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A REPORT OF THREE ADDITIONAL CASES BY THE NEW TECHNIQUE; ALSO, OF A CASE OF INFANT DIARRHŒA TREATED BY SALINE INFUSION.

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In the MEDICAL RECORD of January 2, 1892, and again in the *Brooklyn Medical Journal* for October, 1892, the writer has described a new and entirely simple method of saline infusion, which in severe cases of hemorrhage, of shock, and of cholera, seems destined to replace the former cumbersome plan of using a scalpel, searching for a collapsed vein, and tying therein a cannula for injection.

That plan is, *the insertion of a hypodermatic needle into the common femoral artery, and through this injecting the salt-water, by an ordinary Davidson syringe, directly into the circulation.* In cases less immediately perilous — not almost moribund—the same device is to be used; but now the fluid is thrown simply into subcutaneous cellular tissues instead of into the artery. Regarding this latter method, originality is not claimed.

Also the writer urged, upon physiological grounds, *that the salt-water used should be very hot, not less than* 120° *F.; which is as warm as the hand can possibly bear.* It was shown that no harm could result from less than 40° F. hotter than this; and on the contrary, the stimulant effect of the hot water upon the heart, and also upon the unstriped muscular tunic of the vessels, in restoring their lost "tone," was almost magical; as demonstrated by various kymographic experiments at that time detailed.

In addition to reports of experiments upon dogs by this new plan, in the College of Physicians and Surgeons laboratory, a case was published in the MEDICAL RECORD wherein the patient—moribund from post-partal hemorrhage—

was resuscitated by the intra-arterial salt-water infusion, and recovered.

The only objection (a self-evident one) to the device, is the hesitancy naturally felt to pierce so large an artery; and this should vanish when one reflects that the most prominent plan now used by surgeons for aneurisms so placed as to be inoperable by ligation, and yet threatening rupture, is that of Macewen, of Glasgow; which is *needling*, and in which long needles are thrust—a dozen or so—into the sac, and left for many hours, to cause thicker deposits on the walls—and this with benefit, as a rule.

If a diseased vessel can safely stand such treatment as this, it seems a mild inference that a sound artery can bear a single needle for a single half-hour. And such has been my experience so far.

Of course, if our patient be not too dangerously weak, the salt-water may simply be thrown into the cellular spaces beneath the skin, and diffused by rubbing. Also a warm saline enema should be given in either instance. But in critical cases no one should trust to these slow plans alone, but all would prefer to make *sure* that the heart and blood-vessels get the benefit of the injection; and here the practitioner must choose between the old and cumbersome, and the new and simple.

How many family doctors will actually, think you, take out their unaccustomed scalpel in such cases, hunt up that cannula which must be tied in, and then incise and search for the collapsed vein? Echo does not answer.

I verily believe that many a patient has died from bleeding, of one or another origin, who could easily have been saved by the simple plan of arterial infusion which the writer has devised, and that many such will hereafter be rescued thereby.

All that we need will be always readily at hand: 1. A hypodermatic needle—largest size preferred. 2. A Davidson syringe, from which the usual nozzle of metal or vulcanite rubber is removed. 3. Boiled water (for aseptic reasons), hot as hand can support, plus a heaped teaspoonful of table-salt to the quart.

Never omit the salt—it would be fatal to mix plain

water with the blood, as this at once dissolves out the hæmoglobin from the blood-disks; whereas even so small an amount of salt as that named—six parts per thousand —renders it safe, and, for practical purposes seems as good as the most complicated saline-alkaline formula possible.

I need hardly add here that *blood*-transfusion, either mediate or immediate, has now been dropped by almost all surgeons.

When a person has bled unto death, more than half his blood still remains in his body; and if this is properly increased in bulk by any innocent fluid, this added bulk is all that the heart needs to make it resume work. The remaining blood-cells support life until nature increases their number again, which is done with almost magical speed.

As to the amount of salt-water needed: Here let me say that while a pint at a time is enough within the artery, the operator cannot seriously err on the side of throwing too much into the subcutaneous connective tissues.[1] Almost always the mistake is made of injecting less than half the right amount—which is usually *at least* two quarts; and a gallon would do no serious harm if properly distributed in a dozen or more spots. The half-filled arteries of hemorrhage or shock, or the thickened blood of cholera, will soon use what is needed. If there be an excess over this amount, in a few hours to a day or so, it will gradually be taken up from the connective tissue, meanwhile doing no harm, and the kidneys will dispose of it.

[1] It seems hardly necessary to remark the absurdity of a statement recently made in the MEDICAL RECORD, under the head of "Hypodermoklysis," to the effect that it is unsafe to inject into the subcutaneous connective-tissue spaces considerable quantities of the normal salt-solution, lest the tissues become "bathed" and "drowned" (!), because the kidneys cannot fast enough excrete the liquid. Many times now, by the Cantani plan, much larger amounts of this absolutely unirritating fluid than about a pint (the limit mentioned) have been so injected in treating cholera; and with no such bizarre results. If the patient be *critically* ill, unquestionably much prompter and more certain relief follows the infusion of a pint or so directly into the blood-current; repeating this again and again if need be. The reason for this is obvious.

The doctor makes the mistake indicated (of using too little saline infusion under the skin), because he estimates only the actual blood lost in a hemorrhage, and seeks simply to replace this same bulk of fluid. He forgets that because of shock (caused by that bleeding), the vessels have lost their "tone" and are almost completely dilated. *The patient has bled into his own veins* as well, and the brain and heart are made doubly anæmic thereby. Let us remember that the abdominal veins alone are capable, when paralyzed, of holding all the blood of head, body, and members

For the benefit of those who did not read the original article in the MEDICAL RECORD, it may not be amiss to repeat the technique of arterial infusion.

The Davidson syringe, needle, and hot salt-water being ready, the operator now feels, just beneath the middle of Poupart's ligament, for the femoral artery, here large enough in calibre to carry a lead-pencil. If the heart is still beating, this great pulse can almost always be felt. The aspirating-needle is now forced gently and directly into the artery, entering it at right-angles; not with a sudden plunge, but by a slow, rotary movement. As soon as the point is within the lumen, bright-red blood will fill the needle instantly; whereupon it is held very firmly and steadily in place while an assistant slips over the base of the needle the end of the syringe, already filled, and ties it in place with a thread. The solution is now thrown into the arterial current steadily, and necessarily slowly, which last is an added point in favor of this plan. It takes about one-half hour for a pint to enter.

If the subject be very fat, an aspirating needle is preferable to the hypodermatic, which would here be too short to be held in place steadily; though, indeed, lacking the former long needle, a simple, long incision through the fat may be made, enabling one to approach the vessel more nearly and readily with the fingers.

The Davidson syringe, if old, should be disinfected by pumping boiling water through it before use. If leaky, hold the bulb, and the hand working it, beneath the salt-water, to avoid throwing in air. To maintain the tem-

perature at about 120° F. the bowl containing the solution should be placed in a larger one, holding much hotter water. In this wise, by adding from time to time to the heat of the outer bowl or pan, that of the inner vessel may easily be kept as hot as the hand can bear. As soon as the circulation seems improved somewhat, the subcutaneous method of infusion should supplant the arterial.

In my original article on this subject the technique included the use of a soft-rubber (Nélaton) catheter, to connect needle with syringe. Added experience proves this unnecessary, and it is accordingly dropped.

I have now to report four new cases of saline infusion, in three of which the arterial method was used.

Case I.—Mrs. R——, a patient of Dr. Charles S. Collins, of this city. She was shot just above the left kneecap some days previous to the date of operation. Every symptom pointed to septic infection of the joint, and the patient's general condition was of the worst. Her pulse was feeble, her temperature high, her system shattered from hard drinking. In fact, her husband, for a long time previously, had refused to live with her because of her drunkenness.

Operation on February 4, 1892, Drs. F. J. Brockway and C. S. Collins assisting. The bullet was found embedded in the femur and removed. The joint was distinctly purulent; it was washed out and a half-dozen drainage-tubes inserted where most needed. The patient, simple and brief as was the operation, and almost bloodless, was now in collapse. She presented every evidence of extreme and acute shock, threatening death almost at once. The pulse was 160 to 170, and almost too thready to be counted. Strychnine and strophanthus and whiskey by needle were employed; also a hot enema containing whiskey, and all the usual methods. These not causing rallying, the case seemed to me to call for saline arterial infusion at once. Because of shock the patient was bleeding into her own veins.

In fact, it may be remarked that a certain distinct, severe, and acute type of shock so closely resembles con-

cealed hemorrhage as to be practically indistinguishable from it; and, indeed, the treatment of each should be identical. It is well known that gynecologists now suspect a slipped ligature, and reopen the abdomen, where a few years ago the patient believed to have "shock" was allowed to die unaided, while the open vessel steadily drained away her life-blood.

I am a believer in preventing shock, if possible, rather than waiting to treat that grim and deadly enemy after it has our patient in its grip. At present, perhaps the best single drug for this purpose is strychnine. When shock is already present it may wisely, if cautiously, be carried to the point of producing moderate tetanism; and under its use the pulse, in favorable cases, falls in frequency and rises in strength. But why, if this be a fact, may we not wisely give it in fairly full doses for a few days before our operation, as a preventive?

And why would it not be well, at the end of any and every operation grave enough to make shock a probable result (though, because of the ether, not yet at hand), to inject subcutaneously a quart or two of hot salt-water? It would be painless, the patient not yet being out of anæsthesia. It would certainly be harmless. And I believe it would do much to prevent, by maintaining filled blood-vessels, an otherwise fatal shock from developing. It seems not improbable that we shall ultimately see this done as a matter of routine after all severe operations.

This digression may be pardoned me when we reflect that less advance has been made of late years in our treatment of shock than in any other subject of prime importance in surgery.

To return to our patient. The hypodermatic needle was inserted in her right femoral artery, the vessel being found at the first attempt. A pint of hot saline solution was thrown in by the fountain syringe—which plan I do not like, both because it is impracticable in rooms with low ceilings, and because it is impossible to maintain so well thereby, as by the Davidson syringe and two dishes, an evenly hot temperature in the infusion-fluid. Follow-

ing this first pint, about three pints more were injected, this time into the subcutaneous spaces; and the lumps (eight or ten) so produced on the thighs were diffused by rubbing with the vaselined hand.

The woman steadily revived. Her heart-beats slowly but regularly decreased in frequency. Dr. Collins remained by her side several hours. At length her pulse fell to a trifle under one hundred, and as it was also good in quality, he took his departure; feeling that she was out of danger and could safely be left a short time. Before going he expressly warned her to lie absolutely quiet. No sooner had he gone than she demanded whiskey. This was produced by a relative. She sat up to drink it—and dropped back dead.

I think it will be admitted that this woman would probably have recovered had she obeyed orders, thus avoiding this sudden strain on her heart.

Case II.—Mrs. D——, seen on June 28, 1892. This patient was one in whom the hemorrhage was due to placenta prævia. She was attended by Dr. J. Milton Mabbott, of this city, who called me in to use saline infusion, because in his judgment her circulation was so bad as to require it. The bleeding which followed delivery had ceased by the time of my arrival. I found her pale and covered with cold sweat, restless in the extreme, delirious, asking for air—in a word presenting the usual, and some unusual, signs of anæmia; but as her pulse was not extremely and critically bad, I proposed simply to inject the salt-water subcutaneously.

Dr. Arnold Burkelman was also present, and asked me to use the intra-arterial technique, as he had never seen it. This I accordingly did, the needle entering the artery at the first attempt, as shown by the arterial blood coming from it. Possibly a pint of hot salt-water was thus injected, and possibly between one and two quarts more subcutaneously—I think more nearly the latter amount. The reason I am in doubt is, that in her extreme and even violent restlessness she several times upset the vessel containing the solution.

The subsequent history of the case was thus reported

to me by Dr. Mabbott: "Our patient hung along for six days on the ragged edge of dissolution, and then died of exhaustion. She had no fever, no further hemorrhage of great amount, though Dr. Burkelman was sent for late one night because of a certain amount of bleeding. Of course *any* flow was too much in her state. There was no involution of uterus appreciable at the end of six days; apparent absolute inaction."

Case III.—Marie M——, a servant, had been bleeding steadily from the uterus for six weeks, and had repeatedly refused medical aid, although her mistress was much alarmed by her pallid face. At length, on the night of September 16th, I was sent for in haste. Marie had fainted, and with difficulty had been restored to consciousness.

On examination digitally, I found a piece of flesh protruding from a somewhat dilated cervix uteri. Touching it seemed to start bleeding afresh. She claimed virginity and was indignant when this was doubted. (*En passant*, next morning she admitted pregnancy, and said that a mass had "come away" some days before, and been disposed of in the water-closet.) She was put under ether; the uterus was emptied thoroughly by the finger and was washed out. It was only about three inches in depth; therefore I did not deem it essential to tampon its interior, but placed a solid and firm vaginal tamponade in place, which easily controlled bleeding.

The patient was alarmingly weak, as may be imagined from the duration of the hemorrhage, as well as its amount. I proceeded to use arterial saline infusion. The femoral was entered at the first attempt, and a pint injected as hot as bearable. Following this, about two quarts were thrown under the skin here and there, four to six ounces in each spot, and all thoroughly massaged with vaselined hands.

The patient's pulse gradually gained in vigor. She was seen the following day by Dr. F. J. Brockway and myself, when the tamponade was removed. She complained somewhat of soreness wherever the needle had been inserted, but otherwise was comfortable. Her

circulation had improved wonderfully. She made an uneventful and rapid recovery.

Perhaps this point will be as appropriate as another at which to refer to a criticism upon the new method of arterial infusion, which I have more than once heard; namely, that it is difficult to find the artery with the needle.

I can only reply that such has not been my own experience. A vessel big enough to contain a lead pencil, and pulsating beneath the finger, ought to be an easy mark for a steadily and slowly introduced needle. Those who have not succeeded must in some respect have failed either in delicate tactile sensation or else in technique. An example of the latter is a case published by Dr. Onuf-Onufrowicz, in the MEDICAL RECORD for October 1, 1892.

This gentleman very clearly and interestingly reports his case, but goes on to state that, upon endeavoring to introduce the needle into the artery by my technique, he pushed it into his rather fat subject at an angle of *sixty* (not ninety) degrees with the course of the vessel, directing it "with its point toward the foot." Naturally, he did not succeed in entering the femoral; although if his patient had been thin it is possible that he might have done so.

There can be no doubt as to whether the needle has or has not entered the artery. The bright blood filling the needle is testimony; and, then too, no lump is produced as a consequence of injecting; whereas a pint, or even a quarter-pint, of fluid thrown simply under the skin, would cause a very prominent swelling.

I have now to record one remaining case in which saline infusion has recently been used, although only subcutaneously.

CASE IV.—On September 20th I was called to Elizabeth, N. J., by Dr. G. H. Bridgman. The patient was a baby of five months, suffering from gastro-intestinal catarrh, and had had so many watery movements, in spite of able treatment, that some hours before I arrived the case was regarded as hopeless.

I found a sunken fontanelle, pinched features, very rapid and feeble pulse; and felt that here, just as in

cholera, there was indication enough for the Cantani method of treatment, so far at least as saline infusion subcutaneously was concerned. This was accordingly done : as usual, with very hot salt-water, Davidson syringe, and hypodermatic needle. Into both thighs, just beneath the skin, a considerable amount was injected, which we estimated to be equal in proportionate bulk to two quarts in an adult. In addition I advised rubbing in hot cod-liver oil everywhere (except the abdomen) for an hour, three times in twenty four.

A considerable experience with infantile diarrhœa, begun ten years ago during a residence in the Nursery and Child's Hospital of this city, has convinced me that many a little life, otherwise inevitably lost because nourishment cannot be retained, may in this wise be saved.

In an hour of firm but gentle rubbing, nearly an ounce of the hot oil may be made to pass through the skin; and quite commonly the little patient falls asleep meanwhile, soothed by the massage. Sometimes hot, melted cacao butter will even more readily be absorbed than cod-liver oil.

The next day Dr. Bridgman thought it wise to repeat the hot salt-water infusion, and so reported to me. The child steadily though slowly recovered from its gastro-enteritis. At this date, nearly two months after that of my visit, she is delicate, but has long been convalescent.

A few hours' investigation of this point, in the New York Academy of Medicine library, has convinced me that saline infusion in infantile diarrhœa is a treatment of extreme rarity. This should not be so. Between twenty five and thirty works on pædiatrics were consulted, and but two of these mentioned its use in this complaint. These were Henoch's "Lectures on Children's Diseases," vol. ii., p. 44 (1889), and *Revue des Maladies de l'Enfance*, p. 348, Juillet, 1892.

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