cystic duct and subsequent infection in the gall-bladder. Although neither ova nor worms were found, it is probable that if they were present they would have undergone disintegration in the pus.

5. In view of the numerous cases reported in which small worms have been found in the common duct, we would advise that the common duct be opened and examined in all cases of gall-bladder disease associated with *Ascaris lumbricoides*.

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CONTROLLABLE SPINAL ANAESTHESIA:

SOME RECENT EXPERIENCES WITH SPINOCAIN SPINAL ANAESTHESIA.

BY

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STIMULATED by the experience of several American surgeons who have been using spinocain spinal anaesthesia with success, and by the statement by Dr. Frank A. Kelly¹ that "all textbooks on spinal anaesthesia will have to be rewritten, as a result of the epochal work of Dr. George Pitkin," we decided to try spinocain in a varied number of cases at the Norfolk and Norwich Hospital, and to investigate the advantages claimed for this anaesthetic by Drs. Pitkin and Kelly at the recent meeting of the British Medical Association at Manchester.

All the cases were under the charge of Sir Hamilton Ballance, senior surgeon to the hospital. We have used spinocain in thirty-four cases in all. With the exception of the first one or two we have been agreeably impressed by the anaesthesia obtained and particularly by the comparative absence of toxic symptoms, noticeably of any serious degree of shock and other post-operative complications. Almost all the cases have suffered from some pulmonary, cardiac, or other complication contraindicating a general anaesthetic, and a few have been in such a serious condition that the operation would have been associated with serious risk if performed under general anaesthesia. Our

experience has been confined to adults—eighteen females and sixteen males. We have not yet had any children in which spinal anaesthesia was indicated.

List of Cases.

1. Male, aged 65. Intestinal obstruction due to peritoneal bands.
2. Female, aged 19. Skin graft of leg.
3. Male, aged 68. Strangulated inguinal hernia (radical cure).
4. Female, aged 37. Intestinal obstruction (caecostomy).
5. Female, aged 35. Amputation of cervix.
6. Male, aged 44. Cystoscopy.
7. Male, aged 33. Skin graft.
8. Female, aged 72. Appendix abscess.
9. Male, aged 65. Right-sided colectomy for neoplasm of caecum.
10. Male, aged 62. Extensive anal fistula.
11. Female, aged 24. Carcinoma of stomach (jejunostomy).
12. Male, aged 78. Suprapubic prostatectomy.
13. Male, aged 23. Manipulation of Pott's fracture, and plaster.
14. Female, aged 36. Myomectomy.
15. Female, aged 49. Cholecystectomy.
16. Male, aged 59. Sliding bone graft of tibia.
17. Female, aged 60. Strangulated femoral hernia (resection of small intestine).
18. Male, aged 35. Psoas abscess.
19. Male, aged 73. Suprapubic prostatectomy.
20. Female, aged 50. Colpoperineorrhaphy.
21. Male, aged 63. Radical cure of inguinal hernia.
22. Female, aged 18. Lengthening of tendo Achillis.
23. Female, aged 55. Cholecystectomy and appendicectomy.
24. Female, aged 54. Subphrenic abscess and suppurative cholecystitis.
25. Female, aged 23. Hammer-toes.
26. Female, aged 41. Cholecystectomy and choledochotomy.
27. Female, aged 50. Subtotal hysterectomy.
28. Male, aged 62. Reduction of fracture tenotomy of tendo Achillis.
29. Male, aged 55. Fistula in ano.
30. Female, aged 54. Tumour of colon (colostomy).
31. Male, aged 55. Double inguinal hernia.
32. Male, aged 70. Suprapubic prostatectomy.
33. Female, aged 52. Carcinoma of colon (right-sided colectomy).
34. Female, aged 47. Strangulated femoral hernia.

It will be seen from the above list that the cases, if not numerous, are at least varied, and in every case but one we were able to perform the operation without the aid of a general anaesthetic and without undue anxiety about the patient's condition.

The longest period of anaesthesia was in a male aged 65 (Case 9). The patient had severe myocarditis, but though the operation lasted two and a half hours he stood it well. He died nine days later from a heart attack. Another case which shows well the length of anaesthesia which can be expected is No. 17. The patient had a strangulated femoral hernia of four days' duration, and the operation, involving resection of gut and radical cure of hernia, lasted two hours and five minutes. This patient was in a very serious condition on admission, yet she gave no anxiety during the operation. These two cases and others in which the operation lasted over two hours serve to show that, provided sufficient spinocain is given, there need be no fear of the anaesthesia passing off.

In the above list there have been three deaths, none of which could be attributed to the anaesthetic. There has been no case of severe post-operative toxic symptoms. A few patients have vomited a little during the first twelve hours, and several have complained of slight headache and stiffness in the posterior muscles of the neck; apart from these, the convalescence has been smooth, and almost all who have experienced a general anaesthetic previously declare their preference for the spinal anaesthetic.

In our first few cases, while we had 100 per cent. successes in operations upon the perineum and lower extremities, there was considerable difficulty in gaining anaesthesia above the umbilicus sufficient for an abdominal operation of any length. This difficulty has, however, been easily overcome, as will be shown later.

Spinocain appears to have a selective action, the patient feeling some vague sensations of touch, but yet not complaining of any pain. Sensory fibres conveying temperature and touch are undoubtedly less affected than those conveying pain, the latter being completely paralysed along with all motor nerves below the spinal block.

Technique of Spinal Injection.

With a few important modifications we have followed the technique devised by Dr. Pitkin, and used needles of 20 and 22 gauge, which undoubtedly traumatize the spinal theca less than the ordinary lumbar puncture ones. These needles have an accurate bayonet-fitting joint with the Pitkin syringe, which is made in three sizes to contain 2, 3, and 4 c.cm. of solution. We have confined ourselves to the solution of light spinocain of specific gravity of 1005, containing 200 mg. of novocain and 2.2 mg. of strychnine sulphate, dissolved in 2 c.cm. of a special solvent consisting of alcohol 14.5 per cent. and sterile water, with the addition of amylo-prolamine, which is supposed to prevent diffusion of the anaesthetic fluid. In conjunction with the above we have used the ephedrine-novocain ampoule of 1 c.cm. containing 10 mg. of novocain and 50 mg. of ephedrine, these being the two solutions used by Dr. Pitkin and manufactured by the Metz Laboratories of New York. Following upon an article by Dr. Falkner Hill² we have also used planocain, manufactured by May and Baker, which is really strychnine-free spinocain, and theoretically would appear to be better, the strychnine tending, as Dr. Hill has stated in his article, "to break down the internal resistance of the spinal cord, so that a definite stimulus tends to produce a bigger motor response than in normal conditions."

Following the usual preparations for an abdominal operation, the patient is brought to the anaesthetic room half an hour before the time for the operation, and an injection of omnopon 1/2 grain and hyoscine hydrobromide 1/100 grain given, which serves to allay fear or apprehension. The injection is given in the usual position, the patient lying on his side, the knees being drawn well up and the neck flexed forward. The contents of the ephedrine-novocain ampoule are used to anaesthetize the path down to the spinal theca. A fine-bladed scalpel is then passed along the anaesthetized route, and this, we have found, breaks down the resistance of the ligamentous structures, enabling the spinal puncture needle to pass down to the theca without using the slightest force, and the dura can be punctured with ease. We usually inject between the second and third lumbar vertebrae, though, provided one keeps to the lumbar region of the spine, the actual site does not seem to matter. The patient should feel no pain at all.

Mixing the solution with the cerebro-spinal fluid, to the extent recommended by Pitkin, we have found tends to diminish the depth and length of the subsequent anaesthesia and also to delay the start; hence, once the cerebro-spinal fluid appears, we draw up 1/2 c.cm., slowly inject the mixture of spinocain and cerebro-spinal fluid in the syringe, but before the last 1/2 c.cm. is injected, again draw up a few drops of cerebro-spinal fluid and complete the injection. We believe this is better than alternate aspirating and injecting, as in some of the earlier cases in which this was done often ten to twelve minutes elapsed before the operation could be started. Since we have used the technique just described the onset of anaesthesia has been immediate, or, at any rate, as rapid as with stavaine. Prior to the injection the so-called tiltometer is attached to the table, and the degree of tilt necessary can be adjusted.

In the case of an abdominal operation where a mid-line or paramedian incision is being used, the patient is immediately turned on his back. In the case of a hernia, or an operation on an extremity, the patient is kept on his side with the operable site uppermost for five to seven minutes, hemianaesthesia being thus obtained. Spinocain having a lower specific gravity than the cerebro-spinal fluid, the patient lies on the opposite side to the incision, exactly the reverse to stavaine (heavy solution).

Dosage.—We consider that a dose of 2 c.cm. of spinocain, unless the operation be a short one, is inadequate. Dr. Pitkin stated that 400 mg. of spinocain, equivalent to 6 grains of novocain, could be given with impunity, and we have found that anything from 2.5 c.cm. up to 3.2 c.cm., varying with the length of anaesthesia required, the state of the blood pressure, etc., can be given with safety. Our average is 3 c.cm., equivalent to 4½ grains of novocain, and with this amount anaesthesia up to two hours can be obtained, and the onset is also much more rapid.

The Blood Pressure.

According to Pitkin and Kelly,¹ spinocain does not cause any considerable fall in blood pressure, provided sufficient ephedrine is given beforehand. We cannot altogether subscribe to this statement, for in spite of the injection of 50 mg. of ephedrine a very considerable fall may take place. A patient with a systolic pressure of 160 mm. of Hg before the spinal injection is given may, a quarter of an hour afterwards, register only 70 mm. of Hg. According to Hill² the fall in blood pressure is very variable, and there may be no fall even in the event of the anaesthesia reaching the second dorsal root. We have not found this so, there being usually a considerable fall, even when the anaesthetic agent reaches the fourth dorsal root.

Kelly states that "if the spinocain is allowed to run up to the second dorsal root, all the vasomotor nerves will be paralysed, and a considerable fall in blood pressure will result." We frequently have anaesthesia up to the nipple level, which corresponds roughly to the fourth dorsal root, and in such instances the fall in blood pressure is very variable, being sometimes great and at other times slight—that is, it may fall as much as 100 mm. of Hg or only 10 or 20 mm. of Hg. Hill suggests that the variability of the fall may be due to the posterior nerve roots only being anaesthetized, and not the anterior; the vaso-constrictors thus escaping. It is difficult to see how this can be when it is remembered that spinocain is lighter than cerebro-spinal fluid. One would expect the solution to float to the surface when the patient is lying on his back, and so to affect the anterior nerve roots as well as the posterior. Suffice it to say that a considerable fall in blood pressure may take place, and certainly the addition of strychnine does not appear to prevent it. We agree with Dr. Hill that "the last word has not been said on this question": it is certainly difficult to explain the variability of the fall in these high anaesthesias.

Undue stress appears to have been laid on the fall of blood pressure. It is usually only transient, being greatest during the first half-hour, and from this period onwards it usually rises slowly, and at the finish may be only little below the original reading. In the event of its falling to 70 mm. of Hg we usually inject another half-grain of ephedrine and lower the head of the table, and this usually causes it to rise slowly. We have not seen any patients become nauseated or restless as a result of lowered pressure, and apart from some pallor of the face they do not seem to be affected to any great degree. It would appear that the toxic symptoms of nausea and collapse, which were at one time attributed to the fall in blood pressure in stavaine anaesthesia, are at least in part due to the much greater toxicity of stavaine; they are certainly absent in spinocain anaesthesia, and there is no reason to fear this early fall in blood pressure.

Controllability of Anaesthesia.

Dr. Pitkin states that if the table be lowered to a 5 degree Trendelenburg position following administration, anaesthesia reaching up to the costal margin will be obtained thereby. We had at first considerable difficulty in obtaining anaesthesia above the umbilicus, sufficient for a simple coeliotomy, following the injection of 3 c.cm. of spinocain, even when the table was placed with the tiltometer at zero. It would appear that to gain anaesthesia up to the fourth or fifth dorsal root the fluid would require to run towards the head—that is, downwards—owing to the convexity of the dorsal spine when the table is level as shown by the tiltometer. This is supposed to be impossible. Dr. Hill states that if 2 c.cm. of spinocain is injected into the lumbar region with the patient in a 5 degree Trendelenburg tilt, "there may be anaesthesia running downwards from an inch below the nipple level; or only from an inch below the umbilicus." We have not found this so; as a general rule we have not been able to get adequate anaesthesia to the costal margin with 2 c.cm. when there has been such a 5 degree tilt.

It was this difficulty that finally induced us to put the patient in the reversed Trendelenburg position and allow the fluid to run up to the dorsal area of the theca. We now give the injection with the patient on his side and with the table in a 7 to 10 degree reversed Trendelenburg position. We have found that 3 c.cm. given thus produces

a perfect anaesthesia with good muscular relaxation sufficient for any abdominal operation. With the adoption of this position for the injection it is important to keep the head and upper cervical area lowered; this can be done with safety by placing the shoulders on a level with the cephalic joint of the table, and by lowering the headpiece. This simply means that during the injection the thorax is raised 7 to 10 degrees, but the head and neck are dropped; and this position, with the head dropped after the patient is turned on his back, is maintained throughout the operation. In the event of a fall of blood pressure taking place, or should the operation require it, the table can be placed level, or even in the Trendelenburg position after ten to fifteen minutes; this does not appear to affect the anaesthesia, the solution being apparently fixed after this period of time. We have not found the controllability to be as accurate as Dr. Pitkin would lead one to believe: in the case of an extremity, however, the anaesthesia can certainly be confined to the lower reaches of the cord by using a sufficient tilt, say 12 to 15 degrees.

Duration of Anaesthesia.

Dr. Hill states that "duration is a variable quantity." Possibly it is, if only 2 c.cm. be used, but if 3 c.cm. be given there is no fear of the anaesthesia passing off under $1\frac{3}{4}$ hours. Since adopting the reversed Trendelenburg position we have frequently had anaesthesia lasting $2\frac{1}{4}$ hours, and no case has required general anaesthesia to finish off with.

Comparison with Other Spinal Anaesthetics.

We have had no experience in using percaine or a 10 per cent. novocain normal saline solution. Prior to the introduction of spinocain we have employed Barker's solution of stovaine as a routine. Dr. Howard Jones (*Lancet*, January 25th, 1930, p. 211) seems to be unnecessarily severe in his criticism of the Pitkin method. We have found spinocain to be superior in many ways to stovaine; true, the muscular relaxation may not be so good, but this is more than counterbalanced by the absence of toxic symptoms, so often seen with stovaine, by an increased measure of safety, and lastly by an increased duration of anaesthesia.

Summary.

We regard spinocain as a distinct advance in spinal anaesthesia. Whether the addition of amylo-prolamine is of importance in preventing too rapid absorption of the novocain or not we cannot say; we have certainly found it an ideal spinal anaesthetic which can be given to patients in a critical condition, with little or no fear of a catastrophe. Age does not appear to be any bar, and some of our best results have been in old and enfeebled patients in whom only a local or regional anaesthesia would have been permissible. We regard the most important points in connexion with it to be:

1. A preliminary injection of omnopon and hyoscine half to three-quarters of an hour before the operation.
2. An accurate technique during the spinal injection, which should be painless.
3. Comparatively little mixing of the solution with the cerebro-spinal fluid.
4. For upper abdominal work a 7 to 10 degree reversed Trendelenburg position of the table during the injection.
5. Close attention to the blood pressure readings throughout the operation.
6. Adoption of the Trendelenburg position in the ward for some two hours following upon the operation.

Provided the above details are attended to we are confident that a safe and lasting anaesthesia can be obtained, sufficient for any present-day abdominal operation.

I am greatly indebted to Sir H. A. Ballance for permission to publish these cases, and for his kindly help and criticism of this article.

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- ¹ Pitkin and Kelly: Spinocain, the Controllable Spinal Anaesthetic, *British Medical Journal*, August 3rd, 1929, p. 183.
- ² E. Falkner Hill: Spinal Anaesthesia, *Lancet*, January 18th, 1930, p. 124.

REMARKS BY SIR HAMILTON BALLANCE.

Additional cases of operation under spinocain and planocain anaesthesia have been performed since the above was written, bringing the total to 50 with uniformly satisfactory results, including a difficult case of renal calculus in an old man. Although novocain has been used for spinal anaesthesia for many years, Dr. Pitkin deserves credit for again directing attention to its advantages and for describing a method of painless administration. In the past I have had many anxious times with such drugs as stovaine, tropacocaine, etc., but there has been no anxiety after administration of the novocain solutions. The hypodermic injection of omnopon and scopolamine about three-quarters of an hour before the spinal injection is a distinct advantage; some patients state afterwards that they do not remember coming into the theatre for the operation. The temporary upward tilt of the thorax ten degrees during the injection, but with the head low by means of lateral flexion of the neck, is recommended if anaesthesia to the nipple line is essential for the operation, and I believe this position to be perfectly safe.

The precise action of novocain on the spinal nerves, motor and sensory, may be a matter for discussion, but I have been impressed with the reliability and controllability of the method, the completeness and duration of the anaesthesia, and the absence of bad after-effects on the patients.

TREATMENT OF EYE DISEASE BY TUBERCULIN.

BY

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THE ophthalmic surgeon is not infrequently faced by cases of inflammatory trouble in the eye which do not yield to ordinary methods of treatment, and in some instances progressively get worse until partial or complete blindness results. I am convinced that in some of these cases the trouble is due to tuberculous disease of the eye, and for the last seven years I have been observing the effect of tuberculin in the diagnosis and treatment of certain refractory cases of chronic conjunctivitis, irido-cyclitis, scleritis, episcleritis, and even some obscure forms of retinitis. Apart from tubercle in the choroid in acute tuberculosis, it would seem that tubercle bacilli may reach the choroid and cause a simple choroiditis.

These tuberculous lesions of the eye have some special characters that have helped to obscure their diagnosis. Like the secondaries of syphilis they occur in the secondary stage, when tubercle bacilli are circulating in the blood; therefore one must not expect any phthisical lesion of the lungs. Examination of the lungs may not help in the diagnosis of tuberculosis of the eye, for these eye diseases are earlier in time than the chronic or phthisical lesions of the lungs. They develop slowly—in the course of years rather than months. They tend especially to recur, and they remain localized; yet in course of time one attack after another causes severe symptoms, and though the lesion is limited, it may give rise to pain, headache, and photophobia, and may greatly impair or destroy sight.

Within the last two or three years I have been given the opportunity of making more extended use of tuberculin, through the interest and co-operation of several ophthalmologists, notably Mr. C. L. Gimblett of the Royal Westminster Ophthalmic Hospital and Dr. Douglas McAlpine of the Middlesex Hospital. The necessary ophthalmoscopic examinations during the progress of treatment were made by surgeons interested in their respective cases. The following notes are of cases that have been referred to me for diagnosis, and for treatment when suitable.

CASE I.

An unmarried woman, aged 31, was described by Mr. Gimblett in June, 1928, as being a case of obscure irido-cyclitis of four years' duration, ending in secondary glaucoma. On incising with the keratome the lens was found to be disintegrated and destroyed. A similar condition has appeared in the left eye, which threatens to go the same way as the right. Tested with