On the effects of venesection in renewing and increasing the heart's action under certain circumstances / by John Reid.

ON THE

EFFECTS OF VENESECTION

IN

RENEWING AND INCREASING THE HEART'S ACTION

UNDER CERTAIN CIRCUMSTANCES.

By JOHN REID, M. D.

Demonstrator of Anatomy, President of the Royal Physical and Medical Societies of Edinburgh.

(From the Edinburgh Medical and Surgical Journal, No. 127.*)*

I HAVE observed in several experiments on the lower animals, that disgorging the right side of the heart, when its contractions are enfeebled or suspended, by opening the external jugular, has in some cases a decided effect in renewing its action, which I am convinced may be of considerable practical advantage in promoting the return of the circulation under certain circumstances.

1*st Exper.* While assisting my friend Mr Cormack in some experiments upon the physiological effects of Creosote, we found, on opening the thorax of a dog, into whose femoral vein 25 drops of creosote had been injected, immediately after it had ceased to breathe, that the heart was perfectly quiescent, and remained so even when pricked and cut superficially with a scalpel. As the right side of the heart appeared much engorged, a small opening was made into the auricle, and part of the blood allowed to escape. As soon as the blood began to flow the heart

immediately resumed its contractions, and continued to act vigorously and spontaneously between two and three minutes, and only ceased after five minutes. The same quantity of creosote was injected into the jugular vein of another dog. On exposing the heart it was perfectly quiescent, and refused to contract when irritated. On emptying the right auricle of part of its blood, it gave two or three contractions, and then ceased.

The poison appeared to have acted more powerfully and rapidly in the last dog than in the first. On applying the hand over the chest of the first dog, an irregular fluttering was felt for a short time after the creosote had passed into the vein, while in the second dog the action of the heart was never felt after it had fairly entered the vein. It is important to remark, that the respiration continued for a short time after the heart's action had become arrested.

Struck with the effect which disgorging the right side of the heart had in renewing its contractions under circumstances where no external stimulus was of any avail, I was anxious to ascertain if the same results would follow the unloading of the heart when arrested from other causes.

2d Exper. Three dogs were killed by hanging, and as soon as they had ceased to breathe, the thorax was laid open. In all of them the heart was acting pretty vigorously, particularly in one of them, which was only a few months old. When the contractions had become feeble the external jugular vein was opened. This was followed by a decided but temporary increase in the contractions of the heart in two of them, which were large and full-grown. In the third and young dog the effect was very trifling. The opening of the external jugular was found rapidly to empty the right side of the heart.

The marked difference between the results in the first experiment and those which follow, can, I think, easily be explained. It is well known that there are several poisons which produce death by arresting the contractility of the heart, and Mr Cormack's experiments* show that among these creosote must be placed when injected into the veins. When these poisons are administered in sufficient quantity, they destroy at once and for ever the irritability of the heart, and no remedial agent can be of the slightest avail. We can, however, easily suppose, and facts could be adduced in confirmation of it, that the substance may be given in a quantity merely sufficient to act transiently upon the heart, so as to diminish or arrest its contractility for a short time only; it would appear that after the action of the poison begins to pass away, and when the contraction of the heart would be renewed, it has, during the temporary suspension of its contractility,

* The results of Mr Cormack's accurate and laborious investigations on this substance will be published before this Number of the Journal can appear.

become so much engorged with blood, that no external stimulus can excite it to action, until it has been first emptied of part of its blood. The more rapid action of the poison in the second dog, in which the renewal of the heart's action was to a trifling extent compared with the first, is in exact accordance with this view. In death from asphyxia the contractility of the heart appears to be but little affected at first, but gradually ceases after the circulation through the lungs has been suspended. And though the right side of the heart, as its contractility diminishes, becomes so engorged with blood that its contractions are suspended, and though opening the jugular vein, if not deferred too long, has generally the effect of relieving the right side of the heart of part of its blood, and renewing its contractions, yet we cannot expect the same decided results, as in those cases where the action of a deleterious agent has produced a temporary and fleeting effect upon the contractility of the heart.

3d Exper. While witnessing, along with my friend Dr J. Y. Simpson, the effects of prussic acid upon some dogs doomed to death at the Police-office, on applying the hand over the chest of a dog, immediately after it had ceased to breathe, to whom a large dose of the acid had been given, the heart was felt beating slowly and irregularly. On opening some of the vessels at the lower part of the neck, among which was the external jugular vein, the action of the heart instantly became rapid, regular, and stronger.

4th Exper. A rabbit was killed by a large dose of strychnia. When the heart was exposed its contractions were slow and labouring. On opening the jugular vein, the right side of the heart began to disgorge itself, and this was accompanied by a very decided increase in the number and strength of its contractions.

5th Exper. Two rabbits were killed by a blow on the head sufficient to injure a portion of the brain. On exposing the heart, its movements were feeble, and the right side of the heart was engorged. The escape of blood from the external jugular was followed by a decided increase in the number and strength of its contractions, which lasted for a considerable time.

6th Exper. I was now anxious to ascertain what influence artificial respiration, by favouring the passage of the blood through the lungs, would have in renewing or increasing the contractions of the heart in these cases. These experiments (six in number) were performed upon rabbits, and were far from being so satisfactory as I could have wished. We, however, saw sufficient to lead us to believe that though in cases of asphyxia, the artificial inflation of air into the lungs is sufficient, as numerous experimenters have ascertained, to renew the circulation through the

lungs, if commenced when the contractions of the heart are still going on pretty vigorously, yet if these are less active, they may be assisted by disgorging the right side of the heart.

I have thought that, instead of prosecuting the subject farther experimentally at present, for the purpose of endeavouring to ascertain the extent of its application to the human species, I should leave it in the hands of those practical men, who have ample opportunities of putting it to the test of experience, if they should think it worthy of their consideration.

In these experiments I was assisted by Dr Pollexfen, Messrs Cormack, Skae, and G. Newbigging.

Bleeding from the external jugular vein has been long practised in all cases of asphyxia. Though some may still open this vein in these cases for the purpose of relieving congestion of the brain, it cannot act in this manner, since accurate dissections have shown that no such congestion exists; so that the principal object in bleeding in asphyxia must be to renew the heart's action. * It is with this view alone that some men recommend its use. To produce this effect, the best plan (to judge from the experiments which we have detailed,) is to open the jugular vein and encourage, by all possible means, provided that no air be allowed to pass into the vein, the flow of blood from the lower orifice, and from the lower orifice alone, if we are anxious that much blood should not be drawn. By pressing upon the lower orifice, as is usually done, the blood will be prevented from regurgitating from the right side of the heart, and the most effective method in which blood-letting can favour the renewal of the contractions of the heart will be lost. † Conducted in a proper manner, we believe that in many cases it may act as a valuable adjuvant to the artificial respiration, friction with warm flannels and other remedies which are put in force to restore suspended animation.

The experiments of Legallois show, that injuries extending to a considerable portion of the spinal chord kill by arresting the heart's action; and Wilson Philip has also proved that the same effect follows similar injuries of the brain. On the other hand, injuries of a circumscribed portion of the brain kill by destroying the sensation, the action of the heart being only arrested by the impediment to the passage of the blood through the lungs from the cessation of the respiration. We have here the important distinction between the nature of concussion and compression. No doubt, these are generally intermixed in in-

* Though it can have no effect in diminishing the quantity of fluid within the cranium, it may yet assist in removing any irregularity in the distribution of the blood induced there during the disturbed state of the circulation.

† Though the external jugular vein in the human species has pretty generally a valve near its termination, and occasionally another about its middle, yet these rarely present any decided obstacle to the passage of fluids from the heart.

juries of the brain, but the symptoms of the one may preponderate over the other and demand its appropriate treatment. Many surgeons are decidedly opposed to the extraction of blood during the stage of collapse from concussion, when the pulse is small, rapid, and feeble. But we can easily suppose that during its weakened state, the blood which continues to flow along the veins, may embarrass the action of the right side of the heart, and interfere with the recovery of its contractility, and that opening the jugular vein, and allowing a few ounces of blood to escape from its lower orifice, would in some cases materially assist the action of the other remedies. There may be even a few rare cases in which the injury done to the central organs of the nervous system, may be just sufficient to arrest the contraction of the heart for a short time, and thus resemble the effects of the poison in the first experiment, where stimulants would be of no avail in restoring the heart's action, until the vein was first opened, and where, under proper management, the circulation might be restored.

Sir B. Brodie and others have shown, that poisons produce their fatal effects in one of two ways, either by suspending sensation, or by arresting the contractility of the heart,—in other words, inducing death in a manner similar to compression and concussion.* In these cases, where the action of the poison has only been sufficient to enfeeble transiently the contractility of the heart, opening the jugular, and allowing the blood to escape from the lower orifice, must materially assist the renewal of the heart's action. Of course, care must be taken that we do not, by the withdrawal of a certain quantity of blood, favour the absorption of the poison. It is, however, evident, that we can only expect a decided effect from the blood-letting in those cases, where the action of the poison has been transient, and where, either from the manner in which it has been applied or from the interference of art, no repetition or renewal of its action can take place. The flow of blood from the lower orifice of the jugular vein when opened appears to depend upon two causes. 1*st*, Upon the contractions of the right side of the heart, more particularly when the blood in the veins is nearly stagnant, and the heart is congested. At each contraction, the heart attempts to force a certain quantity of blood along the vessels connected with it, and as there is no *vis a tergo* to prevent the action of the heart, moving the blood along the veins in its immediate neighbourhood, a certain quantity is forced out through the opening in the jugular. This I have often witnessed. During the con-

* For an admirable exposition of the action of the causes of sudden death, see the second chapter of Dr Alison's Outlines of Pathology.

gested and enfeebled state of the heart, the blood passes readily from the ventricle into the auricle, as Haller has remarked. 2*dly*, Upon the principle of derivation, as laid down by Haller, to whose observations upon this subject my attention was directed by Dr Alison, after I had commenced these experiments.

Haller* ascertained by repeated experiments upon the lower animals, that when a vein is opened, the blood rushes towards the opening on the proximal side of the heart as well as on the distal, and from the veins communicating with the opened vein; that this in some cases extended to the neighbouring arteries after the blood had ceased to flow through them, and even after the blood appeared thickened in the veins; that, as the blood continued to flow, the globules resumed their figure and their natural mobility. All this was found to take place independent of the heart, and after the aorta had been tied. These experiments were confirmed by Spallanzani.† Haller, as appears from different parts of his works,‡ was fully aware, that opening the jugular vein would empty the right side of the heart, and so assist the renewal of the circulation in asphyxia. He seems, however, to have attributed this entirely to the derivation of blood, as neither the account of the experiments themselves, or in the deductions from these, does he make mention of the contractions of the heart. He was also aware, that congestion of the right side of the heart arrested its contractions sooner than if it had remained uncongested, but he makes no mention of the effect of unloading the heart in renewing its movements.§ Indeed, the experiments of Haller and Spallanzani on the derivation of blood, made on the large veins in the neighbourhood of the heart, seem to have been liable to a source of fallacy in the renewal of the heart's action, of which they do not appear to have been aware. This could not, however, affect the accuracy of the other experiments made on other parts of the body upon this subject by those two distinguished individuals.

Since the engorging of the right side of the heart arrests its contractions sooner than they otherwise would stop, it will be necessary to bear this in mind in experimenting on the length of time during which the heart remains contractile after death, as the circumstance of the large veins being cut or kept entire, in laying open the thorax, may considerably modify the results.

---

* Sur le Mouvement du Sang. Opera Minora, Tom. i. p. 99.

† Experiments on the Circulation of the Blood. Translated by R. Hall. M. D., p. 387.

‡ Sur le Mouvement du Sang, p. 103–104. Elementa Physiologiae, Tom ii. p. 349.

§ Memoires sur la Nature Sensible et Irritable des Parties du Corps Animal, Tome i. p. 378.

PRINTED BY JOHN STARK, EDINBURGH.