disappeared before the patient was out of bed, instead of persisting into convalescence, as is usually the case.

Technique.—As has been already said, the 376 tests here summarized were made in an out-patient clinic and without further laboratory facilities than form part of the furniture of a physician's office. No thermostat was used, the agar stock cultures being simply kept at room temperature. Bouillon transplantations from these were made about every third day.

The whole blood in fluid condition was used in every case. A single drop of blood expelled into five drops of water (the same medicine-dropper being used for both the water and the blood) was mixed in a test-tube. A drop of this mixture added to a drop of bouillon culture of typhoid bacilli gives a 1 to 10 dilution, which was that used in most cases. Very little blood and very little bouillon are thus required.

The remaining four drops of the blood and water can be used to make higher dilutions. If, for example, we dilute one drop of our blood-and-water mixture with

eight drops more water, and then add a drop of this mixture to one drop of bouillon culture, we have a 1 to 50 dilution.* Similarly,

- 1 drop of blood and water + 18 drops of water + 1 drop bouillon culture = 1 to 100 dilution.
- 1 drop of blood and water + 98 drops of water + 1 drop bouillon culture = 1 to 500 dilution.
- 1 drop of blood and water + 198 drops of water + 1 drop bouillon culture = 1 to 1,000 dilution.

Thus with an original outlay of *one drop of blood and five drops of bouillon culture* we can make dilutions of 1 to 10, 1 to 50, 1 to 100, 1 to 500, and 1 to 1,000, or any other five dilutions we choose. Water is the only thing we need much of.

The time limit used in all these tests was fifteen minutes.

SUMMARY.

- (1) The Widal test can easily be carried out in out-patient work.
- (2) 204 cases of disease other than typhoid tested; all with negative results.
- (3) 39 cases of sure typhoid tested at periods of from one to 18 months after defervescence; 13 of these reacted positively, 1 at a dilution of 1 to 100.
- (4) 9 cases tested quantitatively; 1 case reacted at 1 to 1,000 for several weeks. No data of prognostic value obtained.

* 1 drop of bouillon, 1 drop of water (out of the original blood-and-water mixture), 8 drops of water added, 10 drops of liquid diluting 1-5 of a drop of blood (1-5:10::1:50).

INTRAVENOUS INFUSION IN SHOCK AND HEMORRHAGE, WITH A REPORT OF EIGHT CASES.

BY DANIEL FISKE JONES, M. D., BOSTON,
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TRANSFUSION of blood is a measure which has appealed to medical men of all ages, for since the time of Ovid we hear of occasional attempts to make use of it. Apparently, however, its dangers and difficulties have outweighed its benefits, and at the present time it is practically never used, its place having been taken by the more recent and useful measure *infusion*. By *infusion* we mean the injection into the subcutaneous tissues, or into a vein, of some fluid other than blood, for the support and stimulation of the patient. The first heard of intravenous infusion—the subject of this paper—was in 1677, when an attempt was made to use milk in this way, the experiment resulting in the death of the patient. From that time to within a few years intravenous infusion has scarcely ever been heard of; it is a very recent therapeutic measure, and one which is not yet generally employed. If, however, one will read the more recent literature on the subject, he will be convinced, we think, that it is a measure of the greatest value in saving life.

Carefully conducted experiments on dogs by Bosc and Vedel¹ show that a solution of sodium chloride, between 0.5 per cent. and 0.7 per cent., is to be preferred for intravenous infusion. A 0.7-per-cent. solution has more stimulating power than a 0.5-per-cent., or a still weaker solution, and the beneficial effects which it produces are more lasting. It has also been demonstrated that calcium chloride and potassium chloride added to the normal salt solution will keep up the action of the heart longer than normal salt solution alone. Infusions of distilled water, strong salt solution, and milk have proved fatal in every case. Ordinary water may be used in case of necessity, but it should not be used in large quantities, or often.

The solution used at the Massachusetts General Hospital is a modification of Ringer's solution: it is calcium chloride $1\frac{1}{2}$ grains, potassium chloride 1 grain, sodium chloride 90 grains, water 1 quart.

The technique of intravenous infusion is so simple that nobody need feel that it is necessary to have a surgeon at hand, or even another physician to assist, for it can be done very easily with the aid of one person. There are four points which should be noted when infusion is undertaken; these are:

- (1) Careful asepsis of arm, apparatus and solution.
- (2) Care to get all the air out of the tube before introducing the canula.
- (3) Care to have the solution free from particles.
- (4) The use of a probe-pointed canula, and not a sharp-pointed needle.

With these points in view, there is comparatively little danger in the proceeding; in fact, there are in recent literature no reported cases of death caused by infusion, nor have we been able to learn of any ill effect in about 70 cases at the Massachusetts General Hospital. In experiments upon the lower animals unconsciousness is produced when the pressure of the solution is considerable, but consciousness returns as soon as the pressure is lowered.

The temperature of the solution, it is generally stated, should be 100° F.; but we should urge that it be considerably above this point, for the hotter the

¹ Compt. rend. de Soc. de Biologie, Paris, 1896.

solution the greater its value as a stimulant. An initial temperature of 108° F. to 110° F. is well borne,—the fluid is cooled from one to two degrees before reaching the circulation.

The amount of the solution to be injected at one time varies with the rapidity of the injection and with the quality and tension of the pulse. A thousand cubic centimetres, repeated when necessary, is generally much better than a larger amount given at one time.

The following cases have come under my personal observation. In all but two of the cases the modification of Ringer's solution which is given above was used for the intravenous infusion. It should also be stated that before infusion was resorted to stimulation was carried on by large enemata.

CASE I. J. B., age sixty, male. Operation, nephrectomy, at 11.30 A. M., December 20, 1897. The condition before operation was very poor. There had been constant hemorrhage from the kidney for several months. Suprapubic cystotomy had been performed three weeks before. After the nephrectomy the patient's condition was critical, and he grew steadily worse, in spite of enemata and hypodermic stimulation. At 1.30 P. M. infusion of 1,000 c. c. Patient responded well,—much quieter, with pulse of fair volume at the wrist. At 3.30 P. M. he was unconscious, pulse could not be felt at wrist, respiration very shallow; infusion of 1,000 c. c. Patient responded fairly well, and partially regained consciousness; he then failed slowly, and died at 6 P. M.

CASE II. Mrs. W., age fifty-five. Surgeon, Dr. M. H. Richardson. Operation, cholecystectomy, at 11 A. M., February 15, 1897. Condition before operation poor: long-continued pain and jaundice. Condition after operation that of profound shock. At 2 A. M., February 16th, the respiration became very rapid and shallow, the pulse could not be felt at the wrist, and the patient was unconscious. Infusion of 1,000 c. c. Patient responded well; pulse regular and of fair volume; consciousness partially regained. At 5 A. M. Cheyne-Stokes respiration, pulse imperceptible. Infusion of 1,000 c. c., with good response, the effects lasting much longer than those of the first infusion. Condition remained about the same until 8.10 P. M., February 16, when she died.

CASE III. Mrs. D., age forty. Surgeon, Dr. M. H. Richardson. Operation, nephrolithotomy, at 5 P. M., March 5, 1897. Condition before operation very poor: pyonephrosis for one and a half years. After operation patient regained consciousness, but the respirations were shallow, and the pulse was weak and rapid; patient restless. There was considerable oozing from the cavity of the kidney. At 6.30 P. M. condition much worse. Infusion of 1,000 c. c., with excellent result. At 10.30 P. M. patient unconscious, extremities cold, lips blue, body covered with a cold perspiration, jaw jerking with inspiration. Infusion of 1,000 c. c. Consciousness partially regained, pulse fair at wrist, and extremities warm. At 2.30 A. M., March 6th, her condition was precisely the same as before the last infusion. Infusion of 1,000 c. c. Responded well, but soon began to fail, and died at 2.30 P. M., March 6.

CASE IV. W. V., age forty-five, male. Surgeon, Dr. M. H. Richardson. On March 14, 1897, patient thrown from wagon. Probable fracture of liver, with internal hemorrhage. Condition before accident good;

condition after accident that of great shock. Three hours after accident condition extreme,—gasping respiration, no pulse at wrist, and patient unconscious. Infusion of 1,000 c. c., with very little effect. Pulse responded for a short time, but patient soon died.

CASE V. W., age forty, male. Surgeon, Dr. M. H. Richardson. On February 21, 1897, fracture of base of skull, with multiple injuries and considerable hemorrhage. Condition before accident good; condition after accident that of severe shock and hemorrhage. Patient continued to fail, partly because of the continued oozing from the crushed area. At 10.15 P. M. no pulse found at wrist, patient very restless, respiration gasping. Infusion of 1,000 c. c., with good effect. At 2.30 A. M. patient covered with a cold sweat, pulseless, jaw jerking with inspiration, unconscious. Infusion of 1,000 c. c. Responded well, became conscious in a short time, and from this on held the ground gained; recovery.

CASE VI. DeL., age fourteen, male. Surgeon, Dr. John Homans. On March 5, 1897, amputation of thigh for sarcoma. Condition before operation very poor. During operation subcutaneous infusion of salt solution. This, however, was not absorbed well, and the condition continued to grow worse,—the patient became pulseless, and the respiration was almost imperceptible. Intravenous infusion of 1,000 c. c. Patient responded well; operation completed; recovery.

CASE VII. Mrs. B., age forty. Surgeon, Dr. M. H. Richardson. On April 12, 1897, nephrectomy for tubercular pyonephrosis. Condition before operation poor. After operation there was considerable shock and a good deal of hemorrhage from the field of operation. The patient's condition grew worse, until the pulse became imperceptible and the restlessness extreme. Subcutaneous infusion of 1,000 c. c., with very little effect. One-half hour later intravenous infusion of 1,000 c. c., with good results,—extremities became warm and pulse fair at the wrist; recovery.

CASE VIII. Mrs. F. Surgeon, Dr. M. H. Richardson. Laparotomy for small ovarian cyst on April 28, 1898, at 8 A. M.¹ Condition before operation fair; condition after operation good. Ten hours later the patient was in collapse from internal hemorrhage; the pulse was too feeble and too rapid to count at the wrist. Patient conscious, extremities cold, respiration very rapid. Infusion of 1,200 c. c. of salt solution at 108°F. Immediately after this the wound was opened, a bleeding artery tied, and the blood and clot wiped out of the abdomen. The wound was then closed. At the end of the operation the pulse could easily be felt at the wrist, and was of fair vol-

¹ NOTE BY DR. M. H. RICHARDSON.—The operation in this case was a simple ovariectomy for a tumor of the left ovary about as large as an orange. The pedicle was tied in two sections with silk. At 5.30 P. M. the patient was seen and reported by Dr. Brewster to be in good condition. At 8.30 P. M. the night nurse reported her condition to be alarming. I found the patient at 8.45 P. M. white, restless, gasping, and pulseless, with cold extremities and wet skin. The case seemed to me absolutely hopeless, and a reopening of the abdomen unjustifiable.

As the patient's only chance seemed to lie in stimulation, Dr. Jones did infusion. The effect upon the pulse was in the highest degree encouraging. I was able to open the abdomen, which was filled with blood, to find and to tie the bleeding artery, and to clean out most of the blood. This was my first personal observation of intravenous infusion for hemorrhage. I have never before seen a patient with such a pulse and general condition recover; in my experience all cases of internal hemorrhage so advanced as this was have proved fatal before operation could be performed. (See paper on Extra-Uterine Pregnancy and Pelvic Hemorrhage: *Annals of Surgery*, December, 1894.) In this case operation was advised against, but I am convinced that infusion saved the patient's life. In another case of internal hemorrhage, in hemorrhage from extra-uterine pregnancy, for instance, I should at once do infusion, and attempt to operate.

ume. The pulse grew steadily worse for three hours, when 1,000 c. c. of salt solution was given. The pulse responded well, and after about an hour held its own.

On the second day after operation the temperature had risen to 103°F., and there was a general papular eruption. On the fifth day there was a double parotiditis. From this time, however, there was a gradual lowering of the temperature to normal; recovery.

We have in this list of eight cases but three of the class generally considered the most favorable for infusion, — that is, cases in which shock or hemorrhage occurs in comparatively vigorous individuals. Of these three, one died and two recovered. Of the five remaining patients, not one was in good condition, — their recuperative power was far below normal; yet of these five, two recovered. Although the death-rate of the eight cases is 50 per cent., it is to be remembered that the cases were all desperate ones. In the fatal cases life was undoubtedly prolonged from four to twenty hours. So marked was the effect in three, one could not but believe that, had the patients had a little more recuperative power, recovery would have followed.

In regard to the value of infusion in shock or hemorrhage, this group of cases seems to show that the nearer the case approaches that of pure shock, other things being equal, the less effective is infusion.

It will be noticed that when infusion was done more than once it seemed to be more effective the second time than the first, and its good results seemed to last longer.

In Cases VI and VII there is a chance to compare subcutaneous with intravenous infusion. In neither case was the subcutaneous infusion effective, probably because of the extremely low condition of the patient and the consequently poor absorptive power. Although subcutaneous infusion is undoubtedly effective when there is no immediate need of the solution, and when there is enough vitality left to absorb it, intravenous infusion is much to be preferred when the need is immediate.

We have in this list eight cases, with four deaths and four recoveries. If out of eight desperate cases four can be saved, and if in about seventy cases there are no ill effects, what is there to prevent a more general use of infusion in severe cases of shock and hemorrhage? Wiggin reports a death; but in this case the patient had a weak heart, and three quarts of the solution was rapidly given. Undoubtedly one reason why this measure is not more frequently resorted to is the difficulty in always having the solution and apparatus ready. This, however, is not a valid excuse, for the canula is very small, and the salts can be carried in vials, in saturated solution, ready to use in a given quantity of warm water. The tubing and funnel can be found in almost any household.

PERCEPTION OF X-RAYS BY THE BLIND. — According to the *Medical Record*, a French physician has recently reported to the *Académie des Sciences* the result of his experiments on blind children. Among two hundred and four he found five boys and four girls who were able to recognize the Röntgen rays. Some saw the x, cathodic, and fluorescent rays, others only the cathodic and x rays, and one described them as being of reddish color.

Clinical Department.

REMOVAL OF FIBROID FROM PREGNANT UTERUS WITHOUT RESULTING MISCARRIAGE.

BY JOSEPH F. O'SHEA, M.D., LYNN, MASS.,
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Mrs. A. S., age thirty-two, housewife; large, strong woman. When first seen, March 30, 1898, the patient gave the following history: She claimed to be over five months advanced in her first pregnancy; never had any uterine disturbance previous to conception; carried fetus without discomfort until the night of March 29th. Following the advice of certain ubiquitous old women who "had been through the mill," as they expressed it, she annointed her abdomen with sweet oil every night before going to bed. While applying this unctuous ablation on the night of March 29th she noticed a bunch on a line with, and to the left of, the umbilicus. Later in the night she began to have pains in the uterus and in the recently discovered tumor.

The pains were intermittent in character, and described by the patient as being unbearable in intensity, with a feeling of constriction as though something was grasping the uterus and tumor and squeezing them together. During the night a large sized plug of mucus was discharged from the vagina, but no blood.

When first seen, March 30th, the patient was still complaining of severe intermitting pains, which recurred every ten to fifteen minutes. Upon examination a tumor the size of a large orange was discovered attached to the gravid uterus on the left side of the fundus, its lower third being on a line with the umbilicus. Palpation necessary to determine the nature of the tumor always resulted in inducing the characteristic constricting pains, and increasing their intensity.

Digital examination *per vaginam* revealed a condition such as occurs in the first stage of labor before dilatation of the os — a very thin cervix which showed considerable tension, becoming thinner during each pain, and an absence of the plug of mucus which seals the os of the pregnant uterus. By bimanual palpation the tumor was found to be connected with the uterus and the pains were made out to be true parturient pains. There was nothing found to indicate any abnormal condition except the presence of the tumor. A diagnosis of subperitoneal fibroid, with threatened miscarriage, was made.

Treatment. — The patient was put in bed and sedatives and anodynes administered. This treatment was followed for one day, when, notwithstanding the fact that large doses of morphia, chloral, and bromides had been exhibited, the pains continued, the os became slightly dilated, and a miscarriage seemed imminent.

As it was obvious that the tumor was the cause of the irritation which produced the premature labor pains, a question arose as to the justification of operative measures for the relief of the condition which presented. Surgical interference was decided upon, for the following reasons:

- (1) The tumor being the cause of the condition which would inevitably result in miscarriage, and the parents being willing to make any sacrifice that a living child should be born, the tumor should be removed.
- (2) The excellent physical condition of the patient.