THE IMPORTANCE OF ANAESTHESIA BY LUMBAR INJECTION IN OPERATIONS FOR ACUTE ABDOMINAL DISEASES.

By HENRY PERCY DEAN, M.S.LOND., F.R.C.S.ENG.,
SURGEON AND TEACHER OF OPERATIVE SURGERY TO THE
LONDON HOSPITAL.

THE harmful effect of the administration of a general anaesthetic, such as chloroform or ether, upon a patient suffering from an acute abdominal disease, especially peritonitis and appendicitis, has led to many attempts on the part of surgeons to do without this very serious hindrance to success.

Many cases have been reported in which cocaine anaesthesia has been used for this purpose in two ways:

1. Locally, being injected under the skin.
2. Intraspinal injection in the lumbar region.

I have myself tried the first method on several occasions, and as a general procedure it is certainly out of the range of practical surgery. The second method, by injecting small doses of cocaine, generally about $\frac{1}{4}$ gr., into the lumbar spinal canal, has been employed very largely, especially in France. I have seen abdominal operations performed by this method; they were cases in which the anaesthesia required was well below the umbilicus—an inguinal colotomy and a radical cure of hernia. In cases in which there is acute general peritonitis the effect of a dose of cocaine large enough to produce sufficient anaesthesia would be to diminish the already damaged vitality of the patient.

These two methods, therefore, could be applied only in exceptional cases, and could not be looked upon as a regular surgical procedure for obtaining anaesthesia in acute diseases of the abdomen.

The anaesthetic under consideration is the chlorhydrate of one of the amino-alcohols.¹ It has been given the name stovaine. This new body has been examined carefully, and researches made upon it in various directions have already been published.² It can be used in all cases where cocaine is employed; for example, Paul Reclus³ states that he injects stovaine without fear in cases where he used to inject cocaine—that he has been able to perform operations which would not have been possible with cocaine.

Its chief physiological difference from cocaine is that it is a vaso-dilator, not a vaso-constrictor, and, further, it seems to have a tonic effect upon the heart. Hence the vascular system seems to escape all the harmful effects of cocaine.⁴

When the anaesthesia required is situated at a low level, that is, at any place below the groin, the patient's general condition is not likely to make the use of a general anaesthetic a matter of any moment. In such cases, whether stovaine is used or a general anaesthetic is largely a matter for the patient to decide. It is then rather a question of taste, or perhaps I should say, of sentiment.

When, however, we are dealing with acute abdominal disease, especially general peritonitis, the value of stovaine anaesthesia is at once placed upon a different level. It is no longer a matter of sentiment, but a matter of life and death. The harmful influence of a general anaesthetic, such as chloroform or ether, upon acute abdominal diseases is, of course, well known. We all of us are brought face to face with cases of acute peritonitis in which a general anaesthetic would mean death to the patient, either on the operating table or within a short time of returning to bed. Even if the patient escapes from this immediate effect, the subsequent vomiting, etc., often has a large share in exhausting his vitality.

My experience of stovaine anaesthesia by intraspinal injection in acute general peritonitis has impressed me profoundly with the great value of this anaesthetic, and I will now give a short account of some cases in which I have employed this method.

CASE I.

G. K., aged 22, was admitted with acute abdominal pain of four days' duration. On examination, I considered that there was an early stage of general peritonitis, starting from an acute appendicitis. The patient had had four previous attacks. With the help of the sister and nurse, she was gradually put into the sitting posture, and the needle went in without causing her more than a

momentary pain. The patient was given 0.6 c.cm. of the solution, and at the end of seven minutes she was unable to move the right leg, and could only move feebly the ankles and toes of the left. The anaesthesia was perfect up to a level just above the umbilicus, the operation being commenced at the end of eight minutes.

I proceeded at once to make the usual incision over the appendix, using the ordinary gridiron method. The case was a very bad one, the peritoneal cavity being full of pus, and the caecum and appendix in one mass. As the patient's condition before the anaesthetic was serious, I decided not to waste further time in endeavouring to dissect out the appendix. I found it advisable to make a cut in the middle line, about 2 in. long, so that I could thoroughly irrigate the lower abdomen. As soon as I commenced to make the incision the patient called out, saying that I was hurting her, and this continued for the minute that was necessary to get right through to the peritoneum. As I manipulated the wound she cried out, especially when the parietal peritoneum was touched. As soon as the manipulation ceased the patient became quiet, and felt nothing while she was being dressed. The anaesthesia disappeared and the weakness of the legs returned within two hours of the injection. If I could have dissected out the appendix in the usual way the patient would have been back to bed, having felt practically nothing of the operation.

CASE II.

E. C. H., a girl, aged 16, was admitted on the fifth day of her illness with general peritonitis and marked distension of the abdomen. There was no liver dullness and the patient felt and looked ill—in fact, her condition was very grave. This was her first attack.

She was given 0.6 c.cm. of the solution, and at the end of six minutes she had perfect anaesthesia up to just below the transverse nipple line, extending upwards rather more on the right side than on the left. Owing to the condition of the patient, the injection was given while she was lying on her right side. To my inquiry she said she felt the needle as it was inserted, but said that the pain was nothing to complain of. The motor paralysis was almost complete in the lower extremities, the patient being unable to move either leg or foot, but the left toes could be moved slightly. At the end of four minutes the patient began to pass flatus and liquid faeces, and this continued copiously for about three minutes, so that at the end of six minutes the abdomen had become quite flaccid.

I made the usual incision for the appendix, and found that there were no adhesions whatever, but diffused over the whole abdomen there was a quantity of typical peritonitis pus, the pelvis being full of it. The appendix was gangrenous and perforated at one spot. This was removed, the peritoneal cavity thoroughly flushed, and the wound sutured and dressed in the usual way. From beginning to end the patient felt absolutely no pain and no discomfort. She breathed quietly and regularly throughout the operation. The pulse did not vary in rapidity until towards the end of the operation, when it became slower and was better in character. There was a marked and definite improvement in the pulse towards the end of the operation, and this improved condition remained. It was certainly not solely caused by the irrigation with hot water.

CASE III.

A. T., aged 43 years, was a dock labourer, and had had a good deal of abdominal pain on and off for eight days. This had become very intense during the preceding thirty-six hours. When he came to the receiving room he was vomiting every few minutes. This continued at frequent intervals while he was in the ward, and later on when in the anaesthetizing-room—in fact, one vomit took place just as the needle was being inserted, before the actual dose was given. Owing to this vomiting the patient did not feel the prick of the needle. He was given the same dose as the other two patients (0.6 c.cm.). During the succeeding six minutes he vomited at least three times. At the end of seven minutes he was perfectly anaesthetic up to the level of the fifth rib, and he could move neither leg, the only voluntary movement left being slight movement of the toes of the left foot. When the stilette in the needle was being withdrawn, only a

drop of cerebro-spinal fluid escaped, and when pushing the stilette into the needle again, there was still only a drop or two that escaped. The cerebro-spinal pressure was unusually low, owing probably to the grave condition of the patient.

The diagnosis was general peritonitis, and the cause was thought most likely to be appendicitis. I cut down over the appendix in the usual way, and found that, although there was diffused peritonitis, the appendix was not the cause of the trouble. I found that there was a volvulus of the sigmoid flexure. The latter was small, with a short mesentery, so that when obstructed it did not produce that enormous distension so typical of this condition; still, the abdomen was uniformly distended and tympanitic before the dose was given. There was no passage of flatus or faeces.

After I had made the second incision—that over the sigmoid flexure—I noticed that the skin of the abdomen was dusky, and as I was reducing the volvulus, his pulse became very feeble and the breathing very superficial. I quickly opened the distended colon above the obstruction, tied in the glass tube, and finished the operation in two or three minutes. We then tried artificial

may fairly assume that the lower intercostal muscles were slightly affected, so that when the shock produced by manipulating the volvulus became accentuated, the respiratory difficulty became more pronounced. There was scarcely sufficient peritonitis to affect his diaphragm directly. When the duskeness of the skin was at its worst, I could detect no definite action of the diaphragm, so that we may conclude that the reflex effect of manipulating the volvulus, etc., was largely responsible for the failure of heart and respiration. For the first half-hour after administering the dose the patient's anaesthesia remained steady at the level of the fifth rib, being a little higher on the right side than on the left. In favour of the view that the respiratory failure was only slightly helped by the drug is the fact that quite thirty-five minutes expired before artificial respiration was necessary. I have already mentioned that only a few drops of cerebro-spinal fluid escaped, and I think in this fact lies the explanation of the greater effect of the stovaine in this patient. There was not enough cerebro-spinal fluid in the theca vertebralis at the point punctured to dilute the drug sufficiently, so that we probably got a more intense effect with the same dose than in the two preceding cases.

Fig. 1.—Semidiagrammatic section showing termination of the spinal cord at level of upper border of second lumbar vertebra. The theca has been opened and drawn aside (A). Cannula (B). Filum terminale (C).

respiration, together with oxygen. On carefully observing the respiration, I noticed that the lower intercostal muscles were acting very feebly. After a few minutes we ceased the artificial movements, and I then noticed that the upper intercostals of the extraordinary muscles of respiration were in action. The pulse being still very weak, we resumed the artificial respiration and the administration of oxygen. After about twenty minutes the colour of the skin became much better, but still one could only just feel the pulse at the wrist. We then transfused into the internal saphenous vein three pints of normal solution in the usual way, and to the fourth pint I added an ounce of brandy. By the time half this quantity was injected the pulse began to improve, and finally, in about an hour, the patient was breathing well, with all the intercostal muscles acting and the pulse very much better than it was before the operation. The patient was put to bed and continued in a good condition for several hours. He then began to show signs of cardiac failure, and died some nine hours after the operation.

I am not quite sure how far the stovaine was responsible for the respiratory failure. The bad symptoms did not appear until the patient had been under the anaesthetic for about half an hour, and only became dangerous while I was trying to untwist the volvulus. In order not to minimize the danger of intercostal paralysis, I think we

Fig. 2.—Semidiagrammatic section showing disc between third and fourth lumbar vertebrae. (A) The theca, which has been punctured by (B), the trocar and cannula, shown lying among the bundles of the corda equina; (D) points to a star showing the interval between the laminae of the third and fourth lumbar vertebrae.

If I met with the same condition again, where only a drop or two of cerebro-spinal fluid escaped, I should at once dilute the stovaine with an equal part of physiological solution before injecting it, and I should make a point of injecting very slowly.

CASE IV.

S. N., a youth aged 16, was admitted with marked signs of general peritonitis, probably arising from appendicitis. There was considerable distension of the abdomen, the skin of the abdomen showing the typical mottling associated with acute septic peritonitis. The illness commenced seven days previously; it was the patient's first attack.

He was given 0.6 c.cm. as a first dose, but owing to an accident when injecting the solution we were afraid most of it was lost. We waited for seven minutes, and, finding the effects were very slight, I put in a further dose of 0.4 c.cm. At the end of seven minutes the effect of this was that anaesthesia was definite only up to the middle of the thigh. I then put in another 0.4 c.cm. After the first dose the cannula was not withdrawn, so that the subsequent doses were injected without the patient feeling anything whatever. After waiting another five minutes, making nineteen

minutes from the commencement, the proper degree of anaesthesia was obtained, sensation being lost up to a line drawn just above the ensiform cartilage. Soon after the third dose was injected the patient commenced to pass flatus and liquid faeces, and at the end of five minutes so large a quantity had been passed that the distended abdomen became quite flaccid.

Although this gradual method was rather tedious, we were more than rewarded by the complete success obtained. The patient felt absolutely nothing during the operation. The appendix was completely gangrenous and there was general peritonitis, the pelvis being full of typical peritoneal pus. Up to the time the wound was stitched, drained, and the dressing applied, the patient felt nothing whatever. He did not even complain of anything being pinched. The pulse gradually improved during the progress of the operation, and at the end all observers agreed that it was distinctly better than at the commencement. I could not detect the least degree of shock, either during the operation, at the end of it, or when the patient had returned to bed.

The following cases, Nos. v and vi, were not acute ones, and were not wholly abdominal. The stovaine anaesthesia

Fig. 3.—Sketch of the lower dorsal and lumbar spinal column, showing the laminae in the dorsal region overlapping, and the intervals between the laminae of the lumbar vertebrae. (E) The highest point of the iliac crest on each side. (D) Points to a star at the place where the puncture is usually made.

produced, however, had some interesting features, so that I am including them in this list.

CASE V.

A young man, aged 21, had a tumour on the right side of the scrotum, which was thought to be a hydrocele, secondary to some disease of the testicle. This patient was given 0.6 c.cm. The piston of the glass syringe fitted the barrel very loosely, so that when holding it ready filled for use a few drops of the solution were lost, and therefore I do not think we can say he had more than 0.4 c.cm. At the end of three minutes the patient began to pass flatus and liquid faeces. At about the end of seven minutes the skin of the thigh was practically insensible, and a minute or two later there was partial anaesthesia of the scrotum. I decided to commence the operation, and made an incision about 4 in. long over the scrotal tumour. The actual cutting was not felt by the patient, but he complained throughout the remainder of the operation of being pinched or pushed, but never of anything like a prick or a cut. I opened the tunica vaginalis, let out the fluid, cut away a portion of the sac, and then sutured the wound, and dressed it in the usual way. Although the patient complained a good deal of being pulled and squeezed, yet he admitted when it was all over that he had suffered no real pain, and that his complaints were due to the fact that he thought every minute he was going to be "badly punished."

CASE VI.

The next case was also scrotal tumour (about the size of a Jaffa orange), in a man aged 40. The diagnosis was doubtful, so I decided to make an exploratory incision. The patient was injected with first 0.6 c.cm., and this time not a drop of fluid was wasted. At the end of seven minutes the patient's anaesthesia was complete, so that I was able to proceed to operate without his feeling anything.

The exploratory incision showed that it was a case of sarcoma of the testicle. I prolonged the incision upwards and outwards towards the abdominal wall, parallel with the inguinal canal, and terminating just above the external to the internal abdominal ring. In order to get rid of any secondary deposits in the spermatic cord, I slit up the inguinal canal and followed

the constituents of the cord well up into the abdomen. I ligatured the vessels without the patient making any sign. I then identified the little artery to the vas deferens and picked it up with the artery forceps. The patient moved a little, saying that he felt a twinge, and that was the only sensation he had during the whole of the operation. I followed the vas some distance and then divided it. In removing the malignant mass I cut away a great deal of the surrounding tissue, together with a large piece of the skin of the scrotum. I then decided to explore the lymphatic glands and vessels in the groin. An incision was made from the upper end of the former one, downward along the line of the femoral vessels for about 4 in. I took away the fat and the lymphatics right down to the fascia lata in the area exposed by this wound. The two wounds were then sutured and dressed in the usual way.

At the end of the operation the two skin incisions measured 17 in., and the superficial area of the wound underneath was very large. The patient talked and was quite comfortable during the whole operation, which lasted about forty-five minutes. He had no idea of the kind of operation that was being performed, thinking we were probably "drawing off some fluid from his purse." The wound in this patient was one of the largest I have ever met with in removing a growth of the testicle, and with general anaesthesia I should have expected a fair amount of shock. In this case, not only was there no sign of shock during the operation, but, if anything, the patient's general condition seemed better than at the commencement. His pulse certainly had more tone in it when the dressing was completed. This excellent condition was maintained after the patient was put to bed, so that we may say that he was in some way or another protected from surgical shock. If this case stood alone one might conclude that the man's constitution was one in which surgical shock was not easily produced, but from my experience of the acute abdominal cases I certainly think we were justified in concluding that stovaine anaesthesia protects the patients from surgical shock more than any form of anaesthetic or of antishock precaution that I have ever employed. Removal of the testicle and spermatic cord, especially when done thoroughly, is, in my experience, usually associated with a considerable amount of shock. This patient did not have any action of the bowels during the administration of the stovaine or afterwards.

Before describing the method I recommend, it will be as well to give the procedure that has hitherto been employed in intraspinal injection of this anaesthetic.

1. Lumbar Puncture.

With a rather small trocar and cannula the lumbar spinal canal is entered between two lumbar vertebrae, generally the third and fourth. This point is usually upon a line drawn transversely across the back from one iliac crest to the other. If the patient is in the sitting posture with body well bent forward it is quite easy to get through the interval at this level. If, however, the patient is too ill to sit up it is not quite so easy to enter this spot, because the patient lying on one side cannot so easily flex the spine. Again, if the patient is at all nervous, there is a tendency to move the lumbar spine forward. If this happen just as the trocar is going through the deeper structures one may easily miss the interval.

On one occasion this difficulty occurred to me. In this instance the only trocar available was much larger than I had used on former occasions, and as the patient was very nervous she jerked forward just as the trocar was passing through the tissues. For some reason or another I could not enter the theca vertebralis, and so I removed the trocar, and the patient was given chloroform in the usual way. I am sure that I perforated the ligamentum subflavum, and in all probability the trocar was lying between this ligament and the theca. This is especially likely to occur if the trocar is not a sharp one, and with a large trocar it is not so easy to perforate such a structure as the theca as it would be with a smaller instrument. If a trocar and cannula long enough for the stoutest patient were used for all cases there would be an awkward length of cannula projecting between the syringe and the skin, so that it is best to have trocars of three lengths suitable for men and women respectively; there is considerable disproportion between different individuals in the distance between the skin and the theca vertebralis.

2. The Dose.

The minimal dose of stovaine that can be given without fear of respiratory paralysis is half the ordinary capsule, that is, 0.5 c.cm. of the solution (0.05 gr. of the salt). If the anaesthesia is required low down in the leg, quite a small dose, often as little as 0.3 c.cm. of the solution, is sufficient. With even less than the full amount in a capsule, for example, 0.6 c.cm., there is produced very

often sufficient intercostal paralysis seriously to hinder respiration.

Sonnenburg⁵ reports a number of cases, among which the abdominal operations are: incision for appendix abscess, and an incision for the operation of appendectomy and gastro-enterostomy; there was no case of general diffuse peritonitis. Sonnenburg gives 0.6 c.cm. as a first dose, and if the patient is not sufficiently anaesthetic in eight minutes, he gives another dose, using the trocar again; he does not say the amount of the second dose. Chaput⁶ gives 0.4 as the first dose, and a subsequent dose of 0.3 at the end of ten minutes, if necessary. The patient is again moved on his side for the injection.

3. Anaesthetizing Period.

The anaesthesia commences with a numbness of the perineum, feet, and legs in about three minutes from the injection. By the end of five minutes the patient is usually unable to lift either leg, but may move the toes or even ankles. Within seven minutes he is usually anaesthetic up to the groin and in the scrotal and perineal regions; and the maximum effect is nearly always produced, whatever the amount of the dose, in ten minutes. If by this time sufficient anaesthesia has not been obtained, some surgeons have at once resorted to a general anaesthetic rather than insert the trocar again and give another dose. My own experience has led me to modify certain details in the method I have just described.

GRADUATED DOSAGE.

The first point of interest is that the same amount (0.6 c.cm.) was given in one dose to Case I and Case III, the two patients being operated upon within an hour of each other. This divergence of effect is only what one would expect on *a priori* grounds. If the same dose could be relied upon to produce the same effect in all patients, stovaine would differ from all other drugs with which we are acquainted. In these acute cases it is very difficult to estimate the amount that will be required to produce complete anaesthesia, and, owing to the danger zone of intercostal paralysis being near the limit of the anaesthesia required, it is necessary to feel one's way. I consider that it is of paramount importance in cases in which the anaesthesia has to reach the level of the upper abdomen to commence with a minimal dose and to be prepared to gradually increase it if necessary. This means that it is necessary to keep the cannula in until the maximum effect has been produced. Unless we have some means of finding out the amount of the dose beforehand, the method of gradual injection is imperative in acute cases of this kind. I commence with a dose of 0.6 c.cm. as a minimum; and if at the end of seven minutes it is obvious that the dose is too small, an extra 0.3 c.cm. should be given until the extent of the anaesthesia required is obtained. This is the only way at present to avoid the danger zone of intercostal paralysis. The extra time taken to obtain a safe and definite amount of anaesthesia does, of course, demand extra time and effort from every one concerned, but in these grave cases the gain of avoiding the general anaesthetic is very great; in fact, this extension of time has this important advantage—that if the bowels are opened within the first few minutes after the injection of the dose, and this seems to be a very constant result, it gives time for the assistants to clean up the patient ready for the operation. This gradual method is the only safe way of producing sufficient anaesthesia for acute abdominal diseases. In this way alone can we take precautions against being suddenly face to face with temporary paralysis of the intercostal muscles (see Case III). Although the diaphragm is not affected by the stovaine until the cervical cord is reached, yet in cases of acute peritonitis its action is often much interfered with, partly reflexly and partly by direct extension from the inflamed peritoneum.

Doses during Operation.

In Case I we see a complication which, of course, one might expect—namely, that after a certain interval the anaesthesia tends to disappear. Even if we could foretell the exact length of an operation it would be practically impossible to judge beforehand the exact amount of the drug necessary. For about twenty-five minutes the anaesthesia in this patient was perfect, so that if I could have finished the operation after making the first wound

she would have felt nothing. As, however, it was necessary to make another incision in the middle line at the time when the patient was beginning to lose the anaesthesia, it would have been convenient to give another dose. To meet this difficulty I have arranged my apparatus so that the cannula can be left in during the whole of the operation, and therefore a small dose could at any moment be injected without hurting or, indeed, scarcely moving the patient.

Doses after Operation.

There is another aspect of this subject, though I have not yet had enough evidence to arrive at any definite conclusion, and that is the value of stovaine anaesthesia during the post-operative treatment of the patient. It is quite possible that any recurrence of pain or abdominal distension might be dealt with by another dose of this anaesthetic.

Surgical Shock.

The next point that naturally requires attention is the relation of stovaine anaesthesia to surgical shock. When chloroform and ether anaesthesia were first employed it was thought that surgical shock would probably be enormously diminished when operating upon a patient who was quite insensitive to the surgeon's knife. Experience, however, showed that this was by no means the case. Surgical shock in the ordinary sense of the word was on the whole not much affected by the administration of chloroform or ether. In the pre-anaesthetic days the sudden shock produced by the first incision sometimes killed the patient at once by reflex cardiac inhibition. When the patient is sufficiently under a general anaesthetic this form of shock practically never occurs.

The remarkable feature of intraspinal stovaine anaesthesia is that surgical shock seems to be avoided. Patients with acute septic peritonitis, having extensive wounds inflicted upon the abdominal wall, with manipulation of inflamed viscera and flushing of the peritoneal cavity seem little if at all affected. All of us who saw these cases were impressed with the extraordinary calmness with which the patients stood the whole operative procedures.

In the literature of stovaine anaesthesia, the absence of shock has been commented upon, but operations upon the lower extremities do not afford a good test of this question, unless the operation is a very serious one, such as amputation through the upper third of the thigh or at the hip-joint. I have not yet come across any records of amputations with stovaine anaesthesia at this level.

Although aware of the fact that stovaine seemed to protect the patient from shock in operations upon the legs, I certainly was not prepared to see patients with acute general peritonitis protected in the same manner. I think, therefore, we may with confidence state that in all the stages of stovaine anaesthesia, from the smallest degree up to the maximum limit, the patient is largely protected from the effects of surgical shock.

From a consideration of this aspect of the question, one can foresee that the benefits of rapid and precise operating will be more apparent in these cases than in those operations performed with a general anaesthetic. In the latter cases it is so difficult to estimate the amount of shock produced because of the confusion brought about by the effect of the ether or the chloroform upon the nervous and vascular systems, so that the extremely rapid operating of the pre-anaesthetic days was gradually dropped for more deliberate and slower methods; indeed, the swing of the pendulum seemed to go to the opposite extreme, and with general anaesthesia the surgeon seemed to think that rapidity of operating meant want of thoroughness. With stovaine anaesthesia the appearance of surgical shock would probably indicate either that the effect of the anaesthetic was wearing off, or that the duration of the operation was in itself becoming a danger. Very often these two conditions might be at work at the same time.

Description of Apparatus Used.

Any form of trocar and cannula or exploring needle of small bore can be used if it is desired to evacuate only a certain amount of the fluid. If, however, we wish to inject something into the spinal canal without wasting a single drop, it is better to use an apparatus that has been designed for that purpose. If a large trocar and cannula of the type used for tapping a hydrocele is used it may cause a good deal of pain when inserted, so that the

patient may arch the back forwards and render it difficult to hit the interval between the two vertebrae; further, these large trocars do not penetrate the softer structures so readily as the small ones, and hence may fail to perforate the theca itself; the trocar then lies between the ligamentum subflavum and the theca.

It is quite open to discussion whether trocar and cannula or an exploring needle with its stylet is the better instrument for the purpose. One is often struck with the fact that the softer tissues seem to cling to the cannula, taking a good deal of force to push it into the tissues and to pull it out again. This objection does not seem to be so marked with the exploring needle. In either case it is advisable to lubricate the instrument with a little sterilized glycerine or oil. I lay stress upon these points because some persons when ill feel even a small prick very intensely, and the pain seems to last after the cannula is at rest; and therefore it is most important to employ a method which gives a minimum of pain, although the latter may be only of momentary duration. Freezing the skin of the back has the objection of hardening the skin, so that a great deal of force may be necessary to penetrate it, and this is felt by the patient.

If it is contemplated to inject one dose only, a simple trocar and cannula or exploring needle is all that is required. It would not be difficult to protect the part sticking out from the skin, so that it is not pressed upon during the time the patient is on the operating table. It is the terminal portion inside the spinal canal that might cause damage if there were unusual movement on the part of the patient or any extensive movements like that for artificial respiration should be necessary. To meet this difficulty I have designed a cannula which would be flexible, and its end would be rounded off so that no damage would be done in a sharp edge coming against any nerve or vessel in the theca. I think it will be possible to leave the flexible cannula in position. This, however, is an aspect of the question that further experience alone can decide.

The syringe used has to meet two requirements. It must be, of course, easily sterilized; secondly, it must be of sufficient capacity to hold at least 3 to 4 c.cm. of the solution. It is necessary to have one of this size at least, for the following reason: when the cannula is in position and the fluid escaping the pressure is generally sufficient to force back the piston and so to dilute the stovaine with the cerebro-spinal fluid before the former is injected. As the cerebro-spinal fluid approaches in quantity that of the solution a turbidity appears. The piston is then pushed gently along until all the solution has passed through the cannula into the spinal canal. The graduated syringes with the glass piston have the advantage that the cohesion of the two glass surfaces is slight enough to allow the cerebro-spinal pressure to push back the piston. I do not myself think that this piston needs to be pushed back necessarily by the cerebro-spinal fluid, providing the operator gently pulls the piston back himself, taking care that the cerebro-spinal fluid is not sucked in forcibly. These glass syringes are easily broken and rather expensive. It is unwise to insert the glass nozzle into the cannula direct, because there is a great tendency for it to break. I have had made some small rubber nozzles which at one end are funnel-shaped, so that they can fit on to the glass nozzle of the syringe. The other end is made to fit on to the cannula. In this way the glass syringe is much more easily handled, and the risk of chipping the glass nozzle is avoided. Further, this rubber tube is easily detached from the syringe and then clipped so that the cerebro-spinal fluid is prevented from escaping.

DANGERS AND COMPLICATIONS.

Sonnenberg⁵ reports a case in which the patient died a few days afterwards, and purulent cerebro-spinal meningitis was present. As the patient was suffering from general pyaemia, the relation of the stovaine anaesthesia to the meningitis may not have been direct. In many cases patients have a little headache coming on as soon as the operation is finished, but this generally disappears in a few hours. It would be very surprising if this form of anaesthesia had no drawbacks, and if there were no mortality that could be attributed directly to the method of the administration of the drug, or to the drug itself. It seems, however, definitely proved that whatever the

dangers may be, the mortality is by no means so large as with the general anaesthetics.

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ON THE [SPIROCHAETA PALLIDA AND ITS VARIATIONS.

By ALEX. MACLENNAN, M.B., C.M.,

DISPENSARY SURGEON, WESTERN INFIRMARY; EXTRA HONORARY SURGEON, ROYAL HOSPITAL FOR SICK CHILDREN; VISITING SURGEON TO THE TRAINING HOME FOR NURSES, GLASGOW.

IN the BRITISH MEDICAL JOURNAL of February 3rd of this year there appeared a preliminary note regarding the *Spirochaeta pallida* and the *Cytorrhycles luis* (Siegel); the views there expressed are stated in full in this paper. Altogether over fifty syphilitics have been examined. In most of them the sore, the secondaries, the glands, and the blood were examined by making from four to ten film preparations. Each set was examined by various methods, stains, etc., but generally it was found that the method of fixation or the stain employed did not make any difference, as where spirochaetes were present they were demonstrable by all the methods. Forty of the series were females, and in them the positive results regarding the *Spirochaeta pallida* were comparatively few (eight positive), while in all the cases examined the smaller bodies about to be described, and similar to those described by Siegel, were found. Two glands were dissected out, and numerous films examined, without finding a single spirochaete, while the smaller bodies were found readily. In one instance the *Spirochaeta pallida*, along with the smaller bodies, was recovered from the urine, being found in the smear from the centrifugalized deposit.

The failure to find the *Spirochaeta pallida* in every case was not due to defective technique, because where the organism was found at all it was found deeply stained enough to be readily seen. In any case the *Spirochaeta pallida* is not found in numbers commensurate to the severity of the lesion. Attention has been drawn to this feature of the matter by various workers, and leads one to infer that it is not present always or equally susceptible to stain. There can be no doubt that this organism stains more readily at one time than another, but even taking this into account, its small representation in the lesion suggests another explanation for the severity of the trouble. In a film populated by every imaginable organism it is hardly reasonable to take the scarcest though one of the most striking organisms present and label it specific. It may be taken for granted that: (1) Syphilis is caused by an organism; (2) the organism, whatever be its nature, exists as such in all the primary and secondary lesions in vast quantity; instances of the subtlety and power of the contagion must recur to everyone, whilst the scarcity of the *S. pallida* makes one pause in accepting it as the only or real cause of the disease.

The difficulty in demonstrating an organism may be due to (a) its disinclination to take up stain; (b) its excessive minuteness; to its presence in the lesions varying (c) in numbers or (d) in form.

Staining.

There can be no doubt that the *Spirochaeta pallida* is difficult to stain and requires special methods. This having been recognized, there is now no difficulty in getting the organism to take up the requisite amount of dye to render its presence visible. Further, it is probable that the staining capacity of *S. pallida* varies. This may be due, at least in part, to the nature of the medium in which it lies. If the fluid is highly albuminous, the medium becomes fogged before the organism stains.

With other workers gentian violet has given satisfactory results, and in my own preparations I have used it with perfect success. Unfortunately, however, the stain fades. The first stain was a very old saturated solution of