFUSION OF BLOOD,
ITS HISTORY, AND APPLICATION IN CASES OF SEVERE
HÆMORRHAGE.

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ALTHOUGH the subject of transfusion of blood is a theme upon which little can be said which is not already known, yet as the subject is one fraught with interest, and has occupied much of the author's thought and attention, he has much pleasure in complying with a suggestion made to him of bringing it before the Society.

It is quite unnecessary to premise that "transfusion" literally signifies the pouring out of one vessel into another, and that "transfusion of blood" means the introduction of the blood of one living animal into the vascular system of another. The idea that this operation might be performed with success for the cure of certain diseased conditions of the body is of ancient date, and during the prevalence of the opinion that all diseases arose from a depraved condition of the fluids (the blood being the principal), the supposition was by no means unnatural that, if this vitiated blood could be removed, and the vessels replenished with that which was pure and healthy, all discomfort would be relieved, and the individual restored to health and strength. But, beyond this, an absurd notion was entertained, that an altered state of the blood was not only the cause of disease, but of that decay which is the natural consequence of old age; and hence it was inferred that if the *old* blood could

be withdrawn, and *young* blood introduced in its stead, not only might health be preserved, but life prolonged to an indefinite period: intimations of this notion are found in the fabulous stories of antiquity—the sorceress Medea is described by Ovid, in the seventh book of the ‘*Metamorphoses*,’ as having the power of restoring youth and vigour to those whose bodily frames were sinking under the infirmities of old age; she is represented as accomplishing her object in two ways: First, by injecting the juice of certain magical herbs into the veins; and, secondly, by the use of youthful blood. In both cases the blood was considered the “*fons et origo mali*,” and must therefore be taken away to make room for a more pure and healthy fluid. Her performance on Æson, the father of Jason, is an example of the first, and is thus described:—

“*Stricto Medea recludit
Ense senis jugulum, veteremque exire cruorem
Passa replet succis.*”

After describing the wonderful effects produced, *e. g.* the disappearance of the various existing signs of old age, the story concludes thus:

“*Æson miratur et olim
Ante quater denos hunc se reminiscitur annos.*”

In the second instance, Medea is said not to have performed her promise, the whole transaction being one of treachery and deceit; her directions, however, to the daughters of Pelias, who had applied to her to restore their father to youth, have so distinct a reference to transfusion of blood, that the author makes no apology for transcribing it:

“*Stringite ait gladios, veteremque haurite cruorem
Ut repleam vacuas juvenili sanguine venas.*”

It is interesting to compare the above quotation with another from a little work by Libavius, published in 1615, entitled ‘*Appendix Syntag. Arcan. Chymic.*’ In chapter iv, the following operation is thus described: “*Adsit juvenis robustus sanus, sanguine spirituosus plenus: adstet exhaustus viribus, tenuis, macilentus vix animam trahens. Magister artis habeat tubulos argenteos inter se congruentes: aperiat*

arteriam robusti et tubulum inserat, munitque: mox et ægroti arteriam findat et tubulum fœmineum infigat, jam duos tubulos sibi mutuo applicet, et ex sano sanguis calens et spirituosus saliet in ægrotum, unaque fontem vitæ afferet omnemque languorem pellet."

It is quite clear that the operation as thus described never could have been performed; the vessels directed to be opened were the arteries, and at a period when suppression of hæmorrhage by ligature was unknown; in truth, the author mentions the subject in the way of satire, and not of serious recommendation. We may therefore conclude that at this early period transfusion had never been attempted. For about half a century after the writings of Libavius no notice was taken of transfusion. Between the years 1660 and 1670, the subject was renewed, and experiments actually performed, simultaneously, as it would seem, by Lower in our own country (the author of 'Tractatus de Corde'), and by Denys in France, and a controversy arose between these two gentlemen, each claiming for himself the merit of bringing the operation forward in a more tangible form, and with a view to a more practical result. Various papers were published at the time in the 'Philosophical Transactions,' from which it would appear that both were really entitled to the honour they respectively claimed, inasmuch as each was at the same time investigating the subject without being aware that the other was engaged in a similar undertaking. There can be little doubt that Denys was the first who ventured to operate on the human subject; it is stated, however, that Lower wrote a letter to his friend, R. Boyle, bearing date July 6, 1666, in which he describes the results of his experiments on animals, and expresses an opinion that transfusion might be made available for the removal of many diseases to which man is subject. After this letter was written, but before its contents were made known, Denys had operated, and hence the dispute arose. The editor of the 'Philosophical Transactions' observes: "Before we dismiss the subject, something is to be said of the cause why the curious in England make a demur in

practising the experiment on man; the above ingenious M. Denys has acquainted the world how this degree was ventured upon at Paris, and with what good success it there met; and the 'Journal des Scavans' glorieth that the French have advanced the operation so far as to try it on man, and that with good success. We readily grant they were the first we know of that actually improved the experiment, but then they must give us leave to inform them of this truth; that the philosophers of England had long ago practised it upon man, if they had not been so tender in hazarding the life of man," &c., &c.

The operation of transfusion was not much advanced by the experiments of Denys. Five cases only are related, and the following results recorded: two are said to have recovered, two died, and one who was in good health was in no way affected by the operation. The first was that of a man who had been suffering for two years with intermittent fever; every known remedy had been had recourse to without effect, the blood of a calf was injected into his veins, and, according to Bartholini, "Quasi Medæ arte recoctus, revivixit et melius habuit, quamvis non plane in integrum restitutus ('Acta Thomæ Bartholini'). The following cases are extracted from the 'Philosophical Transactions: ' "A man was labouring under fever, for which he had been bled twenty times, and was left in a state of lethargy: from this he was aroused, and, it is said, cured by the injection of a quantity of blood taken from a lamb."

The next case occurred in the person of Baron Bond, the son of a Swedish minister; four physicians were in attendance, who "bled, purged, and blistered him as much as they thought fit: he grew at last so weak that he was unable to stir, lost his speech and senses, and vomited all he took." The patient appearing to be in articulo mortis, transfusion was employed as a last resource; the effect is thus described: "he revived in a most extraordinary manner, spoke to those around him, the vomiting ceased, and he took nourishment." By the next morning he had relapsed again, the operation was repeated, and in the evening he died. A

post-mortem examination discovered a gangrenous condition of the bowels. Another case which has been reported as unsuccessful was that of a madman, who was but little affected by the operation, his death, which occurred some time afterwards, was unquestionably produced by poison, administered by his wife, as was proved by an investigation of the facts in a court of justice. Dr. Lower and Dr. Edmund King are said to have performed the operation with success; the blood of a lamb was used in this instance.

The precise mode of operating was not generally known. Paulus Manfredus, in his work, 'De Novâ et inauditâ Medico-Chirurgicâ operatione sanguinem transfundente de individuo ad individuum,' expresses his astonishment at this secrecy, and describes the method employed at Rome. There is a curious plate in the 'Armamentarium Chirurgiæ Joannis Sculteti,' published in 1693, wherein the surgeon is delineated in the very act of performing transfusion. The patient is sitting upon a chair, and being bled in the ordinary manner, from the left arm—whilst the system is replenished by the introduction of the blood of a sheep in the following manner: a long tube, composed of the dried intestines of a duck, and tipped with silver at each extremity, in order to facilitate its introduction, is represented as extending from the carotid artery of the sheep to the median vein of the man's right arm, and through this tube the blood is supposed to be flowing. Heister, who wrote in the year 1739, 'De Chirurgiâ Infusoria et Transfusoria,' gives the following doleful catalogue of the effects produced by the system. "Hominum enim illud medicinæ genus expertorum plerique fere in stupiditatem fatuitatem, delirationem aut melancholiam prolapsi feruntur: vel etiam acceleratâ morte ex viventium numero abrepti." He goes on to state that the consequences being so deplorable, "*prout rumor est,*" (for he does not mention it on his own authority), "Quin Gallici etiam senatus sive Parlamenti edicto publico, Parisiis damnata sit ac prescripta." Certain opposers of transfusion have asserted, on the authority of Heister, that the operation had been repeatedly performed in France,

not only with brute, but with human blood also; and that, in consequence of the dangerous results above referred to, it was prohibited by a decree of the French Parliament. Now, it is quite evident that Heister was not practically acquainted with the subject, nor had he formed any definite opinion of his own; he closes his remarks thus: "Vel ut pro lacte calido, jusculo, hominum etiam animalium sanorum sanguine post factam profusionem sanguinem nimium injiciendis: aliisque in morbis usurpanda, id meo quidem judicio, manifestioribus experimentis definiendum adhuc restat." He names several diseases in which it was probable that relief might be obtained by the operation, and refers to a surgical work by Purmannus, in which the author states that he has successfully employed it in several diseases. It should also be borne in mind that Heister's observations were concerning the "Chirurgia Infusoria" generally, of which system transfusion of blood was considered as forming a part. In no instance, however, was human blood employed. G. A. Mercklinus, who writes in 1769, "De ortu et casu transfusionis sanguinis," argues against the use of brute blood, and relates a case in which it was tried on a consumptive patient at Rome, who died shortly afterwards; although he supposes the probability of success would be greater if human blood were employed, he still hesitates in recommending it, because it had never been tried; his own words are conclusive on this point, they are these: "tamen pro indubitato et infallibili præsidio, experimentorum certitudine destitutus, præfracte jactitare nondum audeo." The assertion that the operation had been totally prohibited in France is not correct; it is quite true that its indiscriminate use by any medical man on his own responsibility was proscribed; it was only to be attempted with the express sanction of the Faculty of Paris. This edict Bartholini ascribes to jealousy and envy: "Quia primus D. Denys qui tentaverat, non erat ejusdem ordinis sive non erat in Facultate Medica Parisiensi."

It is needless to state, that the hopes which had been from time to time entertained regarding the benefits to be

derived from transfusion were utterly and totally disappointed; and if the object for which it was instituted, and the means employed in its practice be considered, no one will be surprised at the result; its object was the removal of disease, the means used the injection of brute blood. In many cases, organic lesions had occurred to such an extent as to render recovery impossible. The operation, therefore, was false in theory and dangerous in practice.

At a later period attention was again directed to the subject by Dr. Harwood, who was in after years professor of anatomy at Cambridge: in the year 1785 his thesis on "Transfusion of Blood" was published; abandoning the idea of curing diseases, he performs his experiments with a view of ascertaining whether the operation might be employed with advantage in cases of dangerous hæmorrhage. He answers the question affirmatively, and refers to numerous experiments on dogs in confirmation of his opinion. He observes: "From all the numerous experiments which have been lately made on this subject, one important fact seems to be clearly established, that the blood of an herbivorous animal may be safely substituted for that of a carnivorous, and *vice versa*, without danger, or even inconvenience to the animal who receives it. In cases, therefore, of such copious evacuations of blood as to threaten the death of the patient, would not transfusion be expedient? and if death should be inevitable without it, does it not become a duty to make the trial?"

During the present century, Dr. Blundell repeated the experiments of Professor Harwood on a somewhat extensive scale, having the same object in view, viz., the recovery of animals apparently dying from hæmorrhage; the result, as published by him in a volume entitled 'Researches Physiological and Pathological,' which made its appearance in 1824, were highly satisfactory. He differs in one respect very materially from Dr. Harwood, who supposed that the blood of a carnivorous animal might be substituted for an herbivorous, and *vice versa*; he considers it an essential element of success that the blood employed should be

taken from an animal of the same species as that into whose veins it is about to be injected; and consequently that in operating upon the human subject, human blood should be employed. Like Professor Harwood, Dr. Blundell experimented on a number of dogs; in several instances he injected human blood into the canine vein, and although the animal revived from the immediate effect of the stimulus, it soon afterwards sickened and died. This fact had been demonstrated by Dr. Leacock, who published his Inaugural Thesis at Edinburgh a few years previously, and from whose experiments it was proved that, although a *small* quantity of blood from a different species of animal might be used without any decidedly injurious effect (although in almost every case attended with unpleasant symptoms) yet that in cases of extreme exhaustion from hæmorrhage where it was necessary to inject a larger quantity, the success of the operation was defeated if the blood of one species of animal were substituted for that of another.

Dr. Blundell, Mr. Doubleday, and the author, instituted another set of experiments, making use of another species of animal, namely, the horse; here also the result was most decisive. In no instance where the operation had been properly performed was there failure; the revivification was immediate and permanent. The order of experiment was the following: in the first place, a horse was suffered to die from bleeding, that the symptoms immediately preceding dissolution might be carefully noticed; this was done that transfusion might not be performed in after experiments, before the manifestation of those signs which indicate immediate death. The apparatus employed was very simple, consisting of a long elastic tube, furnished with a stop-cock at either end, for the purpose of regulating the supply of blood; one end of this tube was inserted into the carotid artery of the horse which was to supply the blood, the other end into the jugular vein of the animal into whose system the blood was to be received; the communication between the vessels being continuous, the blood was not at all exposed to the atmosphere. The animal was then bled

from the carotid artery, the blood being allowed to flow until the death struggles supervened; the stop-cocks were then turned, and when a certain quantity of blood had passed from the carotid artery of the one into the jugular vein of the other, the struggles ceased; in a few seconds the horse was able to get upon its legs, and the apparatus being removed, walked away and readily partook of nourishment.

It was impossible to ascertain the precise quantity of blood transfused; it was, however, small in comparison with that which had been removed; this fact was proved by the very slight effect produced upon the supplying animal; this was a point of great importance—as, had the result been otherwise, the operation as regards the human subject would, in all probability, never have been performed, in consequence of the difficulty, if not impossibility, of procuring the necessary supply. In these experiments arterial blood was used, in consequence of the greater facility with which it could be procured. In a few instances, Dr. Blundell made use of venous blood in his previous operations on the dog, with similarly beneficial results. The author is inclined to believe that, even if there were no impediment in the way of obtaining human arterial blood, venous would be preferable, as being the more natural stimulus to the right side of the heart. But will blood thus injected really nourish the system; or does it, as some have supposed, merely act as a temporary excitement? To settle this question, Dr. Blundell kept a dog alive for three weeks without food, a few ounces of blood being injected daily into the jugular vein.

Hence it was satisfactorily proved that, in the inferior animals, transfusion of blood might be used, not only without danger, but with perfect success; and it was reasonable to suppose that human blood, injected into human veins, would also be made subservient to the purposes of the human circulation.

Dr. Blundell relates six cases in which the operation was performed on the human subject; and, although unsuccessfully as regards the preservation of life, the attempts de-

monstrated the fact that transfusion was neither difficult or dangerous.

Of all cases of hæmorrhage, none seemed more favorable for a trial of this operation, than those which occur during the puerperal state, and which from their severity are termed "floodings." The outburst is sudden and profuse, the symptoms alarming, and often dangerous in the extreme. It is true, that in a large majority of instances, the bleeding may be arrested before the development of the more formidable symptoms, if proper means be promptly and vigorously had recourse to; it is equally true that there are cases of an opposite character, where there is no decisive rally, although the uterus is so firmly contracted as to prevent any further loss. The patient becomes more and more faint, each attack of syncope more alarming than its predecessor; the extremities *first*, the general surface of the body *afterwards*, becomes cold, the respiration deep, laboured, and hurried; the pulse at the wrist scarcely, if at all, perceptible, the heart itself feebly fluttering; add to these, restlessness and convulsive jactitation, and the catalogue of symptoms will convince the most inexperienced observer that death is imminent. The difficulty may be increased by vomiting, the stomach rejecting all nourishment and stimuli, and hence this, the usual source of supply, is effectually cut off.

Let it be remembered that there is no organic disease to contend with, the danger arises solely from loss of blood; if, therefore, the quantity of the circulating fluid could be safely increased by the injection of pure blood into the vessels, it was reasonable to infer that recovery would take place: at all events, the facts previously related were sufficiently encouraging to justify the attempt in cases deemed hopeless under ordinary methods of treatment. The expectation has been fully realised, not only in cases of puerperal floodings, but in severe hæmorrhage, the result of accident.

As the successful examples of transfusion bear so marked a resemblance to each other, the time of the society will not be occupied by the detail of many cases; one only will be related—

A lady of delicate habit, thirty years of age, was confined with her tenth child; she had been the subject of hæmorrhage after every labour. It was at this time renewed with increased severity, and attended with symptoms indicating the most urgent danger. Her medical attendant, (an accoucheur of long standing and of great repute), requested the assistance of the author. The patient was found in the following condition: She was lying on her back, with the most perfect death-like countenance, the extremities were of a marble coldness, the general surface of the body also cold; respiration excessively laborious; the eyelids closed, the eyes insensible to light; the jaw dropped; no pulsation could be felt in the radial or carotid arteries; the breathing was the only indication of life. Stimuli had been exhibited, but with no lasting benefit. Transfusion afforded the only chance of saving this patient's life; it was consequently performed without delay. The first injection of two ounces of blood produced no other effect than that of rendering the beat of the artery discernible; the second was followed by decided improvement. After eight ounces of blood had been introduced, this lady was sufficiently revived to recognise her medical attendant. She evidently felt uneasiness over the region of the heart, and placed his hand upon the left side of her chest; no irregular action was discovered on a careful examination. Two or three teaspoonfuls of brandy were given during the operation, and nothing else. The patient suffered from headache, and had occasional hysteric paroxysms, to which she had been long subject. There was no other unfavorable symptom.

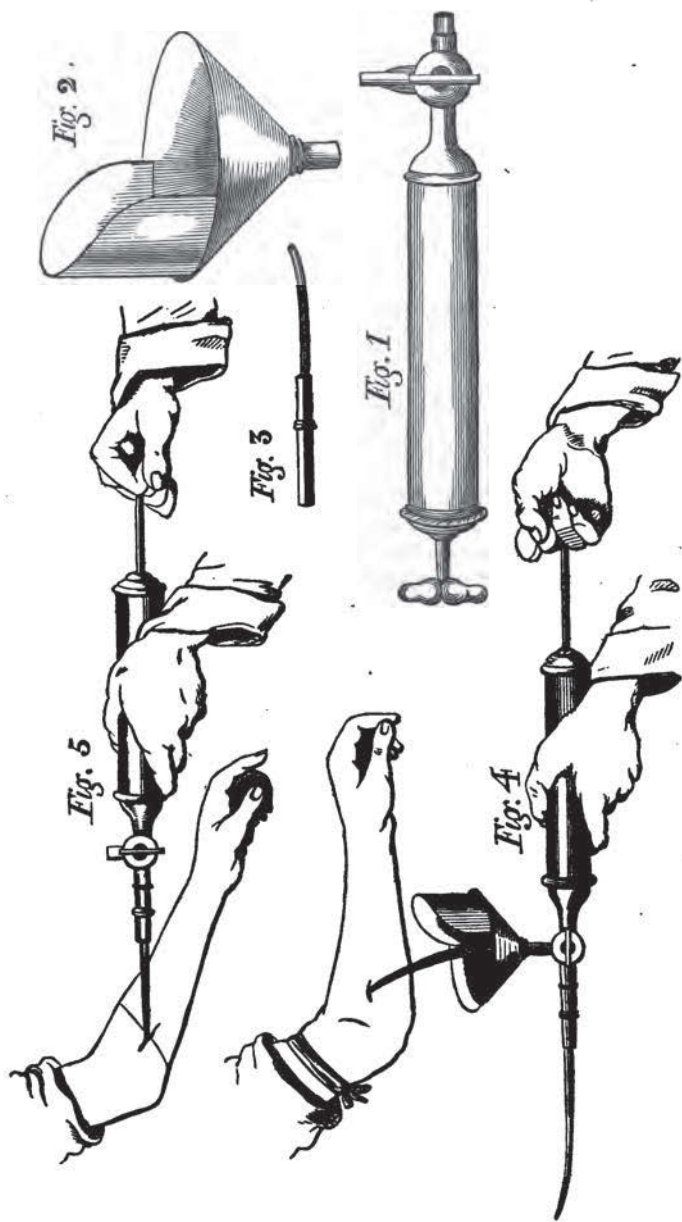
The mode of performing the operation is now so well known, that it will be unnecessary minutely to describe it. Three things are necessary to be observed—

First, that great care be taken to get rid of any air that may be contained in the syringe; secondly, to introduce the blood very slowly, experiments having proved that a sudden and large supply overwhelms the action of the heart, and causes immediate death; thirdly, to wait a few minutes between each injection.

The syringe used by the author is lined with tin, and is capable of containing two ounces of fluid ; it is furnished with a long tubule for the convenient insertion into the vein ; a funnel communicates with the barrel of the syringe, through which the blood passes without being received into an intermediate vessel.

It is seldom, if ever, necessary to inject a large quantity of blood : it is better to discontinue the operation as soon as the rally is decisive, and there is no returning collapse. In one case attended by the author, four ounces only were sufficient to produce this effect. Many persons doubted whether this small quantity could be of real service in a case of collapse otherwise fatal. In forming an opinion it should be remembered, that the intention of the operation is not to restore the vascular system to the condition which existed before the irruption of the blood ; it is well known that the heart and vessels can accommodate themselves to a greatly diminished supply. There is a point, however, at which the circulation ceases. Might not the fatal event be prevented by the injection even of a very small quantity of healthy and pure blood, the heart being thus enabled to continue its contractions until the system was recruited by the usual process of digestion and sanguification ? An example will illustrate the author's meaning. A patient is bled from the arm ; after a certain quantity of blood has been lost, he *feels faint* ; if the compress be now applied, and the bleeding stopped, he recovers ; but if three or four ounces of blood be allowed to flow before the arm be tied up, after the symptoms of faintness have shown themselves, he swoons. Now, if four ounces of blood *lost*, make all the difference between an approach to, and actual deliquium ; may not the same quantity *gained* make the difference between remediable and irremediable syncope ?

As a general rule, from eight to twelve ounces may be safely transfused.



DESCRIPTION OF WOODCUT.

The apparatus employed is represented in the preceding woodcut.

Fig. 1. The syringe capable of receiving two ounces of blood: *a*, the barrel; *b*, the part upon which the funnel is received; it is hollow, communicating with the interior of the barrel of the syringe; *c*, the stop-cock; *d*, the extremity of the instrument, to which the silver pipe is affixed when the operation is about to be performed.

Fig. 2. The funnel, composed of two portions; the part standing up is removable at pleasure, rendering the instrument more portable.

Fig. 3. The silver tubule, bevelled at the point, to allow of its more easy introduction into the vein. The operator should be furnished with two or more of these tubes of different calibres.

Fig. 4 represents the mode in which the blood is received into the syringe, and

Fig. 5, The manner in which the injection takes place; the tubule having been inserted into the vein at the bend of the arm.

In addition to the above, a common probe is required, the blunt end of which should be passed under the vein at the lower part of the incision, upon which pressure should be made by the finger of an assistant, to prevent any oozing of blood.