REGIONAL ANALGESIA

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Every advance in general anaesthesia renders regional analgesia of less importance, because patients prefer to be unconscious when undergoing operations of any magnitude and surgeons usually prefer an unconscious patient. However, regional analgesia will always continue to occupy a place of importance in the anaesthetist's stock in trade. The present article is an attempt to present, briefly, the commoner aspects of the subject in a simple form, and is based on the experience of a surgeon.

The substances commonly employed in regional analgesia are lipid soluble alkaloids which are hydrolyzed by the alkalinity of the tissues, the positive ion reacting with the negative ion in the neurons. Nerve fibres are paralysed in the following order: firstly, the vasoconstrictor fibres, then the temperature, pain and touch fibres, then deep sensation, and finally the motor fibres. Thus with graduated dosage of the anaesthetic substance the patient may be able to perceive some sensation from the injected area, and may be able to move the muscles locally and yet feel no pain. Usually, however, the area is rendered completely insensitive.

The drugs may be tabulated as follows. (In strengths of 1 per cent. or less the solutions should be made up with normal saline so as to avoid the deleterious effects of markedly hypotonic injections. The maximum quantities given are generally considered safe).

COCAINE

1884. Koller. Formula: Cocaine hydrochloride. By surface application only, 4 per cent. eye; 10 per cent. E.N.T. The only vaso-constrictor local analgesic substance. Habit forming. Thermolabile and therefore difficult to sterilize. Note: danger of anaphylaxis.

PROCAINE

1905. Einhorn. (synonyms, Novocaine, Ethocaine). Formula: Para-aminobenzoylethylaminoethanol hydrochloride. By injection: $\frac{1}{2}$ per cent. up to maximum of 300 cc.: 1 per cent. up to maximum of 100 cc.: 2 per cent. up to maximum of 35 cc. Dose: 1 gm. but can be exceeded in weaker solutions. Para-aminobenzoic acid

factor neutralizes sulphonamides 1:250 mols. Thermostable.

NUPERCAINE

1929 (Percaïne). Formula: Butyloxycinchonic acid diethylethylendiamide hydrochloride. By local application, $\frac{1}{2}$ to 1 per cent. Ointment 1 per cent. By injection 1/2000 up to maximum of 300 cc.: 1/1500 up to maximum of 120 cc.: 1/500 up to maximum of 35 cc. Readily decomposed by alkali. Thermostable. More prolonged in action than Procaine or Amethocaine.

AMETHOCAINE

1931 (Decicaine, Pantocaine). Formula: Parabutylamino-benzoyl dimethylaminoethanol hydrochloride. By local application 1 per cent. Eye and E.N.T.; 1 per cent. to $\frac{1}{2}$ per cent. ointment. By injection 1/2000 up to maximum of 300 cc. 1/1000 up to maximum of 150 cc. Thermostable. Good adjuvant to procaine. Self-sterilizing to non-sporeforming organisms. ? risk of anaphylactic reaction. More prolonged in action than procaine.

ADRENALIN HYDROCHLORIDE

1903. Braun. By injection, strength 1/250,000 combined with procaine, nupercaine or amethocaine (maximum dose 1 cc. of 1/1000 adrenalin solution, usual dose $\frac{1}{2}$ cc. or 5 minims). Produces an ischaemic field, prolongs effects of local analgesic, diminishes toxic effects: allow 10 minutes to act. Do not use in constricted areas such as fingers or toes. If used by itself to produce an ischaemic field under general anaesthesia, strength 1/500,000.

The patient should receive some form of sedation before the operation, and for this purpose barbiturates are usually more suitable than derivatives of opium. The operators, both the anaesthetist and the surgeon, must have the patient's complete co-operation and it is, therefore, always advisable to be frank with the patient and inform him of exactly what is going to be done. Theatre noises should be reduced to a minimum, bright lights should not be shone in the patient's eyes, and the operating table must be made as com-

fortable as possible. It is preferable to have the patient's own nurse sitting by his side, to reassure him from time to time if he is nervous. Plugging of the ears and bandaging of the eyes or other matters tending to constrict or restrict the patient should be avoided.

Methods of Regional Analgesia

(1) *Surface application* to produce analgesia by permeation.

(2) *Infiltration of an area.* An initial intradermal weal is made slowly, using a very fine hypodermic needle. This is succeeded by subdermal infiltration in the line of the skin incision, with any necessary subsidiary intradermal weals made from within. The patient should thus appreciate but one prick during the course of the entire infiltration. The injection must be carried out slowly and systematically so that the patient is never pained or surprised by what is being done.

Deeper infiltration should be carried out with great care, ensuring that none of the solution is ever introduced into a vein and that a sufficient quantity of the solution is placed uniformly throughout the appropriate tissue planes. In order to obtain this uniform distribution it is better to inject the solution in smaller rather than larger quantities, and this is much easier to achieve by using a syringe of 5 cc. capacity than one of 10 or 20 cc. A syringe with a 'self-filling' device is of great assistance, with a 'screw on' or 'bayonet' fixing for the needle. For most infiltrations a fine needle 4 inches (or 10 cm.) long should be used. An all-metal syringe with a screw-on needle may be essential when infiltrating badly scarred tissues or around teeth.

The two methods of avoiding intravenous injection are to aspirate before injecting the solution whenever one is working in a field where there are large blood vessels (such as in the posterior triangle of the neck); and to keep the point of the needle moving whenever circumstances permit. These two methods should constitute a habit during all infiltrations.

(3) *Field block*, by producing a cylinder, cone or wall of infiltrated tissue around the site of the operation. This method differs from the infiltration of an area in that the nerves supplying the part are paralysed and the part itself is not injected. Usually, however, it is combined with local infiltration.

(4) *Nerve block* analgesia, either by intraneural or paraneural injection proximal to the site of operation. A small quantity of a stronger solution is used for intraneural injection.

These four are the main methods in use, but it is necessary to mention in addition analgesia of limbs by refrigeration and by intravascular injection

distal to a firm tourniquet. Should this latter method be used it is advisable to have two proximal tourniquets, owing to the danger of spillage into the general circulation should a single tourniquet loosen.

Paravertebral and epidural block are outside the scope of this article.

Technique

(1) In excising lymph nodes and small tumours, or in the removal of sub-maxillary calculi, accessible foreign bodies etc., it is useful to introduce a pool of the local anaesthetic substance, in weak solution (e.g. $\frac{1}{2}$ per cent. procaine), deep to the object to be excised immediately after making the intradermal or submucosal weal. This pool of solution will lift the object or tumour into the field of operation, whereas if the infiltration over the tumour is made first, then the tumour will be thrust deeper into the tissues, and be less readily accessible to the surgeon. If this method is used in the posterior triangle of the neck, the patient should be warned of a possible temporary partial paralysis of the arm.

(2) Use in trauma

(a) *Fractures.* Local injection into the fracture haematoma has been used for a long time, but was popularized by Lorenz Böhler in 1929. It is effective during the first four days but after that time the haematoma becomes organized and the analgesia is incomplete. It is of value in all closed fractures of subcutaneous bones, but should not be used where there is obvious impaction, or where there is the least risk of infection. It is preferable for an X-ray to be taken before the injection, but in some cases, when the patient is shocked or where the fracture is obvious, an immediate injection to relieve pain may be of great value in saving distress to the patient, alleviating shock and enabling X-rays to be taken with much greater convenience. Fractures of the deeper bones may also be injected to relieve muscle spasm, a method of value in treating fractures of the shaft of the femur with skeletal traction. 2 per cent. procaine is used and the amount injected varies between 10 and 35 cc.

The intradermal weal is made over the point of greatest tenderness, and a fine needle of suitable length inserted through a safe area, away from blood vessels, while a small quantity of 2 per cent. procaine is being injected. As soon as it is estimated that the haematoma has been reached, suction is applied to the syringe and aspiration of diluted blood will indicate that the point of the needle is correctly placed for the injection of about one-third of the solution. The needle is held in this position for a minute or two while the pain of

the fracture is partially relieved. It is then inserted further into the fracture haematoma between the broken bone ends, aspiration is again done to ensure that the point of the needle is still in the fracture haematoma, and the rest of the solution is injected. Gentle manipulation after a delay of about three minutes (before the fracture is reduced) will ensure that the anaesthetic solution reaches all points of the fracture haematoma.

It is necessary to emphasize that this method must only be applied with the strictest aseptic precautions. A special trolley with special instruments must be reserved solely for this purpose in any general out-patients operating theatre.

(b) *Sprains etc.* Considerable relief can be afforded to patients with sprained ankles, torn collateral ligaments of the knee joint, torn plantaris tendons etc., by the injection of the damaged ligaments or tendons with small quantities (2 to 10 cc.) of procaine or 2 per cent. procaine. The method is of therapeutic value in that movements are retained, that X-rays can be effectively taken to show ligamentous instability, and that vascular spasm with consequent oedema is often relieved. The injections may be repeated daily for the first two or three days after injury.

(3) *Nerve blocks*

(a) *Brachial plexus block (Patrick).* The method is of value in certain cases where general anaesthesia is contra-indicated and where complete relaxation is required below the level of the elbow joint; and as a supplement to intercostal nerve block and infiltration for operations around the shoulder joint. The patient is best anaesthetized sitting with the head turned to the opposite side and the shoulder of the same side dropped. An intradermal weal is made just above the middle of the clavicle. A fine needle 10 cm. long is introduced through the weal, the point being directed backwards, inwards and downwards. It is important that the needle should pass lateral to the subclavian artery, and the easiest way of avoiding the artery is to palpate it with the index finger of one hand while the needle is being inserted with the other. (The left index finger is used to palpate the artery on the left side and the right index finger on the right side.) The needle is inserted until the patient complains of paraesthesia down the arm, or until contact is made with the upper surface of the first rib. A syringe containing 2 per cent. procaine with adrenalin is then attached, aspiration is made and 5 cc. of the solution is slowly injected. Should the point of the needle lie on the first rib, the needle is withdrawn slightly during this injection. The position of the needle is then altered and the injection repeated until a total of 20 to 25 cc. of the solution has been introduced, the

whole area of the brachial plexus immediately behind the subclavian artery being covered. The region should be massaged gently but firmly and the patient left for twenty minutes before any operation is undertaken. If the region to be dealt with is around the elbow joint, the intercosto-brachial nerve must also be blocked by injecting subcutaneously around the inner aspect of the upper arm.

(b) *Cervical plexus.* The branches of the 2nd, 3rd and 4th cervical nerves become superficial at the posterior border of the middle third of the sternomastoid muscle. By infiltrating this area with 30 cc. of 1 per cent. procaine a very satisfactory block is obtained.

(c) *Peripheral nerves.*

(i) *Ulnar.* This nerve can be blocked by intraneural injection at the elbow behind the internal epicondyle: or by paraneural injection at the wrist just above the pisiform bone and deep to the tendon of flexor carpi ulnaris.

(ii) *Median.* This can conveniently be blocked by a paraneural injection just above the wrist joint. The nerve lies immediately deep to the palmaris longus tendon.

(iii) *Radial.* This is most accessible where it lies in front of the external epicondylar ligament about two fingers' breadth above the tip of the external epicondyle. The ridge formed by the ligament can easily be felt, and a pool of procaine is placed just in front of it, the needle being inserted from the lateral side.

(iv) *Femoral.* The femoral nerve lies less than one finger's breadth lateral to the femoral artery and deep to the fascia covering iliacus muscle and psoas tendon. It is situated, therefore, in a tissue plane deeper than the artery. The needle should be inserted through an intradermal weal placed immediately below the mid-point of the inguinal ligament. If the patient feels paraesthesiae only a small quantity of procaine needs to be injected since the point of the needle will be within the nerve sheath. If paraesthesiae are not experienced, the needle should be inserted until the superior ramus of the pubis is felt and about 20 cc. of 1 per cent. procaine injected after the needle has been withdrawn about 1 cm.

(v) *Sciatic.* This nerve is best approached from the postero-lateral aspect, the patient lying in the lateral position with the upper leg semiflexed at hip and knee and placed across the under leg. The tip of the greater trochanter and the most prominent part of the ischial tuberosity are marked and these two points joined by a line. The nerve passes straight down the back of the thigh from the point where the inner and middle thirds of this line meet. The needle is inserted at this point and is pushed straight into the lower part of the

buttock at right angles to the skin in both planes. The nerve will be encountered just after it has come out of the greater sacro-sciatic notch and where it constitutes a broad flat band. Paresthesia may be felt, in which case only about 12 cc. of 2 per cent. procaine need be injected. If paresthesiae are not felt about 25 cc. of 1 per cent. procaine should be injected and the part well massaged.

(vi) *Obturator.* This nerve leaves the pelvis through the upper part of the obturator foramen where both anterior and posterior branches can be blocked. The needle is inserted just below and outside the pubic spine, and inclined slightly so that the point will strike the superior ramus of the pubis above the middle of the obturator foramen. The point of the needle is then inserted into the foramen by feeling round the lower border of the bone. As soon as it is felt to enter the foramen 20 cc. of 1 per cent. procaine are injected after careful aspiration.

(vii) *External femoral cutaneous.* This nerve enters the thigh by passing deep to the inguinal ligament just medial to the anterior superior iliac spine, and over or through the superficial fibres of sartorius muscle near its origin. (Fig. 1.) A point one and a half fingers' breadth below the anterior superior iliac spine is taken and the needle inserted to bone. It is then withdrawn about 1 cm. and about 30 cc. of 1 per cent. procaine are injected deeply and superficially (Fig. 1B and A) to make a pool within the muscle and covering its surface. (Analgesia of the area of skin supplied by this

nerve is of value in obtaining skin-grafts for granulating areas.)

Block of the femoral, external femoral cutaneous, sciatic and obturator nerves needs to be supplemented by a circumferential subcutaneous infiltration to ensure complete analgesia of the thigh. Communicating branches are derived from adjacent nerves, and the femoral branch of the genito-femoral nerve supplies a varying area of skin on the anteromedial aspect.

(viii) *Internal popliteal.* A point at the apex of the popliteal fossa 2 inches (5 cm.) above the posterior fold of the knee is marked and the needle inserted at right angles to the skin in both planes. At this point the internal popliteal nerve lies a little distance lateral to the femoral vessels and separated from the posterior aspect of the femur by loose fibro-areolar tissue only. The needle is inserted to bone, withdrawn about 1 cm. and a pool of 25 cc. of 1 per cent. procaine solution injected.

(ix) *External popliteal,* or common peroneal nerve, can be felt behind the neck of the fibula and can there be blocked by intraneural or paraneural injection.

(x) *Digital nerves.* These nerves lie at the lateral and medial aspects of the palmar or plantar surfaces of the fingers or toes. They can be paralysed by the injection of 1 cc. of 2 per cent. procaine around each nerve: but it is usually advisable in addition to ring the base of the finger or toe. The quantities of local anaesthetic solution should be as small as possible. The nerves are accompanied by the digital vessels as they pass through the subcutaneous tissue. This is compartmented and not as elastic as elsewhere in the body. Adrenalin should, therefore, never be used in the digits as there is a danger of producing ischaemia.

(d) Cranial nerves.

The fifth. The supraorbital branches of this nerve are blocked by infiltrating superficially to the galea aponeurotica just over the supraorbital ridge. The mandibular division is paralysed by injection through the mouth just above and behind the last lower molar tooth. The maxillary division, on the other hand, is relatively inaccessible. It can be blocked most successfully just after it has left the foramen rotundum at the apex of the sphenomaxillary fossa. The needle is inserted at the junction of a line drawn horizontally out from ala nasae with a line dropped perpendicularly down from the outer canthus of the eye. It is introduced, in the sagittal plane, immediately below the malar process of the maxilla, and then directed upwards (so as to skirt the posterior part of this bone) to the apex of the sphenomaxillary fossa. Here a pool of the anaesthetic solution is placed (about 15 cc. of 1 per cent. procaine).

FIG. 1.—Infiltration for lateral femoral cutaneous nerve.

The vagus. The needle is inserted just below and in front of the tip of the mastoid process, and then passed in so that the point lies on the anterior surface of the transverse process of the atlas bone. 10 cc. of 1 per cent. procaine are injected after careful aspiration. The hypoglossal nerve will probably be paralysed as well as the vagus and, if injection is done on both sides at the same time, (as indeed it may be in operations on the larynx, etc.) there is a considerable risk that the tongue will fall back. It is therefore essential to maintain a clear airway, even though the patient may be conscious.

(4) In specific operative procedures

(i) *Thyroidectomy.* It is now very seldom necessary to operate on patients with disease of the thyroid gland who have not been well prepared and rendered fit to tolerate a general anaesthetic. Local infiltration is, therefore, done more as an adjuvant to the operation than as an adjuvant to the anaesthetic. It is the author's usual custom to use about 70 cc. of 1/500,000 adrenalin solution, injected subcutaneously in the line of the skin incision, and deep to the platysma from the eminence of the thyroid cartilage to the suprasternal notch and laterally to cover the medial half of both sternomastoid muscles. The injection is made after the induction of the general anaesthetic. When analgesia is required, 100 cc. of 1 per cent. procaine are used, with adrenalin to a strength of 1/250,000. A diffuse injection similar to the above is made through weals at each end of the proposed skin incision. Three subsidiary deeper injections are then made, one on each side of the thyroid cartilage in the region of the superior thyroid pedicles and one in the suprasternal notch placing the solution around both sides of the trachea. A cervical plexus block may also be made on one or both sides.

(ii) *Intercostal nerve block, for intercostal drainage of empyemata, for mastectomy, etc.* The intercostal nerves are blocked by injection through intradermal weals placed over the corresponding ribs. 1 per cent. procaine is injected while the needle is inserted down to the surface of the rib. The point is then worked round the lower border of the rib and pushed in a further 5 mm. The point of the needle is thus placed deep to the intercostal muscles in the compartment where the intercostal nerve and vessels are running. 5 to 10 cc. of the solution is injected into each space. It is most important to avoid puncturing the lung, and extensive intercostal blocks are not without danger. The skin and the muscular planes at the site of the operation must also be diffusely infiltrated.

(iii) *For varicose veins.* (Trendelenburg's

FIG. 2.—Infiltrations for inguinal and femoral herniae.

operation.) The central point of the infiltration is situated $1\frac{1}{2}$ in. (3.5 cm.) below and outside the pubic spine. The incision is usually carried in an oblique manner from just over the inguinal ligament down on to the inner side of the thigh, and is about $3\frac{1}{2}$ in. (8 cm.) long. The infiltration should be done subdermally in the line of the incision, and deeper into the subcutaneous tissues covering a circular area centered on the mid-point of the skin incision. Liberal quantities of a dilute solution (e.g. $\frac{1}{2}$ per cent. procaine with adrenalin) should be used.

(iv) *Inguinal hernia.* (Fig. 2.) The incision now commonly made for inguinal herniae runs almost horizontally in the line of the skin creases, extending outwards from near the midline about $\frac{3}{4}$ in. (2 cm.) above the pubic tubercle. A single intradermal weal is made at the outer end of this incision and the line of the incision infiltrated subdermally. (Fig. 2A.) More of the solution is then injected deep to Scarpa's fascia, so as to cover the surface of the external oblique aponeurosis in the line of the inguinal canal. A second intradermal weal is then made from within, 1 in. (2.5 cm.) above and medial to the anterior superior iliac spine. From this point the ilio-hypogastric and ilio-inguinal nerves are blocked by an injection of 10 to 15 cc. of the solution between the external oblique aponeurosis and the internal oblique muscle. (Fig. 2C.) This injection is also carried into the internal oblique. The inguinal canal is then infiltrated throughout its length so as to lift the external oblique aponeurosis from the underlying structures, extending the infiltration medially to the fusion of external and internal oblique aponeuroses. (Fig. 2B.) The midpoint of the inguinal ligament is then noted and an injection is made into the internal inguinal ring just above the inguinal ligament, so as to infiltrate the coverings of the cord and anaesthetize the genital branch of the genito-femoral nerve. (Fig. 2D.)

This injection needs to be done with care and the needle-point directed so as not to puncture the external iliac artery. It is usually quite safe to pass the needle-point in 2 cm. deep to the external oblique aponeurosis, provided that it is directed away from the artery. About 10 cc. of solution are used for this injection, aspiration being done whenever the needle is moved. Finally 5 cc. are injected into the cord just after its exit from the external ring. (Fig. 2, E.) Herniae should be reduced before the infiltration is begun. The method requires minor modifications in dealing with strangulated and irreducible herniae. Should a hydrocoele be operated upon at the same time as the hernia, the subdermal infiltration is extended around the neck of the scrotum. 100 cc. of 1 per cent. procaine with adrenalin is required for the entire infiltration.

(v) *Femoral hernia.* Femoral hernia are now usually operated on through a high incision similar to that described above for inguinal herniae. The method of infiltration is the same, except that the cord need not be infiltrated and the pool deep to the external oblique aponeurosis need not be placed so high. The infiltration must be extended downwards into the thigh deep to Colles' fascia which covers the sac and is attached above to the inguinal ligament (Fig. 2, F, this supplementary injection being depicted on the opposite side).

In resecting strangulated intestine, pain will be caused if the mesentery is pulled upon. The base of the mesentery supplying the gangrenous loop should, therefore, be infiltrated as soon as the gut has been delivered.

(vi) *For gastrotomy, Ramstedt's operation, stab suprapubic cystotomy, blind caecostomy, etc.* For all these operations a simple diffuse infiltration is done. The parietal peritoneum is sensitive and it is necessary to place a reasonable quantity of the solution between it and the posterior rectus sheath or the posterior surface of the rectus muscle.

The correct placing of the local analgesic solution in the different planes of the anterior abdominal wall is facilitated if a needle is used with not too sharp a point. Using a blunted needle, it is easy to appreciate by touch and by sight when the point has penetrated a fascial plane: whereas a very sharp needle passes in without being resisted by the tougher tissues.

(vii) *Anterior abdominal block for extensive epigastric operations.* There is a risk of puncturing the lung in doing thoracic intercostal nerve blocks. It is, therefore, the author's preference to block the intercostal nerves where they enter the posterior rectus sheath immediately below the subcostal margin. This infiltration is begun through a weal placed where the edge of the rectus muscle crosses the costal margin and is carried up and

FIG. 3.—Infiltrations for anterior abdominal block.

down on both sides (Fig. 3, B-B) using a long needle and injecting a total of 120 cc. of $\frac{1}{2}$ per cent. procaine-adrenalin solution. A subcutaneous infiltration is made in the line of the skin incision and carried up over the xiphisternum in the case of mid-line and paramedian incisions (Fig. 3, A-A). A pool of the solution is placed in the extraperitoneal tissues also in the line of the incision (Fig. 3, C).

This infiltration may need to be supplemented by blocking the splanchnic nerves and the branches of the coeliac ganglion. This can be done either from the front after the peritoneum has been opened (Braun's method) or from behind before the operation is begun (Kappis' method). The former is to be preferred since it is quicker, safer, more certain and is not done until a preliminary exploration has been carried out.

BRAUN'S METHOD OF SPLANCHNIC BLOCK

The upper border of the pancreas is felt through the gastro-hepatic omentum. The index and middle fingers of the left hand are pressed back at this level between the aorta and the inferior vena cava until the body of the first lumbar vertebra is palpated, thus separating these two large vessels. A long guarded splanchnic needle is then introduced between the two fingers until contact is made with bone. The needle is then lifted about 1 cm. and held in this position by the surgeon. The assistant injects between 60 and 80 cc. of 1 per cent. procaine. The whole area around the base of the coeliac axis is thus infiltrated producing a complete splanchnic block with certainty.

KAPPI'S METHOD

The injection is made from the back, first from one side and then from the other, a long needle being introduced 7 cm. lateral to the first lumbar

spinous process. The needle is inserted in the coronal plane at an angle of 45° to the sagittal plane. The point of the needle strikes the side of the body of the first lumbar vertebra and is worked forward until it skirts the antero-lateral aspect of the bone. Injection of 40 cc. of 1 per cent. procaine is then made.

The total quantity of local analgesic substance used in anterior abdominal field block and splanchnic block is liable to exceed the quantities noted on page 539. The interval of time over which the injections are made, particularly when using Braun's technique, renders the method safe. For prolonged operations, amethocaine or nupercaine are preferable to procaine.

(viii) *Haemorrhoidectomy.* A circumferential injection of local analgesic solution is made subcutaneously around the whole anus. The left index finger is then inserted into the rectum and, taking all aseptic precautions, the whole anal canal is encircled by a cylinder of the solution which is placed outside the anal musculature up to the ano-rectal ring. This will anaesthetize the sensitive parts of the anus and paralyse the sphincteric mechanism.

(ix) *Extra dural caudal block.* This method is of value in operations on the anus when infection is present and in association with suprapubic infiltration for prostatectomy. It is also used in childbirth. An 8 cm. needle is inserted through the sacral hiatus and passed 5 cm. (2 in.) up the sacral canal. Aspiration is then made, to ensure that the point of the needle is accurately placed below the termination of the dural sac. 30 cc. of 2 per cent. procaine are injected. For fractional analgesia 20 cc. of 2 per cent. procaine are injected hourly. For prolonged fractional analgesia a ureteric catheter is introduced into the sacral canal through a wide bore needle.

Toxic Manifestations and their avoidance

The conscious patient shows excitement, develops convulsions and becomes unconscious. Coma deepens, accompanied by intense vasomotor collapse. The unconscious patient will show an increase in pulse rate and a drop in the blood pressure which will probably not be attributed to the maladministration of the analgesic substance. Convulsions, collapse and deepening coma will follow. Cocaine may rarely cause anaphylactic shock.

Sodium pentothal or other intravenous barbiturate should be administered carefully, together with adrenalin (allowing for the amount that has been injected with the analgesic). The airway should be kept well open and oxygen given by forced respiration. Further absorption from the infiltrated area may be prevented or reduced by wide incision or excision.

The anaesthetist must be continuously on guard against intravenous injection of any of these drugs since one tenth the dose than can be infiltrated into the tissue planes will produce toxic effects when injected directly into the circulation. The anaesthetist should always use the same drug in standard strengths so as to avoid confusion in the dispensing of the solutions. The syringe should, whenever possible, be filled directly from sterile labelled ampoules or phials and the necessary quantity of adrenalin added by the anaesthetist himself. When it is the routine for the theatre sister to present the solution already prepared in an unlabelled bowl or measuring jar, the anaesthetist should insist on being informed by the sister of the precise quantity of the solution and its exact constituents.

Success in regional analgesia depends on enough of a solution of the correct strength being placed in the right tissue planes. It is a mistake to attempt it without a working knowledge of anatomy.

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