SPINAL ANÆSTHESIA, SPINOCAIN
AND DURACAIN.

By E. FALKNER HILL, M.B.

Lecturer in Anaesthetics in the University of Manchester.

EARLY this year Professors E. Forgue and A Basset published a book on spinal anaesthesia, the embodiment of twenty years' experience with novocain. The account they give of it forms a suitable standard with which to compare the Pitkin method, or rather the modification of the Pitkin method, which I use. As novocain is the anaesthetic used in both methods this fact facilitates comparison and rules out all discussion of other anaesthetics such as stovaine, percaine, etc.

Technique. The injection is made in the lumbar region in the middle line in any suitable space. I generally use that between the second and third lumbar vertebrae. Professors Forgue and Basset inject 2 c.c. of an 8 per cent solution of novocain and take eight minutes over the injection. They thus use only 80 mg. of novocain. For a high abdominal operation they increase this dose to the maximum of 120 mg. The dose I use ranges between 200-300 mg. according to the height of analgesia required. The injection takes about one minute to perform. It is possible to use this larger dose, thanks to the presence of gliadin, a viscous body which tends to hold the solution together. From this feature flow two results. Firstly, there is little tendency to diffusion of the anaesthetic, and so we very rarely see vomiting due to the spread of the anaesthetic to the bulb, an occurrence so constant with the method used by Professors Forgue and Basset as to be described by them as classical. Thus on page 42 they say, "A cette dose minima, l'agent chimique excite surtout le centre vomissement." Secondly, the presence of this body slows the absorption of
Spinal Anaesthesia, Spinocain and Duracain

the novocain, so that there is no necessity to take such a long time over the injection as eight minutes, and it spreads the action of the anaesthetic over a much longer period. Thus by diminishing the spread and slowing the absorption we gain more control over the height and are able to give the operator a much longer time; two enormous advantages. It should be pointed out that the presence of a viscous body for the purposes already alluded to, though a characteristic of the Pitkin method, has been utilised before, and was referred to as long ago as 1918 by Rood. How much farther it goes back I do not know. Pitkin used strychnine, but I have long since discarded it as being, in my opinion, undesirable. The reason for this I gave in the paper in the Lancet, January 18th, 1930. Fifteen per cent of alcohol is added to make the solution lighter and the necessary quantity of normal saline. Ampoules containing 3.5 c.c. (novocain 10 per cent) are made for me by Messrs. May and Baker of Battersea. Whatever quantity of this solution is required is mixed with more or less cerebro-spinal fluid and injected into the theca. As the dose is all-important and depends on many considerations, the next subject to be discussed is that of the factors upon which the dose depends.

Factors influencing the dose. The two objects that we try to obtain are the correct height and the right length. The margin at our disposal in operations below the umbilicus is wide, and such operations as a rule present little difficulty. It is quite otherwise with operations above the umbilicus, and here the experience of the anaesthetist is severely tested. The following factors must be correctly gauged if a successful result is to be obtained:

1. The dose.
2. The quantity of cerebro-spinal fluid with which it is mixed.
3. The quantity of cerebro-spinal fluid allowed to escape before injecting.
4. The force with which the injection is made.
5. The inclination of the table.
6. The position of the patient at the time of, and immediately following, the injection.
7. The age of the patient.
8. The build of the patient, including height, weight, and whether thick set or delicately made.
10. The state of the patient's mind.

It is at once obvious that an increase of dose means an increase of height in anaesthesia. An increase in the amount of cerebro-spinal fluid, with which the dose is diluted, also has the effect of raising the height; this is more marked according to the amount of cerebro-spinal fluid that has been allowed to escape before the injection is made. The anaesthesia from a forcible injection will be much higher than that from one made gently. If the table is in the Fowler position a higher anaesthesia may be expected than if it is in the Trendelenburg position. The sitting position gives the highest anaesthesia of all. Pitkin warns us never to use it. Patients over forty, other things being equal, require a slightly smaller dose than younger ones. I should expect to have to give a patient of twenty-five to thirty-five a larger dose than one of forty-five to fifty-five, to get the same satisfactory result. Whether this is due to a different mental outlook or some subtle change in the constitution of the nerve roots and spinal cord I am not in a position to say. The height, weight, and build of the patient are factors to be taken into consideration. A stocky, thick-set man, even though short, will require a larger dose to produce a given height of anaesthesia than a more delicately built one of somewhat greater height. The state of the patient's health has a marked influence on the dose. Thus, Jonesco says: "Les individus débilités par des hémorragies, par les chocs traumatiques ou nerveux, les cachectiques, les infectés, et surtout les cancéreux, ne peuvent supporter qu'une quantité d'anesthésique qui serait incapable de donner l'anesthésie à un patient en bon état général." The state of the patient's mind has on several occasions prevented the appearance of anaesthesia until after this state has been completely changed. Thus a patient who gives such signs of distress at the stroking of a needle across the skin as to prevent any further attempt to begin the operation will, after being put under
Spinal Anaesthesia, Spinocain and Duracain 135

CHCL, for five minutes, stand a laparotomy of an hour's duration without any further anaesthetic.

Seeing, then, that the success of a given injection depends on the correct appraisement of all these factors, control is not absolute: there is some risk; but Professors Forgue and Basset say: "Qu'il diminue au fur et à mesure que l'on se fait la main." This is as true of the Pitkin technique as of theirs.

Preliminary injections. Atropine should always be given. Morphia is undoubtedly a help in very many cases; it soothes and calms the patient, and for this purpose is in a class by itself. I am decidedly of the opinion that it should be given as a rule. But there is one disadvantage. In the event of the development of anoxæmia from any cause, if the respiratory centre is already depressed by morphia the anoxæmic condition may become so profound that the patient by his own unaided effort is unable to rescue himself, seeing the mechanism by which he would do so normally is paralysed. However, it is a great mistake to attempt a high abdominal operation in a nervous subject without either morphia or ether to the stage of unconsciousness. The ideal is to get muscular relaxation with the spinal and unconsciousness with ether: a very small quantity is required.

Results of injections.
1. Analgesia, character of, success of.
2. Fall of blood pressure; fatalities.

Analgesia. Professors Forgue and Basset have noted some irregularity or patchiness in the distribution of the analgesia produced by their technique. They quote with approval the sixth observation of Pitres and Abadie, which says: "Nous avons pu constater, quelquefois en plein territoire analgésique, un ou plusieurs îlots plus large que la paume de la main... au niveau desquels les piqûres et les brûlures étaient douloureusement perçues." I have never seen any such irregular distribution of analgesia. This may, of course, be due to having missed these areas, but it may also be due to the fact that the viscous material in the injection holds the analgesic solution well together, and so prevents irregularity.
The operations done under spinal anaesthesia naturally fall into two classes, those above the umbilicus and those below. The latter group calls for little comment; if the operation is finished without resort to a general anaesthetic it is a success, but if not it is a failure. This simple test is not applicable to operations above the umbilicus. In this region the vagus has very extensive ramifications, and no attempt is made to reach the vagal nucleus with the spinal anaesthetic. Consequently impulses arising from manipulation of the abdominal organs supplied by the vagus will reach this centre and give rise to characteristic effects. If the peritoneum on the under surface of the diaphragm is involved in these manipulations then the phrenic will also take its part in the conveyance of afferent impulses. The effects of the stimulation of these two nerves is always unpleasant, frequently unbearably so, especially if the patient has not had a preliminary dose of morphia. How is the situation to be met? There are several alternatives:—

1. Abandon spinal anaesthesia for operations above the umbilicus, except in the case of the Irish and other heroes and in those who are so desperately ill that such discomfort as is produced passes almost unnoticed.

2. Give morphia beforehand.

3. Give sufficient CHCL₄, ether or gas and oxygen just to render the patient unconscious.

4. Inject novocain into the neck of the stomach to anæsthetize the vagus.

5. Give a small sub-anæsthetic dose of averlin, paraldehyde, sodium amytal, etc.

To abandon spinal anæsthesia in operations above the umbilicus is to abandon it in the field in which it gives its most striking results. It is here that the complete muscular relaxation which spinal anaesthesia alone gives is most useful, for it does away with the necessity of powerful retraction (a prolific cause of post-operative thrombosis according to some surgeons), makes the use of the bridge exceptional, and saves 30 per cent of the time spent on the operation. Because it is impossible to point to the individual life saved by these striking advantages they are apt to be overlooked,
but who can doubt that in the sum total of operations they materially lessen the mortality? If, then, spinal anaesthesia is to continue to be used for high abdominal operations something must be done to render them less objectionable.

Though there is something to be said against all the proceedings mentioned here, it seems to me that the preliminary injection of morphia and the giving of the necessary amount of some general anaesthetic are decidedly preferable to allowing the patient to suffer the discomfort, often severe, that he otherwise has to put up with.

To compel a patient, very frequently a nervous dyspeptic, to face a high abdominal operation with consciousness undimmed is asking more than most human nature can stand.

I have no experience of the preliminary use of avertin, paraldehyde, etc.; it is a very definite addition to the technique, and sooner or later complications tend to disappear. If in these high abdominal operations the spinal anaesthesia produces complete relaxation of the abdominal muscles it has done all that can be expected of it. Whether the addition of an amount of a general anaesthetic is required to cause unconsciousness depends on the temperament of the patient rather than on the height of the analgesia. If muscular relaxation of the abdominal muscles be taken as the criterion of success then there were seven failures in the last hundred cases (up to September, 1930). Of these hundred cases there were forty-nine below the umbilicus and fifty-one above. It was in the latter group that all the failures occurred. They were partial failures in that either the analgesia was not high enough or did not last one hour.

The blood pressure. It is universally recognized that the injection of an anaesthetic into the spinal theca is apt to be followed by a fall of blood pressure, and that this fall usually, but by no means always, varies with the height of the anaesthesia. Consequently, some means to counteract this fall or to neutralise its effect is found in the technique of all who practice spinal anaesthesia. Professors Forgue and Basset are so impressed with this action of the anaesthetic that they say: "La source majeure des contra-indications : c'est l'action hypotensive de la rachi anesthésie." They recognize that the fall of blood pressure may be brought
about in two ways, one by paralysis of the V.C. and
the other by the height of the injection, which, by reaching
the bulbar centres, enfeebles the heart. Thus they say: “Il
faut admettre que ces phénomènes hypotensifs sont produits
par la hauteur de l’impregnation toxique,” and add: “C’est
bien alors le moteur cardiaque qui est frappé”; they do not
explain how the rising of the anaesthetic to the bulbar centres
damages the heart. They conclude: “De là cette règle de
sagesse : ne pas rachianesthesier les hypotens des graves,
avec basse pression aggravée de l’insuffisance du moteur
cardiaque.” On the other hand, many experienced spinal
anæsthetists are of opinion that spinal anæsthesia is the
method of choice in all cardiovascular diseases. Thus Labat
says: “The heart having light work to perform takes a rest
during spinal anæsthesia, and for this reason it is the method
of choice in all cardiovascular diseases.” Pitkin, Kelly,
Stout, and others have all expressed a like opinion.

Such polar differences on the part of experts can only be
resolved by a patient investigation of the facts. And for
this most of them are disqualified, as their practice has been
so uniformly successful that on their own showing they
have never seen a death on the table during spinal anæsthesia.
As a contribution to this investigation I propose to
give the details of four patients, three of whom died on the
table and one did not. If the usually accepted theory that
death is due to the height of the anæsthesia acting on the
bulbar centres be correct, either by its influence on the
respiration or on the heart, the one that did not die should
have done so and those that died should have recovered.
That is to say, that in the three who died there were factors
other than the mere height of anæsthesia which caused death,
which certainly in two and almost certainly in the other one
was not so high as in the case that recovered. Here are the
details:

Case 1. Female aged 70. Forty-one years’ history of
gall-bladder trouble. Three cubic centimetres of spinocain
were injected into the theca at 9.23 a.m. between the second
and third lumbar vertebrae. Just prior to this injection
50 mg. of ephedrine had been injected subcutaneously. The
patient was put into the Trendelenburg position 10° and the
operation commenced. At 9.30 a.m. the blood pressure was 60; the night before it had been 130. At 9.40 a.m., the abdomen having been opened and the gall bladder found, the patient, who appeared quite comfortable, asked how many stones there were in it. The surgeon replied to the question, and then asked to have the table put up. I raised it so that the reading on the tiltometer indicated 5° Trendelenburg. At 9.45 a.m. I noticed that the radial pulse had disappeared, and about this time the patient stopped alternately contracting and relaxing her right hand, which up to that time she had been doing. I then put the table back to a somewhat steeper Trendelenburg position, and commenced artificial respiration, as there was no sign of breathing. She never recovered. The points worth noting are:

1. The patient was well until the time of the moving of the table.

2. The anaesthetic was not as high as the eighth cervical nerve.

3. Death was not due to the height of the anaesthetic; it was due to the moving of the table, though the tiltometer registered 5° Trendelenburg. It was afterwards found that the head of the table had been slightly raised, and as there was a pillow on it there is no doubt that the position of the head favoured the depletion of the bulbar centres of blood. No efficient means of artificial respiration was at hand.

Case 2. Male aged 55. Gangrenous gall bladder with spreading peritonitis. Very ill. The usual preliminary morphia gr. ½ and atropine gr. 1/60 and also 50 mg. of ephedrine had been given. Novocain 0.275 grm. with strychnine, gliadin, and alcohol were injected in the sitting-up position between the second and third lumbar vertebrae mixed with 3.25 c.c. of cerebro-spinal fluid, making in all an injection of 6 c.c. The patient lay on the table slightly in the head-up position and was asked to draw up his legs, which he did. Shortly after (seconds) he felt his legs slipping down the slope of the table. He was immediately put in the Trendelenburg position, but seemed distressed and unable to breathe. I should judge that he had a feeling of tightness in the chest. He gradually became cyanosed, and died. While he was in the Trendelenburg position and in
distress he had a radial pulse, quite definite although feeble, rapid and irregular. He died eight minutes after receiving the injection. His blood pressure before the injection was 120 mm. Hg. The following points are worthy of note:—

1. The patient was desperately ill to begin with.

2. We have no knowledge of the height of the anaesthesia, but judging by the rate at which the legs were paralysed and the sequence of events compared with other cases I am of the opinion that the superior level would have been found in the higher dorsal region.

3. It is certain that the distress in the chest was acute and preceded the complete collapse of the radial pulse. Death in this case was apparently due directly to the anaesthetic, as it occurred within eight minutes and the operation had not started. How did the anaesthetic cause death? Let us assume that the anaesthetic reached no higher than the third dorsal. In this case it would have caused probably, but not certainly, some fall in the blood pressure. This fall in the blood pressure would normally make the heart’s work easier. “The heart having light work to perform takes a rest during spinal anaesthesia” (Labat). But there is another possibility. A patient whose blood pressure was only just sufficient to propel the blood through narrowed coronary arteries might be the subject of acute cardiac failure if that blood pressure were somewhat suddenly reduced, as it is liable to be in high spinal anaesthesia. The distress of which this patient complained resembled that of coronary thrombosis rather than that of angina, seeing that it came on while the patient was at rest and with a falling rather than a rising blood pressure. Or, again, it may have been due simply to the inability of the heart muscle to get sufficient blood.

The acute distress of which the patient complained may possibly have had its origin in acute failure of the R.C. Thus J. S. Haldane, speaking of acute respiratory failure, says: “The patient may feel that he cannot expand his chest to breathe, just as if it were mechanically constricted; and he rapidly develops asphyxial symptoms... these attacks are very dangerous and many sudden deaths are due
Spinal Anaesthesia, Spinocain and Duracain

to them." These cases are promptly relieved by oxygen; but this one wasn’t. Also there is no reason to suppose that the anaesthetic was anywhere near the R.C., and there is some evidence to the effect that, even if it had been near, the R.C. would not have been paralysed thereby. I think, therefore, that this patient died because the anaesthetic lowered the blood pressure and the heart itself was in such a condition that it could not stand such a fall as occurred. There is definite evidence that the fall was not extreme. There are not sufficient data to prove anything, as no post-mortem was obtainable. I am of the opinion that the evidence is decidedly against paralysis or even fatigue of the R.C. and in favour of heart failure owing to the fall of blood pressure, which in this particular instance the heart could not afford.

Case 3. Female aged 41. Disease of gall bladder. Short and very fat; fifteen stones, blood pressure 100. The usual morphia gr. 1/3 and atropine gr. 1/60 were given one hour before, and as the blood pressure was low I gave 100 mg. of ephedrine instead of the usual 50. Three cubic centimetres of spinocain were mixed with 3 c.c. of cerebrospinal fluid and injected in the lumbar region. As the patient was so fat it was impossible to identify any of the lumbar spines, so I could not tell which space received the needle.

The injection was made at 1.4 and the operation began at 1.11, the position of the table being Trendelenburg 10°, the blood pressure 130. The appendix was removed. While this was being done the patient’s face had a definite bluish tinge, an oxygen tube was put in the mouth and the colour subsequently improved. There was some slight discomfort on exploring the oesophageal opening, following which the colour was not quite so good, but the pulse was of good volume, regular and normal in rate. At 1.20 the bridge was put up, the blood pressure just (one minute) previous to this being 130. The pulse, as usual, was not quite so good and the colour went somewhat. The operation continued and the gall bladder was removed. Though the pulse was still palpable it was definitely worse, and so I put the bridge down. The heart failed at this moment and no
cardiac pulsation was ever again felt. Time, 1.30. No treatment was of any avail and, moreover, never looked like being so. The following points are worthy of note:—

1. The time of death was twenty-six minutes after the spinal injection.
2. The blood pressure immediately before the bridge was raised was 130 mm. Hg.
3. The gradual deterioration of the pulse subsequent to the raising of the bridge.
4. The suddenness of the final heart failure.
5. The bluish face on assumption of the Trendelenburg position, relieved by O₂.
6. The obesity of the patient.
7. The extreme rapidity of the operation under these very adverse circumstances.

There can be little doubt that death was due to heart failure, but unlike case two it was not due to fall of blood pressure but due to the bridge preventing an adequate return of the venous blood to the right heart—a well-known cause of heart failure. The blueness of the face is evidence of anoxaemia induced by the Trendelenburg position and relieved by O₂. In this connexion it would be well to consider the effect of the Trendelenburg position. J. S. Haldane says: "We found the recumbent posture greatly favours the development of periodic breathing and therefore of anoxaemia." This he ascribed to the increased resistance thrown on the diaphragm by the liver and other abdominal organs which, at any rate, no longer assist the descent of the diaphragm as they do in the upright position. He goes on to say, "It is evident that in the recumbent position the tendency to irregular distribution of fresh air in the lung-alveoli with any given depth of breathing is much increased, so that anoxaemia from this cause is much more readily produced." If the recumbent position is responsible for all this, much greater will be the effect of the Trendelenburg position. In the particular case that we are here concerned with, all these factors were at their maximum. The weight of the abdominal walls added to the weight of the contents must have produced a quite unusual degree of
Spinal Anaesthesia, Spinocain and Duracain

anoxæmia which the preliminary dose of morphia would accentuate rather than relieve. The patient survived all this, and indeed was in good condition to the moment of putting up the bridge.

The post-mortem examination revealed a greatly dilated left ventricle, in which there was no corresponding hypertrophy; also the pituitary gland was found to be diseased (tuberculosis).

Case 4. Male aged 59. This patient was jaundiced, and had been so for some months. He had refused operation hitherto, but became so much worse during the night that he had consented. The usual morphia gr. $\frac{1}{2}$ and atropine gr. $\frac{1}{60}$ were given, and as the operation was expected to be a high abdominal section I gave him 3 c.c. (300 m.) of duracaine between the first and second lumbar vertebrae. The table was 5° head-up position. The action of the anaesthetic was so rapid that it cut a sentence in half which he had framed in answer to a question that the surgeon put to him. The Trendelenburg position was immediately adopted. Three minutes after he had received the injection the pulse entirely disappeared. He was still breathing. Two unsuccessful attempts were made to give him an intravenous injection. Fifty minutes after the injection the blood pressure was just recordable at 40 mm. Hg. The operation began five minutes later.

Several feet of gangrenous gut were removed. The patient went back to bed in another thirty-five minutes still unconscious. He was still breathing and his blood pressure had risen slightly to 45 mm. Hg. He recovered consciousness during the night and lived another six days. Surely if a high spinal injection will kill, this man ought to have died on the table. He was desperately ill; he had far too big a dose of novocain considering his condition, which was even more desperate than had been expected, and his heart had suffered the toxaemia of jaundice for some months.

Consideration of these four cases and others forces me to conclude:

1. That a high spinal anaesthesia (novocain-gliadin) will not kill even a grossly toxic heart or paralyse the R.C. in the concentration here given up to 300 mg.
2. That patients whose V.C.s are paralysed are in a precarious condition and must be put in a slight Trendelenburg position and kept there. Movement of any kind is strongly to be deprecated. Steep Trendelenburg is not without danger.

3. That the most dangerous cases are those whose hearts are incapable of working at a lower pressure than their normal.

4. With the exception of this condition a fall of blood pressure, however great, provided the patient is not removed from the Trendelenburg position, is quite compatible with safety. I have seen two cases in which the fall was over 140 mm. Hg., and both made excellent recoveries, and are still alive.

5. That a high spinal anaesthesia by lowering the blood pressure puts the patient into a condition which, though perfectly safe in itself, may, by certain intra-abdominal manipulations, such as severe traction on the stomach, evisceration, etc., rapidly pass into a condition of shock. The change is so quick that it would appear to be due to trauma conveyed by the vagus rather than by toxin.

It is usually contended that spinal anaesthesia protects the patient from shock. Thus Tyrrell Gray and L. Parsons, in their Arris and Gale lectures on the "Mechanism and Treatment of Shock" in 1912, say: "We entered on this research on account of the extraordinary control of shock observed in children with the use of spinal anaesthesia." Apart from psychical shock, trauma and toxins (histamine) are recognized as the two great causes of shock. It is improbable that spinal anaesthesia can do anything to lessen shock due to toxins, though it will not add to it as ether does. Gray and Parsons showed quite convincingly that spinal anaesthesia prevented shock due to trauma. From clinical observations I am definitely of opinion that shock is the cause of some of the fatalities that occur under spinal anaesthesia, and is frequently the cause of the alarming condition which patients undergoing a severe laparotomy present. If spinal anaesthesia prevents shock when the operation is confined to the region anæsthetized (and this seems to be beyond doubt), this constitutes no reason for
supposing it will prevent shock when the area of operation is supplied by nerves which are unaffected by the spinal anaesthetic; this is the condition of affairs in a high laparotomy. The vagus, which has extensive ramifications in the viscera down to the region of the caecum, is entirely unaffected by the ordinary high spinal anaesthetic. The consequence is that the patient is shocked. Let us suppose that the patient is anaesthetic to the nipple line. The blood pressure has fallen 20-30 mm. Hg. The incision is made and is painless. The peritoneum is opened and the examining hand introduced into the abdominal cavity. Some expression of discomfort on the part of the patient follows. When the manipulations are severe the blood pressure falls rapidly. The pulse, which before was full, becomes thin, and in certain cases disappears altogether. The thin pulse is due to intense vaso-constriction together with the dilatation of the capillaries and loss of fluid from them. Owing to this loss of fluid from the circulation the heart fails, partly on account of not having enough blood to contract down upon and partly because its own blood supply by the coronary arteries is insufficient for its own nourishment. Under these circumstances, if an injection of vasopressin is given and an intravenous injection of saline, the pulse becomes full and the blood pressure rises from forty or below to its original height in ten minutes. The vasopressin contracts the capillaries and the saline restores the necessary bulk of fluid to the circulation.

At what particular point of the procedure it is advisable to apply these restorative measures must be left to the combined judgment of surgeon and anaesthetist. The most convenient time is at the end of the operation; it would probably be safer to do it immediately the blood pressure goes down to 40 mm. Hg.

These measures would almost certainly have saved Case 1; it is unlikely that they would have made any difference to Case 2 or to Case 3, whose heart failure appeared to be due directly to the raising of the bridge.

Advantages of the Pitkin Method.

1. The presence of a viscous material which holds the
fluid together and so prevents irregular distribution of it
enables us to give a larger dose than is the case if this in-
gredient be omitted. The larger dose gives the operator a
longer time.

2. There is a conspicuous absence of vomiting, probably
due to the same reason, namely, the presence of the viscous
material.

3. Patchiness is unknown.

4. The greater control makes the use of spinal anaesthesia
in the upper abdominal region safer and more certain,
whereas Professors Forgue and Basset say: “Pour les
régions hautes, les échecs sont fréquent et il semble bien que
là on a demandé souvent à la R.A. plus qu'elle ne peut
donner” In this series there have been only seven failures,
all of which were rendered adequate by a very small amount
of general anaesthetic.

Indications for spinal anaesthesia. There is probably no
subject upon which experts differ more than on this question,
thus:—

1. Jonesco, than whom there is no greater authority in
Europe, says: “I am sure, after a practice of nearly twenty
years, during which spinal anaesthesia has been the method
I have used exclusively in all my operations, from the
head to the feet, that it is an admirable method provided
that the technique, simple and easy, at which I have arrived
after so many years of practice and study, is used.”

2. Labat, on the other hand, says: “They (speaking of
this and other similar methods of high spinal anaesthesia)
still involve an element of risk, much greater than when
spinal anaesthesia is intended for operations below the dia-
phragm.” He goes on to say that for these latter spinal
anaesthesia is absolutely safe when all the details of tech-
nique are scrupulously observed (Trendelenburg). Accord-
ingsly, Labat would use it in all cardiovascular conditions,
because the blood pressure is lowered and the heart’s work
made easy, but not in perforations or peritonitis or strangu-
lated hernia, because of the fact that as the vagus is not
paralysed it is free to over-exercise its function of motor
nerve to the intestinal tract, undeterred by the sympathetics
which are paralysed.
3. Stout and other American authors are convinced that some of the best results obtainable with spinal anaesthesia are just in these cases of perforations and strangulated hernia.

4. Gray and Parsons consider, as a result of their investigations into the phenomena of shock, that spinal anaesthesia is strongly indicated in children.

5. Most people consider diabetes and other toxic states a strong indication.

6. Old people generally take it very well and those who are very ill.

7. A strong contra-indication to a general anaesthetic, such as the presence of lung trouble, constitutes an indication for spinal anaesthesia.

8. In all cases where muscular relaxation would be likely to make the operation easier spinal anaesthesia is strongly indicated.

9. Professors Forgue and Basset consider the region below the umbilicus to be the true domain of spinal anaesthesia, especially emphasizing its value in gynaecological and other pelvic surgery. They say: "Mais c'est surtout pour la chirurgie abdominale (sous om bipale) et pour les interventions pelviennes, qu'apparait la superiorité de la rachi-novocainisation sur l'anesthésie générale." They do not, however, regard the region between the umbilicus and the diaphragm as beyond the proper bounds of spinal anaesthesia. Indeed, they recommend it for gastrectomy and for some gall bladder cases. In these latter they feel that each case should be judged on its own merits, and for the worst of them give this piece of advice: "Il vaut mieux alors anesthesier ces malades a l'éther . . . le risque est moindre et la responsabilité moins immédiate."

**Contra-indications to Spinal Anaesthesia.**

1. There are certain contra-indications to spinal analgesia about which there is no difference of opinion, for example, diseases of the meninges, cerebellar tumours, epilepsy, syphilis, etc.

2. But here the unanimity ends, and opinions range from those who would do every operation from the head to
the feet (Jonesco and others), to those who would restrict its use merely to those cases that stand no chance of survival under a general anaesthetic. By a strange illogicality some use spinal anaesthesia only for those grave risks, whilst refusing it as too dangerous where the risk is much less.

3. The most striking difference of opinion, perhaps, is evident in cases of cardiovascular diseases, many regarding these cases as peculiarly suitable for spinal anaesthesia owing to the lowering of the blood pressure which normally occurs, giving the heart, for the time being, an easier task. On the other hand, Professors Forgue and Basset regard a low blood pressure as a strong contra-indication, especially if it is accompanied by "l'insuffisance du moteur cardiaque."

With the introduction of ephedrine a low blood pressure in itself is no longer a contra-indication to spinal anaesthesia, but a feeble heart, from whatever cause, adds much to the gravity of the situation, which under these circumstances needs the most delicate handling.

4. Unless there is complete co-operation between surgeon and anaesthetist and efficient means at hand to do immediate artificial respiration if required, spinal anaesthesia above the umbilicus is contra-indicated.

What is the nature of the precarious condition into which a spinal anaesthetic up to the second dorsal puts a patient? In the course of evolution man has assumed the upright position. He has been enabled to do this by developing a V.C. mechanism, by means of which he can control the calibre of his abdominal blood vessels, and hence his blood pressure, in the upright position. When he is given a spinal anaesthetic this mechanism is put out of action for the time being. Certain disabilities follow. The most obvious of which is that, if he be put in the head-up position he will bleed into his abdominal vessels and die from failure of circulation through the brain. This was the mechanism of death in the first case. But there are other disabilities. Haldane has shown that the recumbent posture favours the development of anoxæmia as stated above. Anoxæmia will rapidly lead to asphyxia, the normal response to which is a rise of blood pressure, but under the circumstances no rise of blood pressure can take place. The necessary adaptation
cannot be made. The R.C. remains unsatisfied and fails to supply the heart with sufficiently oxygenated blood. The rapidity of the heart failure is inversely as its strength. That means with a weak toxic or degenerated myocardium death takes place very quickly.

What is to be done in case of accident? Here again there seems to be great diversity of opinion. The following procedures have been recommended:

1. Artificial respiration.
2. Intravenous or intracardiac injection of adrenalin. Better still, vasopressin and saline.
3. Lumbar puncture and withdrawal of cerebro-spinal fluid plus the intrathecal injection of caffeine.

Whilst many are in favour of artificial respiration others condemn it as useless on the ground that no air can be made to enter the lungs owing to the intense contraction of the bronchioles, as in an asthmatic attack. Spinal puncture and the injection of caffeine is objected to on the ground that it necessitates moving the patient and is likely to interfere with the asepsis of the operation, and prevents artificial respiration, which Professors Forgue and Basset consider of fundamental importance.

Animal experiments recently performed at the University strongly support artificial respiration as the means above all others which will rescue any animal, however low its blood pressure; and, even after the exhibition of ten times the dose of novocain necessary to induce complete paralysis of the R.C., artificial respiration, supplying the heart with oxygenated blood, maintains life until the novocain has all been absorbed and the R.C. is once more free. It is essential that the artificial respiration be efficient and immediately applied. Exact details of these experiments will be published shortly.

**Conclusions.** Spinal analgesia for a high abdominal operation in a patient of suitable temperament or so ill that temperament is no longer a factor is, if the analgesia is the right height, ideal. Spinal analgesia, unshielded by morphia, for a high abdominal operation in a patient of unsuitable temperament, a victim of chronic dyspepsia, is a torture to the patient and the anaesthetist. Such patients should be made
unconscious before the operation begins. The surgeon then has the abdominal muscles relaxed by the spinal anaesthetic and the patient is unconscious with one-sixth of the anaesthetic required for muscular relaxation. There remains the question of the right height. As this depends on so many factors already enumerated it is bound to be of the nature of an ideal rather than an accomplished fact; "Il y a un tour de main à acquérir." "Les échecs, incidents et accidents de la R.A. se raréfient d'autant plus qu'on se familiarise davantage avec sa technique." In operations below the umbilicus failures very seldom occur.

**Modifications of the Pitkin Technique.**

Duracain is better than spinocain in that it contains no strychnine, a body which diminishes the internal resistance of the spinal cord to the passage of afferent impulses. As the whole object of this type of anaesthesia is to prevent the passage of afferent impulses from the periphery to the centre and from the afferent side of the reflex arc to the efferent, it would appear to definitely contra-indicate the use of strychnine. In actual practice it is not unusual to find that the abdominal muscles are becoming rigid before pain returns when using spinocain.

I use a 10 c.c. syringe with an eccentric exit, sometimes mixing the cerebro-spinal fluid with the duracain before injecting, sometimes allowing the cerebro-spinal fluid to sink to the bottom of the syringe and injecting without mixing. Barbotage is not used. The opinions expressed are based on an experience of between 500 and 600 cases, of which I have blood-pressure records of 472. Of these 472 recorded cases, 245 were for operations above the umbilicus and 227 were for operations below.