The A values, therefore, represent the recovery response from the treatment accorded the B series.

The growth increment values by themselves hardly justify a conclusion, since the time interval was unavoidably longer in the A than in the B series. On the other hand, the differences may be valid, since I have noted, but not recorded, the fact that roots left in Pb-culture solutions for more than a day hardly increase in length over that which obtains at the end of the first twenty-four hours. The marked superiority in mitotic index values, however, indicating as it does a far greater cell proliferation activity, is striking proof that growth recovery after Pb-retardation is possible.

Particular note should be made of the fact that roots subjected to a Pb-ion concentration of 5 mg. per litre showed some seven times as many mitoses per 100 nuclei after transference to Pb-free culture solutions as roots subjected to only half the concentration (2.5 mg.), but not subsequently removed from the Pb environment. In view of this, and since root growth in length is to a great degree dependent upon the rate of cell division in the meristematic region, it is probable that the greater growth increment of the A series does in part at least represent a real renewal of length growth.

The results of these experiments show conclusively that the retardative influence of Pb on growth by increase in cell number is not a permanent affair in roots. This is no proof that a like recovery of cell proliferative activity would occur in animal forms under either normal or pathological conditions with cessation of Pb administration. Yet the biological hint afforded should serve as a warning against too high expectations from the use of Pb, or indeed any other metallic element, in the treatment of malignant growths.

In concluding I might state that the details of technique used in this investigation are to be found in the papers cited. They have not been repeated here, in order to save space.

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PROGRESS IN ANAESTHESIA FROM THE SURGEON'S STANDPOINT.

BY

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SINCE the great war, and no doubt as a result of experiences gained from it, the science of anaesthesia has been advanced in certain clinics in this country and on the Continent. Unfortunately, however, the advance at present is slow, and it may be said that, in so far as many clinics to-day adopt inhalation narcosis for practically all operations, irrespective of their magnitude or the condition of the patient, surgical anaesthesia has not kept pace with the requirements of modern surgery. Shock following a severe operation is generally attributed to the manipulations of the surgeon—perhaps a justifiable charge if rough usage of the tissues has occurred. But even the surgeon who handles the tissues with deliberate, gentle, and dexterous movements has his quota of failures in severe and prolonged operations when inhalation narcosis with ether or chloroform has been employed.

In operations demanding complete muscular relaxation inhalation narcosis may necessitate administration of large doses of the narcotic, with the production of serious toxic effects upon the myocardium, the liver, the suprarenal glands, the central nervous system, and, indeed, the tissues generally. Furthermore, the employment of this type of anaesthesia necessitates pre-operative preparation of the intestinal tract. The patient enters the theatre with an empty gut, and often three or four days pass before he is

able to take solid food. Four or five days' starvation takes its toll even of a healthy individual; how much greater must be the effect upon a patient who has undergone a severe operation! Add to this the pain and exhaustion resulting from post-anaesthetic vomiting, and it may be conceded that neither the surgeon nor the anaesthetist may be responsible for failures which follow prolonged anaesthesia by inhalation narcosis, but that it is the anaesthetic which is at fault.

On February 25th, at the Medical Society of London, Professor A. H. Burgess of Manchester, opening a discussion on acute intestinal obstruction,¹ stated that, excluding cases of strangulated hernia and intussusception, the mortality resulting from operations for the relief of this condition during the period 1920 to 1924 in seven leading hospitals was 37.9 per cent. No mention was made of the anaesthetic used, but I hope I am not wrong in assuming that it was some form or other of inhalation anaesthesia, as in a series of fifty similar cases operated upon by me during the period 1926-28, using spinal and block anaesthesia, the mortality was only 13.6 per cent. In view of the very different results obtained in these two series of cases I propose as briefly as possible to describe the procedure as regards surgical anaesthesia at the Bradford Municipal General Hospital.

Rectal Ether.

For operations on the head, neck, mouth, and thorax, including trephining for cerebral tumours, trigeminal neuralgia, extirpation of goitre (especially toxic goitre), total laryngectomy, and radical excision of the breast, rectal ether, and more recently avertin (tribromethyl-alcohol), are the anaesthetics of choice. After trying several mixtures the following formula for rectal ether has been adopted for some time as giving uniformly good results.

Magnesium sulphate	...	...	...	2 oz.
Glucose	...	...	...	1½ oz.
Olive oil	...	...	...	1 fl. oz.
Acacia	...	...	...	5½ dr.
Ether	...	...	...	4 fl. oz.
Paraldehyde	...	...	...	4 fl. dr.
Morphine sulphate	...	...	...	1/4 grain
Water	...	...	...	to 12½ fl. oz. (approx.)

Rub the acacia with olive oil in a dry mortar, dissolve the magnesium sulphate and glucose in 7 oz. of water, then add 1 fl. oz. of this solution to the acacia and olive oil; gradually add the remainder. Transfer to bottle of 16 oz. capacity and add the morphine sulphate, previously dissolved in water. Dissolve the paraldehyde in ether and add gradually, shaking well. Make up to 12½ fl. oz. (approximately). Secure the cork with string and keep in a cool place.

The anaesthetic solution should be made up the evening before operation, securely corked, and kept in a cool place. It is not safe to use a solution that is thirty-six hours old.

The solution is introduced high up into the bowel by means of a rubber catheter, and the procedure is best carried out in a dark room. The introduction requires twenty minutes for its completion, and during this period there may be, though very rarely, an interval of excitement. The onset of anaesthesia varies; it may follow immediately after the anaesthetic has been completely introduced into the bowel, but more often it occurs from ten to twenty minutes later than this. A smell of paraldehyde is readily, and of ether faintly, detected in the patient's breath. It has been suggested, I think with some reason, that in making up the mixture the ether is converted into ethyl sulphate and absorbed as such. This anaesthetic is ideal for operations on the head and neck, and has the following added advantages:

1. There is no anaesthetist's apparatus to hamper the surgeon.
2. The patient's respiration is quiet and uniform, resembling that of normal sleep.
3. The patient's colour is perfect throughout.
4. There are no toxic after-effects, and vomiting does not occur.
5. Following the operation the patient has a refreshing sleep, lasting three to four hours, after which he is able to take nourishment.
6. According to our experience the anaesthetic is absolutely safe, and has no harmful effects upon the bowel.

As a routine the bowel is washed out when the patient returns to the ward.

Combined Spinal and Splanchnic Anaesthesia.

For abdominal operations in the neighbourhood of the diaphragm—for example, partial gastrectomy, gastro-enterostomy, resection of growths of the transverse colon and the flexures, operations on the gall-bladder and ducts—spinal anaesthesia with 0.1 gram stavaine introduced between the second and third lumbar vertebrae combined with splanchnic anaesthesia (60 to 70 c.cm. of a 0.5 per cent. solution of novocain), given according to Braun's method, is the anaesthetic of choice. The combination is used because, for operations lasting over an hour, spinal anaesthesia by itself is not sufficient. The anaesthesia can be prolonged if necessary by administering a further dose of the splanchnic anaesthetic and infiltrating the peritoneum and abdominal muscles with 0.5 per cent. novocain in 1 in 200,000 adrenaline solution. To nervous patients about to undergo an operation which is likely to be prolonged we have given, in addition to the spinal anaesthetic, a dose of avertin by the rectum sufficient to produce a quiet sleep, and thus unconsciousness of the surroundings and of the heat, which some patients find distressing. This anaesthetic combination has the following advantages:

1. It secures complete and uniform muscular relaxation.
2. Diaphragmatic movements are damped down to a minimum.
3. There is a marked absence of post-operative shock.
4. The anaesthetic is non-toxic.
5. Post-anaesthetic vomiting and chest complications do not occur.

Professor Finsterer, whom I have watched and assisted at his work in Vienna, would take three hours or more to perform the extensive operation of partial resection of the stomach for jejunal ulcer following previous gastro-enterostomy, using block anaesthesia to enter the peritoneal cavity, and splanchnic anaesthesia as advocated by Braun; he would repeat the splanchnic anaesthetic, but never more than once. I visited the subjects of these operations afterwards and found very little evidence of post-operative shock. Moreover, inhalation narcosis could not have secured the certain and continued relaxation and the safety rendered possible by the above measures.

Spinal Anaesthesia.

For operations about and below the umbilicus—for example, in acute appendicitis, acute intestinal obstruction, strangulated umbilical hernia, pelvic operations in the female, operations on the bladder, excision of the rectum, haemorrhoids, and so forth—spinal anaesthesia, achieved by introducing 0.05 to 0.1 gram of stavaine into the theca between the third and fourth lumbar vertebrae, is the method of choice. It is also ideal for all operations of magnitude on the lower extremities, and has the same advantages as the anaesthetic combination described above. In operations for intestinal obstruction spinal anaesthesia confers an added advantage: the caecum can be exposed without escape of viscera, and if distended it can be tapped. The action of stavaine being to cause strong and active peristalsis, the tapping is followed by rapid emptying of the gut. In cases of intestinal obstruction it is more than ever essential to use an anaesthetic of minimum toxicity but affording complete and uniform muscular relaxation.

Infiltration and Block Anaesthesia.

This anaesthetic (solution of novocain 0.5 per cent. in adrenaline 1 in 200,000) has been freely used alone in such instances as strangulated herniae in very old bronchitic subjects, for caecostomy in cases of acute intestinal obstruction where the toxic effects are very marked, and for amputation for gangrene in old people who have accompanying serious constitutional complications. For removal of superficial tumours—for example, lipomata, etc.—infiltration anaesthesia is the one of choice.

Avertin.

I first saw this compound used in Berlin by Professor Katzenstein in December, 1927, and was impressed by its properties; I have since used it in over a hundred cases, and find that, though not in itself a complete analgesic, it is a powerful amnesic. It is useful in combination with infiltration anaesthesia in adults and older children, and

with light ether anaesthesia in younger children. Combined with infiltration anaesthesia it may be used in cases of operation for goitre, appendicitis, hernia, excision of the breast, and so forth. It is entirely non-toxic, and must find a useful place both in general surgery and obstetric practice.

For the reduction of fractures avertin in combination with local anaesthesia is ideal, and is used extensively on the Continent; 50 to 60 c.cm. of 0.05 per cent. novocain solution in 1 in 200,000 adrenaline are injected into the blood clots surrounding the fractured ends of the bone. The surgeon, having ensured that his needle has entered the blood clot by withdrawing blood-stained fluid into the syringe, may carry out the necessary manipulations in a perfectly painless manner five to ten minutes after the injection.

I would say in conclusion that since using the above-described method of anaesthesia I have witnessed a 50 per cent. fall in the mortality from my abdominal operations. I hope the time is not far distant when ether and chloroform narcosis with their inevitable mortality will have been superseded.

REFERENCE.

¹ *British Medical Journal*, March 2nd, 1929, p. 398.

APPARENTLY SPONTANEOUS RUPTURE OF THE
NORMAL SPLEEN.

BY

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It is a fact well known to all surgeons that in various pathological conditions, of which chronic malaria affords the best example, the spleen may rupture following the slightest degree of trauma, or even without injury at all. To the latter condition the term "spontaneous rupture" is applied. Rare cases have been reported in which it is claimed that a similar spontaneous rupture has taken place in a perfectly normal spleen. That a healthy spleen should without apparent cause suddenly burst is difficult of belief, and the following case is recorded as offering an explanation of the anomaly.

The patient was a fairly well-covered and muscular male, aged 50, by occupation a shopkeeper. He stated that he had previously been quite healthy, and that he was one of a large family all of whom were healthy. He gave a history that on the evening of March 12th, 1927, he suddenly, and without apparent cause, experienced acute pain in the epigastrium, which within a few minutes became so severe that he had to stop work. The pain later spread to both his shoulders. He went to bed, but was not seen by his doctor until March 14th, when he was immediately ordered to hospital.

On admission the patient looked extremely ill, his face being pale and covered by a cold sweat. The temperature was 99° F., and the pulse 120; the respirations were shallow and grunting. The tongue was slightly furred. The abdomen did not move on respiration, and was uniformly rigid to superficial palpation. Deep tenderness was present all over the abdomen, being most marked in the epigastrium. A rectal examination was negative. The patient was regarded as a typical case of perforated gastric ulcer, which diagnosis was made independently by his doctor, the house-surgeon, and the surgeon.

Operation (March 14th).—The abdomen was opened by a right paramedian upper abdominal incision. Immediately on opening the peritoneum there was a profuse outpouring of blood, at first dark and old, but later mixed with fresh blood. Investigation showed the spleen to be the source of the haemorrhage, and this organ was removed after the left rectus muscle had been divided transversely to obtain better access. The patient was by this time very collapsed; an intravenous saline was therefore given on the table, while the abdomen was rapidly closed with through-and-through sutures. The patient rallied well from the operation, and had a normal uneventful convalescence. He was discharged on April 11th.

Macroscopical Appearance of the Spleen.—The normal appearances of the spleen were almost completely obscured by two large subcapsular haematomata, one situated on the outer convex surface, the other on the concave side of the organ, the two communicating with each other round the posterior border. The only normal spleen visible was a narrow strip along the anterior border. The haematoma on the convex aspect of the organ had ruptured through the capsule at one point, and it was through this rupture that the haemorrhage into the abdomen had taken