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# INTRAVENOUS INJECTION OF SALINE SOLUTION

IN

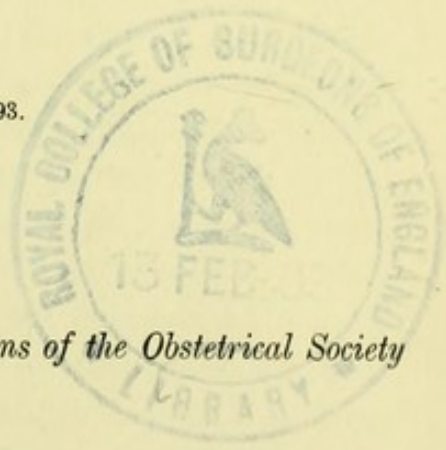
## CASES OF SEVERE HÆMORRHAGE.

BY

PETER HORROCKS, M.D., F.R.C.P.,  
ASSISTANT OBSTETRIC PHYSICIAN TO GUY'S HOSPITAL.

Read December 6th, 1893.

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## INTRAVENOUS INJECTION OF SALINE SOLUTION IN CASES OF SEVERE HÆMORRHAGE.

By PETER HORROCKS, M.D., F.R.C.P.,

ASSISTANT OBSTETRIC PHYSICIAN TO GUY'S HOSPITAL.

TRANSFUSION of fluids of different kinds in cases of severe hæmorrhage has been advocated and practised for centuries. Until recently the transfusion of blood, either directly from arm to arm, or indirectly, withdrawing the blood from the giver, removing the fibrin, and then injecting into the receiver, has been recommended in the various text-books. Most of the apparatus in use has been arranged for this operation. The transfusion of various saline solutions has also been tried with varied results by different physicians.

It must have been the experience of many to see transfusion carried out in the manner advocated, and about eight to ten ounces, or even more, of blood or of saline solution have been thrown into the circulation. If the patient died it was thought to be due to the fact that she was too far gone to be revived, rather than as in any way due to the transfusion or to the fluid transfused.

The late Dr. Wooldridge, an original thinker, held very strong views regarding the question of the transfusion of blood. He believed that not only was it useless, but that it was injurious. Indeed, he thought that when the transfusion had been ably conducted so far as getting the blood into the circulation, the death of the patient was almost sure to follow, and if it did not, there was little, if any, credit due to the transfusion.

Dr. Wooldridge first spoke to me on this subject in 1885. We intended to try an intravenous injection of



salt and water in the first suitable case that occurred. Unfortunately he was cut off suddenly, and he left behind him no notes on this subject. Since his death, however, I made his views known as far as possible at Guy's, and the first successful case was published by Mr. Lane in the 'Lancet' in 1891. We have had a good many successes since, but I shall, however, give you details of those cases only with which I have had to do myself. Before doing so, however, I will lay before you, as clearly as I can, the theories and the facts which led up to this method of transfusion.

1. When a person is dead from rapid hæmorrhage there is still in the body sufficient blood to carry on life, if it can be circulated.

2. Theoretically half the volume of blood could do the same work if it were given double the velocity.

3. Death from hæmorrhage is due to failure of the heart, and this is due to want of extension owing to the fall in the blood-pressure.

4. This blood-pressure can be raised if as much fluid be transfused as there has been blood lost.

Kronecker and Sander, in 1879, experimented on dogs with saline fluid, *vide* 'Berliner klinische Wochenschrift' for December 29th, 1879.

The following experiment was made by Dr. Wooldridge, confirming their results in a striking manner :

Two dogs as nearly equal as possible in breed, age, size, weight, and strength, were taken and bled to death by opening a vein in the neck. When it is said they were bled to death, it means that they were bled until they ceased to breathe and pulsations were no longer palpable. One of the dogs was left untouched, and never showed signs of life again. The other was transfused by means of an apparatus consisting of a cannula for the vein, a piece of tubing, and a syringe. As much water (containing a little salt) was injected as the blood which had been lost. This blood was caught in a vessel, and so its volume was known. The dog immediately jumped up,



ran about, and ate a beefsteak, and showed no signs afterwards of any ill effects following the experiment.

It will be obvious from this experiment that the bleeding vessel was secured, so that as the saline solution was injected no further hæmorrhage took place.

Since September, 1891, this method has been used at Guy's very largely, not only in cases of severe and moderate hæmorrhage, but also in cases of collapse without hæmorrhage. I have, however, no experience whatsoever of copious intravenous transfusion of saline fluid for cases of simple collapse. Theoretically, I should have argued that although the immediate effect might be beneficial by supplying more fluid to an underfilled heart, yet when reaction took place the bulk of the blood temporarily lodged in, say, the large vessels of the abdomen, re-entering the general circulation might cause over-distension of the heart and thus prove fatal.

As to the cases of hæmorrhage in which transfusion should be tried, I think no case should be allowed to die from loss of blood without this therapeutic measure being tried. It was our custom in the Guy's Charity when blood was used as the fluid, never to transfuse if a pulse could be felt at the wrist, and it will be noticed in all the cases I have brought forward to-night the patients had lost so much blood that no pulse could be felt at the wrist. But I think it is quite possible for a person to lose so much blood that it proves fatal, and yet there is a pulse at the wrist even after the bleeding has ceased. Thus a surgeon performs an operation involving a considerable amount of hæmorrhage. When all the vessels have been secured so as to prevent further loss, and the operation is completed, it is found that, although feeble, there is still a distinct pulse at the wrist. The patient is put to bed, and perhaps rallies to some extent, but some hours later death takes place. Our literature contains many such cases. Post-mortem examinations reveal that no further hæmorrhage has taken place. The death is attributed to shock, exhaustion, or syncope.



I think with those who believe that the heart failed through the fall in the blood-pressure, that this pressure was maintained for some hours by the vaso-motor system, but when this failed a fatal syncope resulted. If this view be correct it is obvious that many such cases may be saved by a timely intravenous injection. I do not think this operation should be done in trivial cases, but I do think that where a patient is known to have lost a large quantity of blood, an equal amount, as near as can be calculated, of saline fluid should be injected into the veins, even though the patient is not in a pulseless condition.

I have never seen any harm result from transfusion, except a little suppuration in the wound over the vein, a little pyrexia within two or three days, and a rapid pulse. The latter is obviously physiological, inasmuch as the blood-corpuscles are so diminished in number, necessitating greater velocity in order to accomplish an equal amount of work in a given time.

I am sorry that my spare time has been too little to permit me to refer to the work of others on this subject. I have recorded here simply my own experience. I have not touched upon the question of rectal and subcutaneous injections, which are both interesting and important, but I think they are only useful in the less serious cases. Neither have I had any experience in adding alcohol in any form to the fluid used.

CASE 1.—E. L—, aged 29, married five years, one child three years of age, never pregnant since ; no miscarriages. Periods regular to the day, as a rule. Last period five weeks ; a few days ago began to have pain in the abdomen. This got worse, and Mr. L. Stokes of Eltham was called in. He kept her in bed and applied hot flannels and gave a sedative. The pain increased in severity, and the patient became paler. At 7 a.m. Mr Stokes found her blanched. At 9 a.m. I saw the lady at Lee with Mr. Stokes, and her condition was so serious that immediate operation was decided upon. Mr. L. Burroughs kindly



gave the anæsthetic, and Mr. L. Stokes ably assisted. There was no nurse, and we three had to manage as best we could. The abdomen was opened and was found to be full of blood. The left broad ligament was immediately clamped with a long pair of clamp forceps, and sponges were then stuffed into the wound in order that transfusion might be done, the patient being quite pulseless and apparently moribund. Having begun the intravenous injection, I handed it over to Mr. Stokes, who went on with it whilst I continued the operation. The abdominal cavity was cleared of blood as far as possible, a jugful of water was poured into it and then sponged out, the left ovary and tube were removed, and the broad ligament ligatured. The abdominal wound was then sewn up, leaving an india-rubber drainage-tube at the lower end.

The patient had then ceased to breathe, and there was no pulse at the wrist; artificial respiration was performed, and in a few minutes she breathed again. The bandages were now found to be saturated with blood. Fearing fresh hæmorrhage, the abdomen was again opened, and a lot of blood cleared out. It was, however, only some blood that had lodged high up in the abdomen, and which had been driven down during the movements of the artificial respiration. When she was sewn up again and carried to bed the case seemed hopeless, but transfusion was persevered with until quite six pints in all had been injected. The pulse could then be felt feebly at the wrist, and to make the story short she got well without a bad symptom, beyond some suppuration along the track of the drainage-tube. The operation was performed in November, 1892. She is living and well at the present time, menstruating regularly without pain (October, 1893). I examined the parts removed, and pass them round to-night. You will see that it is a tubal foetation which ruptured very early. It was impossible to say that it was an ovum until it was examined microscopically, but under the microscope the villi of the chorion are unmistakable; I have put specimens on the table to-night.



The water used in this case had not been boiled. Its temperature was guessed at, and a handful of salt was thrown into a jugful of the water.

CASE 2.—On the evening of the 17th February, 1893, I was asked to see a case with Drs. Creed and Owen in West Kensington. The patient was aged 33, married, with three children, the youngest five and a half years of age. She was generally regular every four weeks, lasting two days. Her last period was at the end of November, 1892. Her first attack of pain in the abdomen was February 13th; she got better and had another attack on the 16th, when she was blanched. She became more blanched on the 17th, and a consultation was held. Ruptured tubal gestation was diagnosed and immediate operation was advised. The patient's surroundings were unsatisfactory, and one of the children had scarlet fever; she was therefore brought to Guy's in a brougham wrapped in blankets. On arrival at Guy's Hospital at 1.30 a.m., February 18th, everything was ready for operation, and the patient was carried from the brougham on to the operating table. Ether was used as the anæsthetic, and very little sufficed to produce anæsthesia. Antiseptic measures were adopted, and the abdomen was opened by an incision three to four inches long. A black mass was seen through the peritoneum before it was opened. Its cavity contained a large quantity of dark blood, both fluid and in clots, caused by the bursting of the ovum from the outer part of the right Fallopian tube. When the mass was raised out of the pelvis, the sac ruptured and the fœtus escaped. The pedicle was ligatured and the parts removed. The abdomen was irrigated thoroughly with hot water, and the wound was sewn up with silkworm-gut sutures, a glass drainage-tube being left in Douglas's pouch. During the operation the patient became pulseless, and hot water (102°) with salt (about 3j to Oj) was injected into one of the venæ comites of the right brachial. The student who was operating tried the median basilic vein first, but he cut it to pieces, and so a fresh incision



was made along the course of the brachial. About five pints were injected in twenty to thirty minutes. The pulse was then felt distinctly at the wrist, beating at the rate of 120 per minute. After the operation the patient was carried into the general ward. The fluid was drawn from the drainage-tube every half hour at first. Three ounces were thus withdrawn during the first six hours. The next day, about twelve hours after the operation, milk and barley water, 5j of each mixed, were given by the mouth every half-hour, and nutrient enemata every two hours. The patient made a good recovery; her temperature, however, averaged  $99.5^{\circ}$  the first three days, reaching  $101^{\circ}$  on the fourth day, and  $103.4^{\circ}$  on the eighth day. On the fourth day there was some vomiting and diarrhoea. But it was discovered that the patient was phthisical, and it was thought this might have something to do with the symptoms.

The sutures from the two wounds in the arm were removed on the eighth day.

The drainage-tube was kept in the abdomen until the fourteenth day because the fluid withdrawn did not lose its red colour. When the glass tube was withdrawn an india-rubber drainage-tube was inserted. This was gradually shortened, but was not removed completely until two months after the operation. She was then transferred to a medical ward under the care of Dr. Goodhart, who treated her lung trouble. She finally left the hospital and went to a convalescent home. In August, six months after the operation, she was looking and feeling much better, but still had a bad cough with muco-purulent expectoration.

CASE 3.—On the 26th October, 1892, I was asked by Dr. Roberts of Peckham Rye to see E. S—, aged 28; married six years, had been twice pregnant, one resulting in a miscarriage at the third month, and the other in a premature labour at the seventh month. This was nearly five years ago.



The patient was usually regular, but had seen nothing for two months. Two weeks ago, whilst walking about the house, she felt a violent pain in the stomach, and went to bed, where she remained two days. A week later she was doing her work again when she had a second attack of pain with vomiting; she also passed some blood *per vaginam*. Poultices were applied to the abdomen, and she was kept in bed. On the 26th October she got out of bed to pass water, when she became faint and deathly white. When I saw her the abdomen was slightly distended, very tender, and an indistinct thrill could be felt. *Per vaginam* an indefinable something could be felt through the roof, and *per rectum* this something was more perceptible.

Ruptured tubal gestation was diagnosed and immediate operation was recommended. Suitable surroundings were unattainable, and the patient was brought to Guy's in an ambulance. She was carried straight to the operating table (2.30 a.m.).

The abdomen was found full of blood coming from a ruptured left tubal gestation. The parts were removed, and the abdomen was washed out with hot water; much difficulty was experienced in getting rid of pools of blood lodged amongst the coils of intestines.

Before the operation the patient became quite pulseless, and intra-venous injection was commenced as soon as the pedicle was tied. Six pints of saline solution (at 102° F.) were injected into the right median basilic vein. The pulse could be felt at the wrist when the operation was over. Nutrient enemata consisting of brandy  $\bar{z}$ iss, yolk of one egg, and peptonised milk alternating with peptonised beef tea ad  $\bar{z}$ v, were given every three hours.

A glass drainage-tube was used, but as the fluid became nearly clear, the tube was removed on the fourth day. The pulse was 120 after the operation, and for a day or two the temperature was as high as 101° F.; on the fifth day it was 102·8°. The abdominal stitches were removed on the



seventh day. The arm wound suppurated a little and it was dressed with boracic ointment. The patient made a good recovery and left the hospital on the 24th of November, four weeks after the operation. In August, 1893, she was in good health, and I failed to recognise her owing to the colour in her cheeks.

CASE 4.—A. T—, aged 36 ; eleventh pregnancy ; said to be seven months pregnant ; attended in the Guy's Hospital Lying-in Charity by Mr. R. Hewlett Hayes. When first seen the patient stated that she had fainted the previous day whilst defæcating, and that she had been in pain ever since.

The os was fairly large, but the membranes were not ruptured. Later they burst, and liquor amnii escaped and then gushes of blood. The vertex was presenting. Dr. Horrocks and the two resident assistants, Messrs. Mason and Davies, came down, and under an anæsthetic the cervix was further dilated by Champetier de Ribes bag, podalic version was performed, and a dead male child was extracted. During this operation the patient became pulseless at the wrist, and injection of saline fluid was begun in the median basilic vein. When six pints had been injected there was a distinct though weak pulse at the wrist. As there was no further hæmorrhage and the uterus was well contracted, Dr. Horrocks and the senior assistant, Mr. Mason, left. About an hour and a half later the patient's pulse again became imperceptible at the wrist. The median basilic vein on the other side was opened and more saline solution was injected. The pulse became perceptible, but was only very feeble and soon disappeared, and the patient died.

A post-mortem was made and a large effusion of blood in the left broad ligament was found, and a tear in the cervix uteri extending upwards to the left broad ligament. There was no blood in the peritoneum.

CASE 5.—J. M—, aged 44, married ; nine children ; admitted into Guy's Hospital August 2nd, 1892, for



uterine hæmorrhage which was due to cancerous growth in the cervix uteri.

It was decided to remove this growth by means of the galvanic cautery. When the platinum wire was fixed round the cervix, the man in charge of the battery turned on much too strong a current; the wire became white-hot, and rapidly cut through the enclosed tissues. Severe hæmorrhage was the result, and it was found that both broad ligaments were opened, the pouch of Douglas was opened, and the base of the bladder was damaged. Some of the large bleeding vessels were caught with catch-forceps, an attempt was made to sew up the peritoneum, but the parts simply broke away and made the hole larger. Packing with long strips of iodoform gauze was therefore resorted to, and pressure was made by means of a T-bandage. The patient was very collapsed afterwards, and after about sixteen hours the pulse, previously very weak, became imperceptible at the wrist. Saline solution was injected into the right median basilic. Three pints three ounces were injected. The pulse was then distinctly felt at the wrist.

In two days the temperature was  $101.2^{\circ}$ , and the pulse 148. On the fourth day the vaginal plug was removed. It was rather foul. The vagina was gently syringed with a solution of boric acid. On the twelfth day urine flowed from a large vesico-vaginal fistula.

The patient recovered from the operation and is still living (August, 1893), but an attempt to cure the vesico-vaginal fistula was a failure, and, as the cancer has recurred in the pelvis, no further attempt will be made.

CASE 6.—On February 22nd, 1893, I saw a lady with Dr. Hartt, of Greenwich. She had been married eleven years and had never been pregnant. She had missed her periods for two and a half months, having been previously regular. She had pain in the abdomen recurring now and then and causing some collapse.

When I first saw her she was pretty comfortable but



the abdomen was slightly tender, slightly distended, and *per vaginam* an indefinable mass could be felt through the vaginal roof, more especially behind.

Ruptured tubal gestation was diagnosed and abdominal section was recommended. This was done and the abdomen was found full of dark blood, fluid and in clots, and a two and a half months' gestation was found in the right Fallopian tube. Unfortunately the anæsthetist did not keep her fully under, and the spasm of the recti abdominis muscle was so great that it was impossible to work. The result was serious hæmorrhage on partially separating the mass from the bottom of the pelvis. Ultimately the parts were removed, the foetus measuring over 3 inches in length.

The nurse on counting the sponges said one was missing. This was hunted for a long time but it was not found. Injection of saline fluid was then begun, as the patient had become pulseless at the wrist. Mr. A. T. Rake kindly did this for me in a very able manner. As the sponge could not be found, an extensive and careful search was made everywhere in the abdomen; at last the nurse admitted that she was in error and the sponges were all right. Six pints of saline solution were injected and the pulse was perceptible at the wrist. The patient rallied very well, but showed signs of peritonitis and died on the fourth day. A post-mortem revealed suppurative peritonitis.

Before concluding, I would like to mention a case which occurred in the spring of this year.

CASE 7.—I was asked to see a patient in Camberwell with Dr. Carré. She was young, and had not been married very long. She had been ill with pain and collapse before coming to Camberwell, and when Dr. Carré saw her he advised a consultation. Her husband declined, but the next day she was in such an alarming state that he consented.

On arrival we found her blanched, with a weak rapid



pulse. The abdomen was tender and rather full. On vaginal examination the uterine mobility was not good, and the pouch of Douglas obviously contained something that was abnormal. No bimanual examination was possible. I suggested abdominal section, but the husband refused to allow her to be touched until he had obtained the consent of his mother-in-law, of whom he seemed to be in dread. We left, and a few hours later I received a telegram to say they were bringing her to Guy's. I had everything prepared, and she was carried from the brougham on to the operating table, but she expired just as she was laid on the table. Brandy was injected subcutaneously, artificial respiration was tried, and then my assistant opened the right median basilic vein and commenced intravenous injection of saline fluid. There was absolutely no result; after a few pints had been injected I opened the abdomen, which was full of blood, and removed the specimen of ruptured tubal gestation, which I show to-night. The injection was continued until six pints had been used.

This case shows not only the danger of delay, but also that the heart and vessels do not long retain their power of carrying on the circulation if it once stops.

It will be seen from the above cases that the patient has a much better chance when the bleeding vessels can be secured before the transfusion. Hence, it does not offer so good a prospect in cases of post-partum hæmorrhage where the vessels are out of reach as in cases of cut throat, &c., where the bleeding points can be clamped.

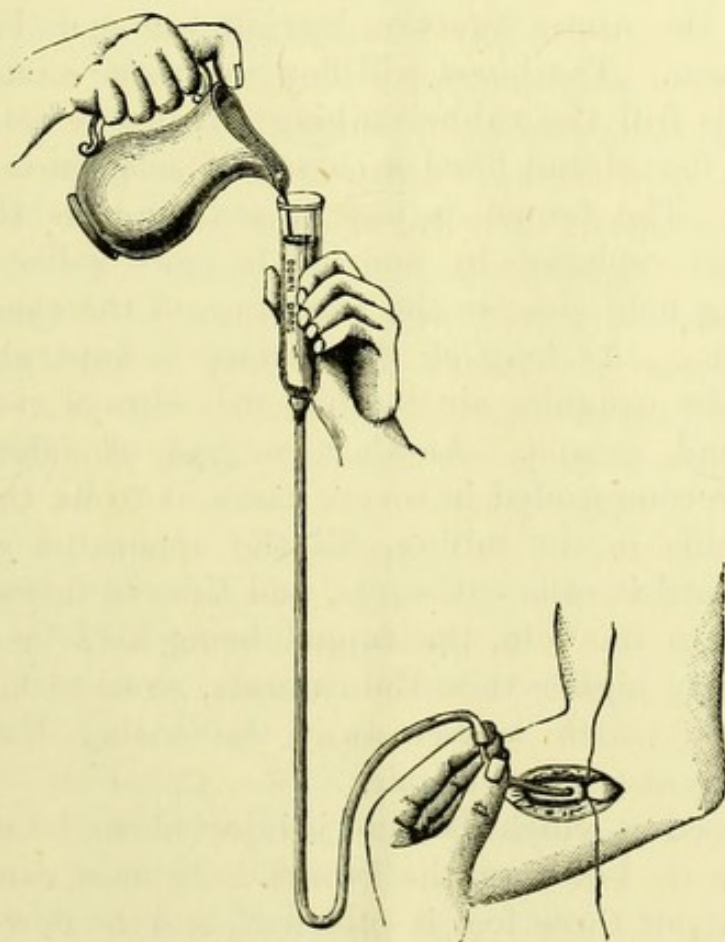
The fluid used in transfusion of this kind, and done with the object of raising the blood-pressure, should be water. The addition of salt may perhaps be useful, but it is not essential. When it can be obtained easily it is best to boil the water, and then to cool it down by placing ice or cold water outside the containing vessel until it reaches  $39^{\circ}$  C. ( $= 102.2^{\circ}$  F.). It cools down to blood heat,  $37.7^{\circ}$  C. ( $= 100^{\circ}$  F.), as it passes along the transfusion apparatus. If at hand common salt may be added



in the proportion of a teaspoonful to the pint of water.

The amount of fluid injected varies in different cases ; the object is to replace the blood lost by an equal amount of fluid. In the worst cases six pints have been used, but in less severe cases two, three, four, or five pints will be found enough ; the criterion being the condition of the radial pulse, which will be felt with the finger beating distinctly when sufficient fluid has been injected.

Last year I showed at this Society a simple apparatus for effecting this injection. The essential parts consist of a cannula, a piece of tubing three or four feet long, and a glass funnel. As the two latter can be obtained in



almost any house, it is only necessary to carry the cannula in order to be always provided potentially with an apparatus.



For the sake of those who may not have seen the operation done, I will describe it.

*Operation.*—Make an incision about one inch long, and expose the median basilic or any other vein of not less calibre. In some cases it is found useful to cause filling of the vein by tying a pocket handkerchief or bandage round the arm. With a needle pass a silk, or gut, or other ligature, under the vein, cutting it so as to leave two ligatures. Draw one to the lower angle of the wound, and tie it round the vein by a double knot, cutting the ends short. With the dissecting forceps pinch up the vein and make a small snick in it with scissors, taking care not to sever the vein completely. Introduce the cannula (silver or glass) into the vein, and tie it in by means of the upper ligature, leaving the ends long as in the diagram. The blood will flow down the cannula, and when it is full the rubber tubing previously attached to the glass funnel and filled with saline solution is fixed on the end. The funnel is now raised, and as the water flows it is replaced by pouring in more saline solution from a jug held close to the rim to avoid the causation of air bubbles. As long as the funnel is kept above the level of the cannula, air bubbles will always rise to the surface and escape. Another method of introduction, and one recommended in severe cases, is to fix the funnel and cannula in the tubing, fill the apparatus with salt solution until it runs out warm, and then to introduce the cannula into the vein, the funnel being held by an assistant slightly higher than the cannula, so as to keep up a gentle flow which washes away the oozing blood, and ensures the absence of all air.

The speed at which the fluid is injected can be regulated by raising or lowering the funnel. In most cases a distance of about three feet is sufficient, and the flow is found to be about a pint every four minutes.

When enough has been injected, remove the cannula from the vein. Cut the latter completely across, and tie the upper end with the long ends of the ligature. Sew



up the wound with a continuous or interrupted fine silk or other suture, and fix a clean pad with a bandage.

*Summary.*

1. Transfusion of blood is useless and probably injurious.
2. Water with or without salt should always be used.
3. The amount injected should equal, as far as possible, the amount of blood lost.
4. Enough fluid should be injected to cause the pulse to be perceptible at the wrist.
5. The worst cases require about six pints.
6. No patient should be allowed to die from severe hæmorrhage without an attempt being made to save by injection of a copious quantity of fluid.
7. In less severe forms of hæmorrhage where the patient is in a low condition, though not pulseless, intravenous injection of several pints (two to five) of saline fluid should be given, to avoid secondary syncope.
8. In the more moderate cases each one must be judged on its merits, but when in doubt it is better to inject; many of these, however, will rally by copious watery injections into the rectum, or by subcutaneous injections into the cellular tissue between the shoulders and other parts.

For those who wish to refer to the literature on this subject I would mention the following:

Kronecker und Sande ('Berliner klin. Wochen.,' December 29th, 1879).

Mikulicz ('Wiener Klinik,' 1883-4).

Schwartz ('Medical Times and Gazette,' 1881).

Jennings ('Transfusion,' 1883).

Herbert Spencer ('Lancet,' June, 1892).



in the year 1776, the Continental Congress declared the colonies independent of Great Britain, and on the 4th of July, 1776, the Declaration of Independence was adopted.

The first step towards independence was the adoption of the Declaration of Independence, which was a statement of the colonies' reasons for separating from Great Britain.

The second step was the adoption of the Articles of Confederation, which was a treaty of union between the thirteen colonies.

The third step was the adoption of the Constitution, which was a fundamental law for the United States.

The fourth step was the adoption of the Bill of Rights, which was a statement of the rights of the people.

The fifth step was the adoption of the Judiciary Act, which was a law that established the Supreme Court.

The sixth step was the adoption of the Federal Reserve Act, which was a law that established the Federal Reserve Bank.

The seventh step was the adoption of the National Bank Act, which was a law that established the National Bank.

The eighth step was the adoption of the National Currency Act, which was a law that established the National Currency.

The ninth step was the adoption of the National Debt Act, which was a law that established the National Debt.

The tenth step was the adoption of the National Tax Act, which was a law that established the National Tax.

The eleventh step was the adoption of the National Customs Act, which was a law that established the National Customs.

The twelfth step was the adoption of the National Coinage Act, which was a law that established the National Coinage.

The thirteenth step was the adoption of the National Mint Act, which was a law that established the National Mint.