resulting scoliosis. All too often, when the transverse processes are left, the persistence of an elongated, flattened, but not wholly obliterated cavity can be seen in the costo-vertebral sulcus.

Tuberculous Empyema.—Of the seven subjects of tuberculous empyema treated by thoracoplasty, five are dead, one is alive but deteriorating, and one is well and cured of his tuberculous empyema but still requires a small plastic operation to complete the epithelization of the remains of the cavity. All cases had been treated conservatively for a long period before being presented for thoracoplasty. Operation undertaken at an earlier date before the general effects of the continued toxæmia become too marked and the pleural membranes too thickened would undoubtedly produce more satisfactory results.

Summary

From the public health point of view no person with a sputum positive for tubercle bacilli should be at large in the community.

Thoracoplasty will arrest the disease in a certain proportion of cases and allow return to work.

Indications for thoracoplasty are: The disease should be in the fibrotic stage, and must be mainly unilateral; pneumothorax should have been tried; the cavities should not be too large. The age limit is given as 15 to 45, with exceptions. The general condition of the patient should be good.

Ten-rib paravertebral thoracoplasty with removal of the transverse processes is the operation of choice.

Results at the surgical clinic of the Lancashire County Council Tuberculosis Service in the period 1933-40, with follow-up in May, 1941, are given. Fifty-two cases were operated on for parenchymatous disease: 35 (67%) are fit and well, with negative sputum, and 30 (86%) of these are working.

Seven cases were operated on for tuberculous empyema, with total arrest of the disease in one case only. These cases should be operated on earlier.

Our thanks are due to Dr. G. Lissant Cox, Central Tuberculosis Officer, Lancashire County Council, for permission to publish this report. We acknowledge the great help given to us by the tuberculosis officers of the county in the follow-up of these cases. Our greatest appreciation is due to the members of the medical and nursing staff of High Carley Sanatorium for the after-care of these most difficult patients. The anaesthesia was conducted by Dr. John Halton.

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To meet urgent needs, some of them arising out of the war, four new teaching departments have been set up at Leeds General Infirmary. One is a department of thoracic surgery, another is a school of physiotherapy, the third is a school of radiography and radiotherapy, and the fourth is a school of dietetics. An account of these developments is given in the *Yorkshire Post* of November 21. The thoracic surgery department is especially noteworthy, and by its inauguration Leeds becomes the first of the teaching hospitals in the Provinces to take this step. The founding of the school of physiotherapy has been expedited by the war, for the establishment of such a school, with its own building, was until lately no more than a suggestion for post-war development. Damage to London hospitals has led to the immediate demand for a physiotherapeutic instructional centre elsewhere. The course at Leeds will occupy two and a half years, and is intended to prepare students for the examination of the Chartered Society of Massage and Medical Gymnastics. At the school of radiography and radiotherapy students are in training for the examination of the Society of Radiographers during a two-year course which, as a war measure, will be reduced to six months. The school of dietetics gives six months' practical training for those who have done the theoretical work at a college of domestic science. It will function in close contact with the special kitchen set apart by the Leeds General Infirmary for the preparation of food for patients on a special diet.

AN IMPROVED METHOD OF REGIONAL ANAESTHESIA IN ACUTE ABDOMINAL SURGERY

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The advantages of regional anaesthesia in *grave abdominal cases* have long been recognized. While in America and on the Continent the work of such pioneers as Crile, Labat, Finsterer, and others has been received with enthusiasm, regional anaesthesia has never achieved popularity in this country. This, we think, is because (1) most patients dislike being conscious during an operation; (2) the administration of a regional anaesthetic is often in itself an ordeal for even the most stoical patient; (3) too often anaesthesia proves to be incomplete, and deep general narcosis is found necessary.

Types of Regional Anaesthesia

The forms of regional anaesthesia in use to-day are as follows:

Spinal Anaesthesia.—(a) *Subarachnoid Block*:—By this method an extreme degree of relaxation of the abdominal muscles is obtained together with what Farr describes as "negative intra-abdominal pressure." If the anaesthetic ascends as high as D 5 splanchnic block is also obtained. The liability to grave falls in blood pressure and the risks of sudden collapse make spinal anaesthesia (subarachnoid block) unsafe except in comparatively fit patients. (b) *Epidural Block*:—The work of Dogliotti (1933) and Odom (1936) aroused interest in this method. It is now generally considered that epidural block is neither reliable nor safe.

Field Block.—This method is the most popular in use owing to its comparative safety and ease of administration, and may well be associated with the work of Finsterer (1923). Although anaesthesia at the site of incision is usually adequate, relaxation is often poor; this is a serious defect in an exploratory operation. "Negative intra-abdominal pressure" is absent, and protrusion of the abdominal viscera often occurs, especially if the patient strains; this may be aggravated by inadequate preliminary sedation and rough handling of the viscera by the surgeon. Sometimes, after the abdomen has been opened, it becomes clear that the first incision must be extended or a fresh incision made; local infiltration or additional field block may then be necessary if deep general narcosis is to be avoided. To protect the patient from the effects of traction on the viscera, field block is often supplemented by splanchnic block, the most popular technique being that of Braun (1924).

Infiltration Anaesthesia.—This method, so strongly advocated by Farr (1930), has recently been used by Vishnevsky (1938), Synovich (1940), and Novikov (1940). Injection of large quantities of dilute anaesthetic solution—e.g., equal parts of 0.25% novocain and 1 in 4,000 percaïne—into the fascial pockets surrounding muscles and viscera generally requires the use of a power-driven pump; the aspiration test cannot be performed, and there is always risk of mechanical breakdown. Infiltration anaesthesia carries with it all the disadvantages of field block.

Bilateral Paravertebral Block.—If a true paravertebral block is performed in the manner originally suggested by Sellheim (1905) and perfected by Labat (1922) then the rami

communicantes and the sympathetic nerves are blocked as well as the intercostal nerves. If this procedure is repeated bilaterally from D 7 to D 12 then excellent abdominal anaesthesia and relaxation occur; a substitute for splanchnic block is, in addition, obtained. Unfortunately this otherwise excellent method has grave disadvantages. Skill above the average is required to place the point of the needle at the exit of the vertebral foramen. The difficulty of accurate injection makes this method unreliable. Ever present is the well-known danger of injecting anaesthetic solution into the prolongations of the subarachnoid space along the spinal-nerve roots. The all-important aspiration test may then be wrongly interpreted owing to cerebrospinal fluid being colourless. Paravertebral block is not a practical proposition in the hands of the average anaesthetist and surgeon.

Bilateral Mid-axillary Intercostal Block.—Here the intercostal nerves are injected in the mid-axillary line, generally from D 7 to D 11. This method has always enjoyed a certain amount of popularity, and quite recently has been recommended by Bartlett (1940). It has the disadvantage that having injected the intercostal nerves on one side the anaesthetist must change position, prepare the skin, and repeat the injections on the other. If the anaesthetist wishes to perform splanchnic block by the posterior approach of Kappis, which for reasons stated later we prefer to the anterior approach of Braun, the patient must undergo a change of posture, with fresh skin preparation and rearrangement of towels.

An Improved Method of Regional Anaesthesia

We believe that the method here recorded is free from the major disadvantages of the techniques described above. It has six main features: (1) adequate pre-operative omnopon (pantopon) sedation; (2) the preliminary use of a short-acting barbiturate—e.g., hexobarbitone *B.P.* (evipan); (3) posterior bilateral thoracic-nerve block; (4) bilateral splanchnic block by the posterior approach; (5) oxygen therapy with the B.L.B. mask; and (6) attention to gentleness in operative technique. A detailed description of the method follows.

Preliminary Sedation

If no sedative has been given before admission, or if sedation has been inadequate, then as soon as consent for operation has been obtained the patient receives an intravenous injection of omnopon. We use the drug intravenously because of its rapid action by this route and because, by giving it slowly, the dose can be regulated to the patient's requirements. The respiratory rate should not be depressed below 14 to the minute. A small dose of atropine (1/100 grain) is given subcutaneously half an hour before operation.

Surgical Preparation

In the ward a radiant-heat cradle is used, the foot of the bed is raised, and when required, as in cases of intestinal obstruction, the stomach is emptied by a small-calibre tube (Ryle or Miller Abbott), which is left in position both during and after operation. Intravenous infusion is employed when necessary: in cases of profuse vomiting, intravenous glucose saline is given; plasma or blood is used as indicated. A B.L.B. mask is applied when anoxia is suspected and in cases of intestinal obstruction with distension (Fine, Hermanson, and Frehling, 1938). When the condition of the patient has improved the abdomen and back are prepared in the usual way.

Preliminary Intravenous Narcosis

If the patient's condition permits, intravenous hexobarbitone *B.P.* (evipan) is given in the anaesthetic room.

Should further omnopon sedation appear necessary we find that drawing up 1/3 grain of omnopon into the evipan solution is a safe and useful procedure provided the resulting straw-coloured solution is introduced with extra slowness and caution. One of us (N. R. J.) has used this method since 1937. We prefer evipan to pentothal because after a "single" dose it gives a long light narcosis without undue depression of the respiratory and cardiovascular centres. Evipan does not diminish the oxygen capacity of the blood (Pask, 1941). Intravenous evipan with omnopon sedation not only renders the patient unconscious during the insertion of the regional anaesthetic but, if a suitable dose has been given, keeps him asleep throughout even a long abdominal operation if no unanaesthetized area is stimulated. The benefits of light general narcosis supplementing regional anaesthesia and thus preventing psychic trauma were first emphasized by Crile and Lower (1920), and were recently referred to by Hewer (1940). The short-acting intravenous barbiturates—e.g., evipan—are particularly useful in that they protect against the toxic effects of regional anaesthetic solutions (Rovenstine and Cullen, 1939). Moreover, they are portable, easy to administer, and non-inflammable—virtues which are especially important in war surgery. Should the patient's condition be so grave as to make him apathetic to his surroundings, then supplementary intravenous narcosis is used only if he becomes restless during operation. It is omitted in cases of severe vomiting, for then the risk of inhaling vomitus is present even though continuous gastric aspiration is employed. The importance of maintaining a clear airway cannot be emphasized too strongly. We use a nasopharyngeal tube, made by cutting an old Magill's endotracheal tube of suitable diameter to a length equal to the distance between the lobe of the patient's ear and the alae nasae. A safety-pin is inserted through the non-bevelled end to prevent the tube being inhaled. If this short tube is placed correctly it is tolerated even in very light narcosis.

Regional Anaesthesia

Preparation of Solution.—Wearing sterile gloves, the anaesthetist prepares a 1% solution of novocain with adrenaline. We take two 1-gramme sterile ampoules of planocaine and dissolve the contents in 200 c.cm. of sterile normal saline to which is added, from a sterile ampoule, 0.5 c.cm. of 1 in 1,000 adrenaline. The sterile 10-c.cm. syringe (we use the Lundy type) and needles, which have been previously sterilized by boiling and allowed to cool gradually, are washed through with cold sterile water.

Technique of Posterior Bilateral Thoracic-nerve Block.—The patient is turned on to his left side and the vertebral column is flexed by an assistant as in spinal anaesthesia, care being taken that the airway is maintained. A small pillow is, when necessary, placed under the loin to prevent sagging of the lumbar spine. The skin is painted with 1 in 1,000 flavine in spirit and the highest points in the iliac crests are palpated to determine the intercostal line. Immediately below this line lies the fourth lumbar space, and from here the first lumbar space and then the tip of the first lumbar spine are identified. A point is taken 6 to 8 cm. (3 or 4 fingerbreadths) lateral to this spine, and here a 10-cm. needle is inserted to rest on the twelfth rib at its lower border. The syringe is now attached, and the point of the needle is made to slip off the lower border of the rib and is advanced for a distance of not more than 1 cm. The needle point now lies in the region of the neurovascular bundle, but it is difficult to know when it is just in the right fascial plane. It is therefore important that, as the injection is given, a to-and-fro movement of the needle is made; only in this way can one be sure of "hitting off" the nerve. A total of 8 c.cm. of the anaesthetic solution

is injected, and this subcostal injection is repeated up to and including D 6. The whole process is then repeated on the other side. In thin patients the ribs can be palpated, but in obese or muscular subjects they must be found by exploration with the needle. This is not difficult, but it should be noted that the tenth and eleventh intercostal spaces are appreciably wider than the preceding ones. Anaesthesia by this method is easy to perform and is associated with good relaxation of the abdominal muscles and with "negative intra-abdominal pressure." This last factor is very important in acute abdominal surgery.

Technique of Splanchnic Block.—We use a 0.5% solution of novocain with adrenaline; this we obtain by adding an equal quantity of saline to the 1% solution remaining from the thoracic-nerve block. At the site of injection of the twelfth dorsal nerve a 12-cm. needle is introduced at an angle of 45 degrees to the median plane and is advanced until its point strikes the body of the first lumbar vertebra. The needle is then partly withdrawn and advanced again more tangentially, and the procedure is repeated until the needle is felt to slide past the body of the vertebra for a distance of not more than 1 cm. If no flow of blood occurs 1 c.cm. of 0.5% anaesthetic solution is injected to clear the needle. The aspiration test is performed carefully and, if negative, the remaining 9 c.cm. is injected; the aspiration test is repeated at least once during this injection. A total of 30 to 40 c.cm. is given in this way, and the technique is repeated on the other side. It is important that the needle point should lie in the loose retroperitoneal areolar tissue and not within the substance of the crus of the diaphragm. Some indication of its true position is given by the feel of the piston as the injection is made; if the needle is placed correctly the piston is pressed home without resistance. We prefer to use this posterior approach of Kappis (1914) because: (1) the block is inserted and has time to take effect before the operation has begun; (2) the intra-abdominal manipulations of the anterior approach are avoided; (3) the anterior approach cannot be performed efficiently except through an upper abdominal incision; and (4) we have found it an efficient and safe method. Hewer states that "experimental injections made in the post-mortem room with methylene blue showed that this technique does soak the splanchnic area efficiently." He also states that "posterior splanchnic block is a reasonably safe procedure if carried out with all precautions."

Management of the Patient on the Table.—The patient is lifted on to the operating table and a pillow is placed under the knees. This small degree of hip-joint flexion improves relaxation of the abdominal wall. The legs are held in position by a padded strap passed over the thighs just above the knees. The patient's head rests on one pillow, and the hands are placed under the head in the "sun-bathing" position. The arms in this position may easily be controlled and a further intravenous injection may readily be given, if required.

Oxygen Therapy

We believe that in all grave cases oxygen therapy is of great utility. We have used it as a routine, and have come to regard it of value in every case not only during operation but also pre- and post-operatively. Waters, Wineland, and Seevers (1931) have pointed out that morphine and the barbiturates are two of the many factors which may cause anoxia in the surgical patient. We use a B.L.B. mask with all ports closed, the oxygen flow being adjusted to 6 to 8 litres a minute. A flowmeter should always be employed, as the flow of oxygen may be inadequate though the bag may appear to be filling properly. A reducing valve should be used if available.

Points in Operative Technique

(a) The towel clips should not include the skin. (b) An adequate incision is important: a little extra length often allows the operation to be carried out with ease and without undue traction on the viscera. (c) A vaselined glove makes insertion of the hand and exploration of the abdomen a much less traumatic procedure. (d) The adoption of the Trendelenburg position in the lower abdomen and of the reversed Trendelenburg in the upper abdomen allows the intestines to fall away and often obviates the use of intraperitoneal packs. (e) A gentle operative technique is essential throughout. Retractors and packing should be avoided where possible, and traction on all tissues should be gentle and gradual.

Scope and Indications

We are aware that we are describing no new technique of regional anaesthesia, but we believe we have evolved a method by which its long-recognized advantages in acute abdominal surgery can be put to practical use. Regional anaesthesia is often supplemented by "light" inhalation narcosis, but in many of such cases we have observed that the inhalation narcosis has been anything but light and the regional anaesthesia in reality superfluous. While the method we describe is useful in "interval" surgery, we believe it to be of most value in the "poor risk" acute abdomen. We consider that, where possible, the patient should not undergo the ordeal of being conscious during the administration of a regional anaesthetic or during the subsequent operation. *The advent of the short-acting barbiturates has in our opinion revolutionized the possibilities of regional anaesthesia.* We have found that after adequate preliminary omnopon a single intravenous injection of evipan (usually 0.5 to 1 gramme in the "poor risk" abdomen) keeps the patient asleep throughout even a long abdominal operation if no unanaesthetized area is stimulated. In experienced hands the method we describe is safe and reliable and is not difficult to perform. It does require practice, and the anaesthetist must be fully conversant with the use and dangers of intravenous narcosis. The application of this method to abdominal war surgery should be of value.

Summary

The various types of regional anaesthesia in present use are discussed. A new method is described. It combines: (1) adequate pre-operative omnopon sedation; (2) the preliminary use of hexobarbitone B.P. (evipan) in preference to pentothal; (3) posterior bilateral thoracic-nerve block from D 6 to D 12 inclusive; (4) bilateral splanchnic block by the posterior approach of Kappis; and (5) pre-operative, operative, and post-operative oxygen therapy, using the B.L.B. mask.

The importance of gentle operative technique is stressed.

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