

# INTRAVENOUS SALINE INFUSION FOR RELIEF OF SHOCK AND ACUTE ANÆMIA.<sup>1</sup>

By LEWIS S. PILCHER, M. D.,

OF BROOKLYN.

SURGEON TO THE METHODIST EPISCOPAL HOSPITAL.

IN bringing the subject of intravenous saline infusions before the profession again, I am aware that the merit of novelty does not attach to it. The conditions of the circulation which render its practice valuable have been thoroughly studied and are well established; the practical results of its application have been fully demonstrated, and the technique of its practice is simple and well understood. Nevertheless, I am persuaded that the recourse to such infusions is not as frequent as it might be with advantage to patients suffering from the shock of injury and the loss of blood; that the possible difficulties that attend its practice are not infrequently exaggerated in the minds of practitioners; and too often it is regarded as one of the rarer resources at the command of surgeons in great hospitals rather than one of the possible helps easily at the command of the general practitioner.

For these reasons I have ventured to report the following cases from recent personal experience, that if possible they may serve to renew interest in these infusions and again emphasize their value and practicability.

Rapid hemorrhage, when sufficient in amount to compromise life, produces its harmful effects, not by the reduction of the amount of the vital elements of the blood in the vessels below a point sufficient for maintaining life, but by so reducing the pressure of blood within the vessels as to render its adequate circulation impossible. The dominating indication is to quickly restore the volume of the circulating fluid to that point which will make possible the continual action of those forces by which its continual flow through the vascular channels is carried

<sup>1</sup> Read before the New York State Medical Society, Feb. 4, 1892.

on. It is, therefore, now one of the accepted tenets of physiology, to which the labors of many have contributed, that, in efforts to resuscitate those dying from hemorrhage, the essential requirement is to fill the elastic tubes of the vascular system with a certain amount of fluid, not necessarily blood, and that all the benefits derivable from blood transfusion may be obtained by the simple device of infusing into the veins a solution of common salt.

In cases of injury that present themselves to the surgeon in actual practice varying degrees of shock and hemorrhage are likely to be combined. I would divide them roughly into three classes :

1. Those in which the effects of hemorrhage predominate.
2. Those in which hemorrhage and shock are both present in marked degree.
3. Those in which shock predominates.

Of the first-class I will recite but one case in brief outline, as follows:

Male. Aged 37 years. Suicidal gash of throat. Profuse hemorrhage. When received for treatment pulseless, voiceless, unconscious, moribund—no reaction to heat and hypodermic administration of stimulants. At end of forty-five minutes infusion into radial artery of twelve ounces of salt solution. Immediate return of pulse—progressive improvement—subsequent amenability to ordinary stimulants. Rapid and complete recovery.

As to the value of infusion in the second class, I present the following examples :

1. Male. Aged 22 years. Pelvis crushed by a falling bank of earth. Fractures of pelvic bones; laceration and extensive blood infiltration of soft tissues of pelvis; laceration of urethra; median perineal section; suprapubic cystotomy; free counter openings into pelvic tissues for drainage in perineum.

Patient developed symptoms of profound shock, combined with those of acute anæmia, accompanied by restlessness and thirst; surface of body cold, pulse too rapid and weak to be counted. Continuous and uncontrollable capillary oozing of blood from his wounds.

Twenty ounces of saline solution infused into the median basilic vein. Immediate improvement in his pulse and general condition

followed. But after some hours the good effects of the infusion seemed to have become exhausted. The heart's action again became feeble and rapid, and restlessness and thirst re-asserted itself. The capillary oozing, however, had now become checked. Hypodermics of morphia, atropia, digitalis and strychnine, and of whiskey began to manifest power to steady and sustain the heart. Renewed improvement declared itself, which from this time steadily progressed. His wounds were healed, his urethra restored, and an absolute recovery secured.

2. Female. Aged 17 years. Operation for removal of multiple tubercular adenomata of neck, mass filling right side of neck from mastoid process to clavicle. Operation prolonged by reason of extensive periglandular thickenings of the connective tissue and the cheesy degeneration of many of the glands. Near the close of the work, while traction was being made at the root of the neck to expose a gland in the supra-sternal fossa a flood of venous blood suddenly inundated the wound, and added the effects of its rapid loss to the previously existing shock and anemia. The depression was profound and threatening of speedy dissolution. While the lateral tear in the internal jugular vein, for such proved to have been the cause of the hemorrhage, was being secured, my assistant proceeded to infuse a saline solution into the median basilic vein. The quantity of solution injected was regulated by its effects, and the injection was continued until the normal volume of the pulse was restored, three pints having been thrown in before the desired effect was obtained. This full beneficial effect of the infusion soon began to wane, and the ordinary symptoms of severe shock reasserted themselves after an hour or so. She responded now, however, to the usual treatment for such a condition; by the succeeding day she had fully rallied, and she passed on to an uneventful convalescence, none the worse for her jugular accident.

3. Female. Aged 46 years. Exploratory incision to determine character of a doubtful knee-tumor. Abundant hemorrhage with demonstration of the existence of a vascular sarcoma of the lower end of the femur. Immediate amputation through middle of thigh. Much immediate shock, with subsequent gradual aggravation of all symptoms. At end of four hours patient pulseless, unconscious, moribund. Infusion into median cephalic vein of one pint of saline solution. Immediate revival. Able to receive and converse with friends for some hours. Gradual relapse into condition of depression, against which the usual stimulating remedies were powerless. Final death.

I might add other examples to these, illustrating the happy

effects of intravenous saline infusions in the two first classes of cases enumerated. But these are quite enough. They are in accord with physiological teachings and the practical experience of many others. In approaching the subject of shock, however, I do not feel that I am standing on so secure ground. The effects of shock are well recognized. What it is—the origin, sequence and connection of the processes which result in the profound vital depression that characterizes its more pronounced types baffles as yet our means of research. The blood pressure falls, the remote arterioles contract, the heart falters. Death outright may occur. Just how the pouring of a quantity of warm saline solution into the right heart may help in overcoming these conditions I will not venture to explain; I will not even claim positively that such infusions will have this power at all; but I have had some experience which seems to indicate such a power, and this I submit in the following cases:

1. Woman. Aged 29 years. Thrown into profound shock by an internal strangulation of bowel. Despite morphia, atropia and stimulants, shock became more profound while preparations for laparotomy were being made, until finally she was pulseless, unconscious, extremities cold, apparently dying. About eight ounces of saline solution were then injected into the median basilic vein. She revived, her radial pulse appeared again with some fullness and strength. Laparotomy was proceeded with. She bore a somewhat prolonged operation, but later sank again into collapse from which renewed infusion was powerless to rally her, and death supervened.

2. Woman. Aged 45 years. Vaginal hysterectomy for carcinoma. General strength already much reduced. Operation embarrassed and prolonged by rigidity of perineum, size of uterus and friability of the cervix. Patient in profound shock at close of operation. Saline infusion to the amount of one quart into median cephalic vein. Usual accessory treatment for shock also applied. Immediate restoration of the pulse. Subsequent gradual general improvement. Uncomplicated healing. Satisfactory recovery.

3. Male. Aged 13 years. Run over by a wagon. Multiple contusions over chest and abdomen. Profound shock. Vigorous measures to secure reaction, including lowered head, external heat, hypodermatic administration of whiskey, digitalis and nitroglycerine, resorted to in vain. Patient's condition became steadily worse. Pulse almost imperceptible, breathing short and gasping, pupils dilated,

consciousness lost. While thus moribund a saline infusion was instituted. When one quart had been injected the pulse had become slower and more full, his gasping respiration disappeared and signs of returning consciousness began to be evinced. The injection was continued until two quarts had been infused, by which time he had become perfectly rational and his pulse 124 per minute. His after history was uneventful. A slow but steady improvement in all symptoms followed, and a perfect recovery was secured.

Most of the cases that I have related occurred in my service at the Methodist Episcopal Hospital in Brooklyn, and the infusions were done by the internes on duty there. The saline solution used has not been the same in all cases, in some a simple six pro mille solution of common salt was employed, in others a more complex formula was adopted, in which an attempt is made to include all the salts of normal blood serum. I do not consider that the latter is at all important, indeed, equally good results have been obtained from the infusion of pure water alone. Wherever a little table salt and some boiled water can be procured, all the material that is requisite has been supplied.

No complicated apparatus is required for the infusion. We have used the well-known Colin's transfusion apparatus because it is convenient and it has been at hand. This comprises only some elastic tubing, a tip and a funnel with a syringe attached to it. The syringe, however, is unnecessary. A glass funnel, two or three feet of clean rubber tubing, and a bit of glass tubing for a tip to introduce into the vein is all the apparatus required.

The exposure and opening of the vein is one of the simplest operations possible, and may be done with the crudest instruments, if better should chance not to be at hand. I would guarantee to do it quickly and safely with a pocket-knife, a bent pin and an ordinary pair of scissors to be found in any house, if the emergency required.

Let me urge the more general and frequent resort to this procedure in all cases of acute anæmia from hemorrhage and of profound shock that does not respond to ordinary stimulation. Let it be remembered that its value depends on the rapid diffusion throughout the circulating apparatus of a considerable volume of fluid, and that for this purpose no other procedure can compare

with it for efficiency. Intra-arterial, intra-peritoneal, rectal, interstitial injections are all subject to great limitations, either as regards the rapidity or the volume with which they can pour fluid into the blood vessels, and are all inferior to the intra-venous method.

I am inclined to think that in my earlier cases an error was made in not injecting a larger volume of the solution into the vein. I am not satisfied now that some of my fatal cases would not have terminated differently if a larger volume of the fluid had been infused. Certainly the infusion, when once commenced, should be proceeded with until full reaction of pulse and consciousness is secured, and if later renewed collapse should threaten, it should again be done as boldly and as freely as at first.