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LOCAL ANAESTHESIA IN GENERAL SURGERY.

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## LOCAL ANAESTHESIA IN GENERAL SURGERY.

### INTRODUCTION.

With the discovery of the analgesic properties of cocaine there was opened up a new field in anaesthesia, one that has since been steadily widened. Corning<sup>1</sup> in 1885, first put these properties to practical use, in the application of solutions of the drug to the surfaces of mucous membranes. Later he extended the use to the tissues generally, by the injection of the solutions into them. This method was further developed by Reclus and by Schleich. Cocaine, in the strength of solution at first used, frequently gave rise to toxic symptoms, and these observers steadily diminished the strength of the solutions that they used.

<sup>2</sup>Schleich infiltrated the tissues with an hypotoxic saline solution containing only .2% of cocaine. This he used in the belief that anaesthesia was produced by purely physical means, the flooding of the tissues with an heterotoxic fluid, the cocaine being added merely to prevent pain during the infiltration. It has been shown, however, that an equal degree of anaesthesia can be produced by the same percentage of cocaine in normal salt solution, which is less irritating and damaging to/

1. New York Med. Journ. 1885.
2. Deutsche Klinik 1899.

to the tissues.

The next step in the development of the subject was the discovery by Oberst that anaemia of the part intensifies and prolongs the action of the drug by concentrating its effect and by delaying its absorption into the general circulation. This anaemia he attained by means of an elastic constricting band. Its use was necessarily confined to the extremities. The discovery of adrenalin and its vaso-constrictive powers brought into the field a physiological means of obtaining local anaemia and there has since been a constant association of this substance and the drugs for local anaesthetic purposes.

Esch<sup>1</sup> showed experimentally that the action of cocaine and novocaine is intensified by the addition of adrenalin. He states that this is not altogether a result, as is generally supposed, of the local anaemia producing concentrated action of the drug and greater susceptibility of the tissues, but is partly due to a specific action of adrenalin on nerve.

The toxic properties of cocaine brought into the field against it many allied drugs, chiefly of a synthetic nature. The relative value of these has been extensively tested and many have rapidly fallen into disuse. Le Brocq<sup>1</sup> presented a report on local anaesthetics to the Therapeutics Committee of the British Medical Association in 1909. His selection was/

1. B.M.J. March 27th, 1909.



was based on the following five requirements.

1. The drugs shall have an anaesthetic power at least equal to that of cocaine.
2. They shall have a less degree of toxicity than cocaine.
3. They shall be readily soluble and capable of being easily sterilised.
4. They shall not cause local irritation.
5. They shall be compatible with adrenalin.

He found five drugs that fulfil the first condition - alypin, beta-encaine lactate, novocaine, tropacocaine and stovaine, the first four being about equal in anaesthetic power to cocaine, the last more powerful. He drew up the following toxicity table for mammals.

Cocaine	=	1
Alypin	=	1.25
Stovaine	=	.625
Tropacocaine	=	.5
Novocaine	=	.49
Beta-encaine lactate	=	.414

The toxic action of all these is upon the central nervous system. All five substances are freely soluble, can be sterilised by boiling, and in solution are fairly stable. All are compatible with adrenalin. Strong solutions were used to test the possibility of irritative/



irritative action on the tissues, and it was found that, whereas there was a considerable reaction to stovaine, beta-encaine and tropococaine, cocaine caused but slight reaction, and novocaine none at all. As a result of his experiments he decided that novocaine is the best of local anaesthetics, possessing as it does an anaesthetic value equal to that of cocaine, ~~and~~ much less toxic power, and no irritative action on the tissues.

Chevalier<sup>1</sup> reports on an experimental investigation of the relative toxicity of local anaesthetic drugs. In dogs the following figures were obtained as the toxic doses.

By subcutaneous injection -

Cocaine	=	.04 gramme.
Alypin	=	.07 "
Stovaine	=	.12 "
Beta-encaine	=	.30 "
Novocaine	=	.45 "

By intravenous injection-

Alypin	=	.002 gramme
Cocaine	=	.003 "
Beta-encaine	=	.05 "
Stovaine	=	.1 "
Novocaine	=	.2 ""

These figures again show novocaine to be by far the/

1. Bulletin des Sciences Pharmacologiques, Nov. 1909.

the safest drug to use. Beta-encaïne is an energetic cardiac depressor and its toxicity is increased if it is rapidly introduced into the circulation.

Those drugs of greatest practical value in the production of local anaesthesia having now been briefly considered, their adjuvants may next be discussed.

Reference has already been made to the most important of these, adrenalin, and to its power of intensifying the action of the local anaesthetic.

Apprehension on the part of the patient is a factor which must be considered in operations under local anaesthesia, and to allay this, and at the same time, to diminish sensibility generally, it is advantageous to give an opiate about two hours before the commencement of the operation.

For this purpose I have used hypodermic injections of morphine,  $\frac{1}{4}$  to  $\frac{1}{3}$  of a grain, and the recently introduced opium derivative, omnopon. Omnopon is a preparation of opium introduced by Sahli<sup>1</sup> of Berne. It is a combination of twelve different alkaloids of opium in the same relative proportions as in opium. It produces marked narcosis without any preliminary stage of excitement and it is said to be less depressing/

1. Munch. Med. Woch. 1910. No. 25, p. 1326.

ing than morphia to the respiratory centre.

Omnopon was at first used for medical purposes, but it was soon adopted as a preliminary to general anaesthesia. Leipoldt<sup>1</sup> reports very favourably on its use in this respect and says that there is less tendency to an excitatory stage in the induction of anaesthesia than with scopomorphine.

Gray,<sup>2</sup> of Aberdeen, was the first to report on omnopon as an adjuvant to local anaesthesia. He used the drug alone and in combination with scopolamin, and found the combination by far the more effective. He concludes from his series of cases that omnopon-scopolamin enhances the success of local anaesthetics by fully 50%. Among the operations performed by him were such severe ones as gastrectomy, hysterectomy and prostatectomy. He found the drug to act best in patients of over 50, a fact that makes this method particularly valuable as it is often in these patients that it is least desirable to administer a general anaesthetic.

Fleischner<sup>3</sup> has recently reported favourably on the use of omnopon-scopolamin in ear and nose surgery, a very small quantity of A.C.E. mixture being sufficient to produce complete anaesthesia. He gives a warning that/

3. Lancet, Feb. 11th 1911.

2. Lancet, Sept. 2nd 1911.

3. Munch. Med. Woch, June 4th 1912.



that special care is necessary in regulating the dose in alcoholic subjects.

In this connection it is interesting to note that in a recent paper Brun<sup>1</sup> reports on 300 cases of operations on children, of age ranging from a few months to 15 years, in whom he used morphine as an adjuvant to general anaesthesia. He found that in 34 cases of young infants it alone sufficed as an anaesthetic, and notes its usefulness in plastic operations about the mouth. He asserts that the danger of morphine in children has been exaggerated and that they tolerate it quite as well as adults.

#### Classification of local Anaesthesia.

In the consideration of the production of local anaesthesia, a nerve may be divided into three parts.

1. The terminal filaments in the skin or other sensitive tissue. The anaesthetisation of these by direct application of solutions of drugs is the true "local anaesthesia" but as this term is commonly used in a much wider sense, I shall in this thesis apply the name "infiltration anaesthesia" to this method.
2. The main nerve trunk in its course outside the spinal canal. To the anaesthesia produced in this part/

1. Gazz. degli Osped. April 16th, 1912.

part the names of "regional" and "conduction" anaesthesia are given.

3. The nerve trunk in its course within the spinal canal. The anaesthetisation of the nerve in this part of its course constitutes spinal anaesthesia. With this branch of the subject I do not propose to deal.

#### Infiltration Anaesthesia.

For the production of anaesthesia by this method I have used novocaine in .5% solution in normal saline. As a rule, the solution has been freshly made up, but I have not noticed any diminution in its anaesthetic action when it has been kept for from seven to fourteen days. Adrenalin (1-1000) is added to the solution immediately before using, to the extent of 3 drops to 10 c.c.s. of the solution. The solution is warmed to body temperature before injection. For the injection I have used Barker's special syringe fitted with fine Schimmel's needles an inch or an inch and a half in length. I have found the longer fine needles so pliable that it is difficult to control the direction of the point in the tissues.

Method of infiltration. The needle is inserted through the whole thickness of the skin and is pushed along parallel with the surface, in line of the proposed incision. When it has been pushed to its full extent, it is slowly withdrawn, and during the withdrawal the/

the novocaine solution is steadily injected. (I have not used the endermic method of injection, for I have obtained excellent results with the subdermic method, and the former is a procedure more painful to carry out, and more apt to impair the vitality of the skin).

The needle is again thrust in on a deeper plane and more solution injected. If it be cyst or a smaller tumor, for example, that is to be removed, the injections are made on either side of it and into the tissues on which it rests. Anaesthesia is, as a rule, very quickly established, within two or three minutes, but I have found it best to make an allowance of fifteen minutes before commencing the operation. If pain is felt in the deeper parts, further injections are made directly into the sensitive areas. By means of successive injections as the tissues are opened up, the use of the infiltration method may be extended to operations of considerable magnitude.

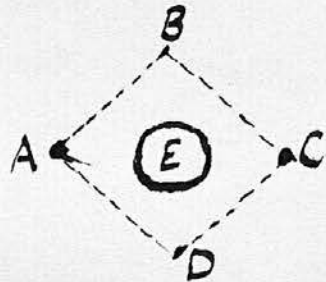
#### Hackenbruch's Method.

A method of anaesthesia intermediate between infiltration anaesthesia and regional anaesthesia proper is that introduced by Hackenbruch. It aims, by means of a line of subcutaneous infiltration, at a "blocking" of sensory nerve branches immediately before/



before they enter the area of operation. This method is specially applicable to localised tumors, cysts etc., of the skin and subcutaneous tissues. The excision of a sebaceous cyst may be taken as an example for its use. The procedure is planned so that the area of operation is surrounded by a zone of novocain injection.

In the diagram E represents the cyst to be removed. The point A is taken at a distance of about half an inch from the margin of the cyst. Here the needle is inserted and passed along just beneath the skin to the point D and the solution is injected. The needle is then almost withdrawn and again passed in the direction of D, this time on a deeper plane, and near to the deep fascia of the part, and a further injection is made. The procedure is repeated in the direction of B, and finally an injection is made partly across the diagonal AC on a deep plane towards the base of the cyst. A similar series of injections is made from the point C. In this manner fine nerves supplying the area of operation are anaesthetised near their termination, and the operation can be painlessly carried out. Even the points of injection can be anaesthetised by the application of smaller drops of pure carbolic acid a few minutes before the introduction of the needle.



A modification of this method is the circular or semicircular injection of the subcutaneous tissue of a limb. The cutaneous nerves running in that tissue are bathed in the solution of novocaine and there is produced a skin anaesthesia for some distance below.

For this anaesthesia I have found .5% solution of novocaine efficient. The advantage of this method over infiltration anaesthesia, in superficial operations, is that it avoids the production in the operation area of that oedematous condition of the tissues that is so considerable a drawback in the use of the latter method, obscuring, as it does, the anatomical details of the part.

#### Regional or Conduction Anaesthesia.

A knowledge of the course and distribution of the sensory nerves is the main factor of success in this mode of anaesthesia, the development of which is largely due to the work of Braun.<sup>1</sup> There are few parts of the body to which this method cannot be applied, but the ease with which a successful anaesthesia is obtained varies immensely with the accessibility or otherwise of the nerve or nerves supplying the area in question.

Fortunately it is not essential for the production/

1. Die locale Anaesthesie, Leipzig, 1905.

tion of anaesthesia that the solution of novocaine should be injected actually into the nerve trunks, for it is found that injection into the immediate neighbourhood is sufficient to "block" the passage of sensory impulses along the nerve.

There are thus two methods of producing regional anaesthesia, the endoneural and the perineural. The endoneural method is carried out as a rule in combination with infiltration anaesthesia, under the influence of which the nerves are exposed and directly injected. Cushing<sup>1</sup> recommended this method in operating for inguinal hernia. In the cases of large nerves it may be possible to perform an endoneural injection without exposing them. There have recently been published accounts of the injection of the cords of the brachial plexus as they lie upon the first rib. To this further reference will later be made.

In the production of regional anaesthesia I have used a solution of novocaine of 2% strength in normal saline, with the addition of adrenalin. It has been practically entirely the perineural method that I have used, though doubtless in some cases the injection has been an endoneural one. The rapidity with which anaesthesia has been produced has varied very considerably, and the more rapid cases may be accounted for by endoneural/

1. Annals of Surgery. Jan. 1900.



endoneural injection. In the rapid cases anaesthesia has become complete over the area of distribution of the nerve almost immediately. In the general run of cases anaesthesia was complete in from ten to fifteen minutes, while in others as much as half an hour elapsed before the operation could be commenced. It is not an infrequent experience to find that though tactile sensation remains present even for the lightest touches, pain sensation may be entirely abolished. This phenomenon may be very misleading when one tests for anaesthesia in a part merely by lightly touching.

#### The Sensibility of the Tissues.

Before proceeding to discuss the application of local anaesthesia in operations upon the various parts of the body, it will be well to consider the varying sensibility of the tissues. The work of Lennander stands pre-eminent in this subject. In relation to the abdomen especially, his work is of the greatest value. He found that the parietal and diaphragmatic peritoneum are alone sensitive to pain, and that they are extremely so, especially if the stimulus be of a dragging nature. The visceral peritoneum and the viscera themselves are entirely insensitive, and it is only when a pull is communicated from them to the parietal peritoneum that pain is experienced. The mucous membrane of the alimentary canal from the commencement/

commencement of the oesophagus to the muco-cutaneous junction in the anal canal is insensitive to pain. The vagina and uterus are insensitive to pain if dragging be avoided. The testis and epididymis are insensitive, the parietal layer of tunica vaginalis is sensitive. The parietal layer of the pleura is highly sensitive, the visceral layer, the lung, and the trachea are insensitive. Such organs as the kidney and the thyroid gland have sensitive capsules, but are themselves insensitive.

The periosteum is sensitive, bone itself and bone marrow insensitive.

I propose next to deal in order with the various regions of the body in their relation to local anaesthesia.

#### The Head and Neck.

The Scalp. The sensory nerve supply to the scalp is very abundant, the various nerves converging towards the vertex of the head. Anteriorly are the supratrochlear and supraorbital branches of the ophthalmic division of the trigeminal nerve, and the auriculo-temporal branch of the inferior maxillary division. These can be easily anaesthetised by the regional method, as there are definite bony guides to them - the supero-internal angle of the orbit for the supra-trochlear, the supraorbital notch for the nerve of/  
of/

of the same name, and the root of the zygoma for the auriculo-temporal nerve. The pulsation of the superficial temporal artery can be felt as it crosses the zygoma and the injection for the auriculo-temporal nerve should be made immediately posterior to it. Blocking of these nerves anaesthetises the forehead and anterior portion of the scalp, and the lateral aspect as far back as a line joining the <sup>tips of the</sup> auricles. The posterior scalp nerves are less definite in their surface markings. The mastoid branch of the great auricular nerve runs upwards upon the mastoid process. The great occipital nerve becomes superficial at a point about half an inch external to the occipital protuberance, and the small occipital nerve ascends about midway between <sup>the</sup> bony prominences. The posterior part of the scalp is best anaesthetised by Hackenbruch's method, the line of injection being made from the occipital protuberance to the mastoid process.

I have removed papillomata and sebaceous cysts of the scalp under local anaesthesia, using both the infiltration and the regional methods. For such minor cases the former is the more convenient.

Operations for removal of cerebral tumours have been carried out under local anaesthesia<sup>1</sup>. The dura mater is sensitive to pain, being supplied with sensory/

1. Braun. loc. cit.



sensory branches from the cranial nerves, especially the fifth. Braun states that it can be rendered insensitive by infiltration of novocaine-adrenalin beneath the pericranium. The adrenalin is of service in decreasing the haemorrhage from the diploe. The cerebral substance itself is devoid of sensation.

Leedham Green<sup>1</sup> says that scalp, periosteum, bone and dura mater can all be anaesthetised by free infiltration between the scalp and the bone.

The face and Buccal Cavity. Superficial operations upon the face are conveniently performed by the local infiltration method, but if the dissection is a deep one it is necessary to anaesthetise the branches of the trigeminal nerve supplying the parts involved. The branches supplying the forehead have already been considered. The infraorbital branches are readily anaesthetised by injection at the point where they emerge from the infraorbital foramen, half an inch below the centre of the lower margin of the orbit. The area thus rendered insensitive includes the inner portion of the cheek, both skin and mucous membrane, the ala of the nose and half of the upper lip. The mental branch of the inferior maxillary division is best injected from within the mouth at a point corresponding to the interval between the two lower bicuspid teeth. The outer part of the cheek is supplied by the/

1. Medical Annual, 1912.

the buccal branch of the inferior maxillary nerve. It becomes superficial at the middle of the anterior border of the masseter muscle. The sensory nerves to the region of the parotid and angle of the jaw come from the cervical plexus through the great auricular nerve, and they will be referred to again later.

Two of the most important branches of the trigeminal still remain - the lingual and inferior dental branches of the inferior maxillary division. These nerves are easily accessible for injection from the cavity of the mouth. The needle is held parallel to the line of the lower teeth, the point is inserted through the mucous membrane just above the crown of the last molar tooth and pushed backward in close relation to the inner aspect of the ascending ramus of the lower jaw for a distance of about half an inch. The lingual nerve lies close to the bone here, and a little anterior to the inferior dental nerve at the point where it enters the lower jaw. Successful injection of the lingual nerve anaesthetises the anterior two-thirds of the tongue and the mucous membrane of the corresponding part of the floor of the mouth. The posterior third of the tongue is supplied with sensory branches from the glossopharyngeal nerve, and it may be rendered anaesthetic by infiltration/

infiltration with .5% novocain. This may be done through the mouth, or, as advised by Braun, from the neck. In the latter case the injection is made in the middle line, the needle being inserted just above the hyoid bone. With a finger placed upon the root of the tongue the needle is guided while the injection is being made.

The use of local anaesthesia in operations about the mouth, and especially in excision of the tongue, has long been advocated by Professor Caird. The ease with which the operation can be carried out is greatly increased, and the greatest of dangers in such cases, inhalation pneumonia, is avoided. The field of operation has not to be disputed with an anaesthetist, the patient can sit up, can hold his mouth open and so avoid the use of gags, can move his tongue to suit the working of the operator, and, lastly and chiefly, can spit out the blood from his mouth. The amount of bleeding, too, is greatly diminished by the presence of adrenalin in the anaesthetic solution. The patient is saved from the distress of post-anaesthetic vomiting, and his general condition is infinitely better than that of a patient to whom a general anaesthetic has been administered.

Case 1. Male aged 47, suffering from carcinoma of the tongue superimposed upon a testicular syphilitic lesion/



lesion. The carcinomatous ulcer was situated on the left side of the tongue at the attachment of the anterior pillar of the fauces, on to which it extended. Two hours before operation a dose of omnopon  $\frac{2}{3}$  gr. and scopolamine  $\frac{1}{150}$  gr. was given intramuscularly.

Fifteen minutes before the commencement of the operation the lingual nerve on each side was injected with 5 c.cs. of 2% novocaine solution. The root of the tongue was then infiltrated from the mouth with .5% solution, and the region of the fauces on the left side was similarly treated. The amount of this solution used was between 15 and 20 c.cs. and to it were added 15 drops of 1 : 1000 solution of adrenalin. Anaesthesia became perfectly established within two or three minutes. Rather more than half the tongue was removed by the Whitehead method, and on the left side the pillars of the fauces, the tonsil and a part of the soft palate. The anaesthesia was entirely satisfactory, the patient stating that he felt no pain whatever. The amount of haemorrhage was exceedingly small, even the lingual artery scarcely bleeding at all. To it alone was a ligature applied. It was feared that some bleeding might take place when the effect of the adrenalin had passed off but none occurred, and the man's condition was altogether remarkably good.

Novocain/

Novocaine can conveniently be used for the removal of enlarged tonsils in adults. The needle is entered between the anterior pillar of the fauces and the tonsil and the peritonsillar tissue infiltrated. The projection of the tonsil caused by this infiltration aids the operator.

Blocking of the inferior dental nerve is carried out in the same manner as for the lingual, and it is useful for tooth extractions in the lower jaw. The incisor teeth are apt to escape, as they may receive some innervation from the nerve of the other side.

The method of treating trigeminal neuralgia by means of the injection of alcohol into the main divisions of the nerve or into the Gasserian ganglion has within the last year or two been imitated for the production of regional anaesthesia, novocaine being used as the anaesthetic drug<sup>1</sup>. A long fine needle is used for the injection. The ophthalmic division is reached by inserting the needle first at the outer angle and then at the upper and inner angle of the orbit, and thrusting it backward in contact with the orbital wall for a distance of 4 to 5 cms. The injection is thus made into the region of the sphenoidal fissure. The superior maxillary division is reached by inserting the needle just below the malar bone in a line/

1 Leedham Green Medical Annual 1912.

line vertically below the outer margin of the orbit, and passing it in an upward, inward and backward direction for a distance of 6 cms. bringing the point into the neighbourhood of the nerve in the pterygo-palatine fossa. To reach the foramen ovale with the third division of the nerve the needle is inserted just below the centre of the zygoma and thrust directly inwards until the external pterygoid plate is struck. It is then withdrawn a little and pushed in again in a slightly backward direction.

I have not had any experience with these procedures.<sup>1</sup> They have been used in excision of orbital tumours, of the upper and lower jaw and of the tongue.

The Neck. The back of the neck is supplied with sensory nerves from the posterior primary divisions of the cervical nerves. In this part infiltration or Hackenbuch's method is best e.g. in cases of carbuncle.

The antero-lateral aspect of the neck is supplied with sensation by the cutaneous branches of the cervical plexus - the great auricular, the superficial cervical, and the descending branches. These all become superficial along a line corresponding to the posterior border of the middle third of the sternomastoid muscle. By injection along this line these nerves can be blocked and anaesthesia produced over a great part of the side of the neck and the lower part of/

1. Since writing the above I have used regional anaesthesia of the superior maxillary nerve in the radical operation for empyema of the antrum of Highmore. The anaesthesia was perfect.



of the parotid region. The submental area is not anaesthetised by this injection as its sensory nerves are derived from the mental nerve.

I have used this method in the excision of tuberculous cervical glands and have found it satisfactory in the cases where there was little periadenitis, and where the glands could be dissected out without much dragging.

Local anaesthesia is of particular service in operations upon the air passages, especially for obstructive conditions in these, necessitating laryngotomy or tracheotomy. Infiltration is the best method in these cases, part of the injection being made subcutaneously, and part beneath the deep fascia. By this method I have performed high tracheotomy in a case of carcinoma of the upper end of the oesophagus, and low tracheotomy in a case of carcinoma of the thyroid gland.

In operations upon the thyroid gland local anaesthesia has been extensively used. Many surgeons prefer to avoid the use of a general anaesthetic in these cases, and this is especially advocated by Kocher.<sup>1</sup> The operation is carried out by infiltration beneath the skin, then beneath the fascial sheaths of the muscles before they are divided, and finally into the region of entry of superior and inferior thyroid vessels.

1. Operative Surgery p. 448.

THE THORAX.

For operations upon the Thorax the use of local anaesthesia is very valuable, and fortunately it is here that regional anaesthesia is particularly easy to secure. The greater part of the skin of the thorax is supplied with sensory branches from the segmental intercostal nerves, which also supply a corresponding area of the parietal pleura. The anterior aspect of the chest wall down to about the level of the third rib, receives branches from the descending cutaneous nerves of the cervical plexus. These can readily be anaesthetised by a line of subcutaneous infiltration along the front of the clavicle.

Each intercostal nerve passes from behind forwards in close relation to the lower border of the corresponding rib, in the intermuscular interval between the external and internal intercostal muscles. About midway between spine and sternum there is given off a lateral cutaneous branch, which becomes superficial and divides immediately into anterior and posterior divisions. The anterior division runs forward and supplies cutaneous sensation at least as far forward as a point midway between its origin and the sternum, where its area merges into that supplied by the external/

ternal terminal branch of the intercostal nerve. The internal terminal branch supplies the skin over the front of the sternum and extends for a short distance beyond the middle line.

Anaesthetisation of the intercostal nerves may be used in operations upon the breast, the thoracic wall, and the contents of the thorax, these last being insensitive to pain.

Having regard to <sup>the</sup> above anatomical details, it is seen that the nerves should be injected at a point a little in front of the angle of the rib, before the giving off of the lateral cutaneous branch. For operations upon the sternum the nerves on both sides must be blocked. In making the injection the rib is marked with a ~~finger~~ of the left hand and the needle is driven in until it just touches the rib near its lower border. The point is then guided downwards so as to slip under the lower border and to penetrate a small fraction of an inch further. The nerve itself may be pierced, and the patient give a sharp wince of pain. In this case the injection may be endoneural, but more often it is perineural. If the needle be not pushed too far the fluid escapes into the cellular plane between the intercostal muscles, and bathes the nerve freely.

In the removal of simple tumours and cysts of the breast/



breast I have injected the intercostal nerves from the second to the sixth, and have thus obtained anaesthesia of the whole breast. One must remember in operations upon the upper part of the breast that the terminal branches of the cervical descending nerves reach to it. In resecting portions of rib for the drainage of empyema I have used both infiltration and regional anaesthesia, and have found the latter much the more satisfactory. In the former method the injection of the periosteum generally causes pain, and it is more difficult to obtain perfect anaesthesia than with the nerve blocking method.

I think that in the rapidly developing surgery of the thorax, local anaesthetics will have a field of great usefulness, for in operations upon the respiratory organs, it is practically always desirable to avoid the use of general anaesthesia.

The Upper Limb.Anaesthetisation of the Brachial Plexus.

One of the most recent extensions of the application of local anaesthesia is to the brachial plexus. This was first brought forward by Hirschel<sup>1</sup> and by Kulenkampff<sup>2</sup>. Neil and Crooks<sup>3</sup> have reported 40 cases with good results. The technique is as follows. The cords of the brachial plexus are injected as they cross the first rib lying immediately external and slightly posterior to the third part of the subclavian artery, the pulsation of which is used as a guide in making the injection. The forefinger of the left hand marks the vessel just above the clavicle, and a fine needle is entered just external to the line of the vessel and is pushed backwards, downwards and inwards towards the upper surface of the first rib, which lies at a depth of 1.5 to 3 cms. The nerve cords, aggregated into a bundle, lie superficial to the rib and the needle may strike them first. The indication of this is the occurrence of paraesthesiae of the nature of "pins and needles", usually in the fingers. If, however, the rib is struck without any paraesthesiae having occurred, the needle must be withdrawn slightly and a systematic search made, along the/

- 1 Munch. Med. Wöch. No. 29. 1911.
- 2 Zentralblatt J. Chir. 1912. p. 1337.
- 3 Brit. Med. Journ. Feb. 22nd, 1913.

the surface of the rib, for the nerves.

Unless definite paraesthesia is obtained before the injection is made, the resulting anaesthesia is likely to be imperfect. The injection consists of 20 ccs. of 2% solution of novocaine with 5 drops of adrenalin (1-1000) added. In searching for the nerves the needle may enter the subclavian artery. This happened in one of my cases, but no ill result followed. The needle used is a very fine one. The syringe should not be attached to the needle while the nerves are being sought for, lest the injection should be made direct into a blood-vessel. This applies to all injections for the regional method. If the point of the needle is in a blood vessel, blood will escape along the needle.

With a successful injection anaesthesia comes on in a few minutes and lasts from an hour and a half to three hours. There is complete anaesthesia of the whole limb with the exception of the skin of the shoulder region, supplied by the descending cervical nerves, and a small skin area on the inner aspect of the upper arm supplied by the intercosto-humeral nerve. The anaesthesia is accompanied by paralysis of the muscles of the limb.

I have used the method five times in four cases.  
Case 1. Female aged 20, suffering from compound palmar ganglion./



ganglion. At the first attempt injection was made after securing but very slight paraesthesiae, and the result was unsatisfactory, no more than a numbing of parts of the limb being produced.

Operation was deferred, and a week later the injection was repeated, this time after a very distinct sensation of "pins and needles" had been felt in the fingers. The dissection was a tedious one occupying an hour and a quarter and it was carried out absolutely painlessly up till the insertion of the skin sutures when sensation was found to be returning. There had unfortunately been some delay in commencing the operation, and the total time that the anaesthesia lasted was two hours.

Case 2. Male aged 12, suffering from a compound separation of the lower epiphysis of the humerus. In this case the anaesthesia was rapidly developed and complete, the manipulations of the limb causing no pain whatever.

Case 3. Male aged 40, suffering from a mal-united fracture of the shaft of the radius and extensive adhesions in the elbow joint. In this case the anaesthesia was only partial and insufficient for the carrying out of the necessary manipulations. The failure in this case may in part at least be ascribed to a faulty action of the syringe during the injection/

jection.

Case 4. Male aged 36, suffering from compound fracture of both bones of the forearm with severance of some of the tendons at the wrist. Morphine  $\frac{1}{8}$  gr. and atropine  $\frac{1}{150}$  gr. were given hypodermically an hour before operation. The brachial plexus was injected with 15 ccs. of 2% solution, and anaesthesia followed in a few minutes and was accompanied by complete muscular relaxation. The fracture was reduced, the radius was plated, and the torn tendons were sutured. The whole operation occupied about an hour and anaesthesia was complete.

From this small experience that I have had with the method I feel sure that it is one that will prove of considerable value, especially in cases of injuries to the limb, fractures and dislocations, for it not only produces anaesthesia but also the muscular relaxation necessary in these cases. Doubtless, with further experience in the injection of the plexus, few failures would fall to be recorded.

At this point I may refer to an important use of local anaesthetics as a means of diminishing shock in major amputations. This has been much advocated by Crile, who extends the use to many operations. The violent sensory impulses that are conveyed to the brain as a result of nerve injury constitute a prime factor in/  
in/

in the production of operative shock. The fact that the patient is under the influence of a general anaesthetic does not lessen the effects of these impulses, and the aid of local anaesthetics may therefore with great advantage be called in to block the afferent nerves. In performing such an operation as an inter-scapulo-thoracic amputation, the subclavian vessels and the cords of the brachial plexus are exposed in the neck at the first stage of the operation. The nerves are directly injected with 2% solution of novocaine, and after a few minutes have been allowed for the drug to act, are divided at a point below the block.

I have used this method in an amputation through the upper part of the humerus and have observed it in a case of disarticulation of the hip, and in both these cases the amount of shock from which the patient suffered was very small, this being due, in my opinion, to "nerve blocking", combined with careful avoidance of loss of blood, by exposure and ligature of the main vessels before division.

The Upper Arm. For lesser operations upon the upper arm and the shoulder region Hackenbruch's method is most convenient, for there are in this part very numerous/



numerous cutaneous nerve supplies and no definite landmarks to guide to the main branches.

The Forearm and Hand. From the elbow downwards as the various sensory nerve areas become more definite and the main nerves more surely accessible, the regional method of anaesthesia is easy of application and very satisfactory in its results. The cutaneous nerves of the forearm are the cutaneous branch of the musculo-cutaneous nerve, the internal cutaneous nerve, and branches from the musculo-spiral nerve. These nerves all pierce the deep fascia above the line of the elbow joint and thence run downwards in the sub-cutaneous tissue as far as the wrist. They are most conveniently anaesthetised by the method of circular or semi-circular injection of the limb above the site of operation. This method suffices only for superficial operations, for the sensory nerves to muscle sheaths, periosteum etc. accompany the motor nerves to the muscles and for deep operation the main trunks of these must also be anaesthetised.

These main trunks are the ulnar, median and musculo-spiral nerves.

The Ulnar Nerve. This nerve can best be injected as it passes downwards in the groove behind the internal condyle/

condyle of the humerus. With the elbow flexed, the needle is driven outwards immediately behind the condyle, the point being kept close to the bone. Successful injection is followed by anaesthesia of the ulnar side of the hand, both back and front, of the little finger and of the ulnar side of the ring finger. A typical case of the use of regional anaesthesia of the ulnar nerve was one in which I removed the fifth metacarpal bone for tuberculous disease. The nerve becomes superficial again at the wrist, crossing the anterior annular ligament to the inner side of the pisiform bone. Injection here, however, is not of much service for it anaesthetises only the palmar aspect, the dorsal branch being given off an inch above the wrist.

The Median Nerve may be anaesthetised either in the antecubital fossa or as it lies among the tendons in front of the wrist. In the first case the brachial artery is defined by its pulsation and the injection made to its inner side. Injection at the wrist is much more commonly done. The nerve lies internal to the flexor carpi radialis tendon and almost directly behind the tendon of the palmaris longus, at a depth of from 1 to 1.5 cms.

Blocking of the nerve gives anaesthesia of the anterior aspects of the thumb, index, middle, and radial side of the ring finger with a corresponding portion/

portion of the palm.

The Musculo-Spiral Nerve may be injected as it winds round the shaft of the humerus in the musculo-spiral groove. The point taken is one at the junction of the middle and upper thirds of a line drawn from the insertion of the deltoid muscle to the external condyle of the humerus. The needle is passed down to the bone and the injection made into the tunnel through which the nerve passes, between the external head of the triceps muscle and the humerus. The radial subdivision of the nerve is much more frequently injected than the main trunk. It accompanies the radial artery on its outer side in the middle third of the forearm. At a point about 2 inches above the styloid process of the radius the nerve leaves the artery, winds backwards beneath the supinator longus tendon and becomes superficial, supplying sensation to the back of the hand over an area corresponding to that of the median nerve in front. I have found it most convenient to anaesthetise the nerve before it leaves the front of the forearm. The line of the artery  $2\frac{1}{2}$  inches above the wrist is ascertained by feeling the pulsation and the injection is made to the outer side.

The Fingers. Each finger is supplied with sensation by four digital nerves, two palmar, and two dorsal. These run practically laterally to the flexor and extensor tendons respectively, and to anaesthetise them/



them the injection may be made towards those points.

Practically the simplest method is to inject a ring of .5% novocaine solution around the base of the finger and to reinforce the anaesthesia by a tourniquet applied as high on the finger as possible (Oberst's Method).

In clean cases e.g. recent injuries, this is the method I adopt when trimming up, or when amputating beyond the metatarso-phalangeal joint. In amputations at this joint and in all cases where septic conditions are present in the fingers or hand I use the regional method, which enables the injections to be made at a distance from the seat of infection. The procedure is as follows. The hand is prepared for operation and bandaged up as far as the wrist. The skin of the forearm is then separately sterilised with 5% alcoholic solution of iodine and the injections made as required. All the digits but the fifth receive their nerve supply from more than one main nerve. The fifth is supplied by the ulnar nerve alone, the thumb, the index and the middle finger by the median and radial, the ring finger by median, radial and ulnar nerves. Novocaine solution of 2% strength is used and an interval of from 15 to 20 minutes is allowed for anaesthesia to become complete. I have had numerous opportunities of using this method in the fingers and hand and have found it most/

most satisfactory, complete anaesthesia being obtained in all but a small proportion of cases, and this proportion is diminishing as greater experience is gained in the technique. The method is especially useful in the out-patient department of a hospital where patients suffering from injuries and septic conditions of the fingers are so numerous and so often not in a desirable condition for a general anaesthesia.

THE ABDOMEN.

The abdominal parietes are supplied with sensation by the last five intercostal nerves, the last dorsal, the ilio-hypogastric and ilio-inguinal nerves. The nerves supplying the series of cutaneous zones, supply also the deeper layers and a corresponding area of the parietal peritoneum. The position of the various areas may be indicated by stating that the 10th intercostal nerves supply the zone which includes the umbilicus.

In the upper part of the abdomen, the regional method of anaesthesia can be carried out in the same manner as in the thorax. For the performance of gastrostomy I injected the 7th, 8th and 9th intercostal nerves on the left side. In this operation, carried out as it so often is, when the patient has been greatly weakened by starvation, it is highly desirable to avoid the additional tax imposed by the administration of a general anaesthesia.

The use of regional anaesthesia might be extended to many other operations in the upper part of the abdomen, but I have had no opportunity of carrying them out.

In suppurative conditions of the liver, where the effects of general anaesthetics, and especially chloroform, are to be feared, novocaine might well be used, for/



for either the transpleural or the abdominal route of operation.

In operations performed through the mid line the infiltration method is very convenient, for the whole thickness of the wall may be anaesthetised by a single line of injection, and the oedema produced does not interfere with the operative procedure.

The following is an illustrative case.

Case 2. Female aged 26. Admitted to hospital 36 hours after the onset of acute abdominal pain. A diagnosis of perforated gastric ulcer was made. The abdomen was greatly distended, the temperature was subnormal, the pulse rate 140 per minute and the condition of the patient altogether precarious. It was doubtful if a general anaesthetic could be borne, and I decided to operate under local anaesthesia. I injected the whole length of the linea alba with 5% solution of novocaine-adrenalin, the injection being made in one subcutaneous plane. When the operation was commenced, 15 minutes later, anaesthesia was complete. The abdomen was opened above the umbilicus and abundant confirmation of the diagnosis found. General peritonitis was present and there were extensive recent adhesions of flaky lymph between the stomach and adjacent organs, and the parietal and diaphragmatic peritoneum. It was necessary to separate some of these to explore the stomach and it was at this stage of the/

the operation only that any pain was felt and it was but slight.

Two perforations were found on the anterior wall of the stomach and were closed. With an incision for supra pubic drainage the operation was completed. The relief of the abdominal distention by the evacuation of gas and fluid considerably improved the patient's general condition and the pulse was a few beats less and of better quality. The improvement was maintained for about 24 hours, but then she became rapidly worse and succumbed to general peritonitis 36 hours after the operation.

Although this case terminated fatally, I am sure that the use of local anaesthesia gives such cases a better chance. Of acute abdominal conditions, the one in which it is most desirable to avoid a general anaesthetic is acute intestinal obstruction in which faecal vomiting is present. The great danger with the general anaesthetic is that regurgitating foul stomach contents may enter the air passages, and cause either suffocation, or later septic pneumonia. This danger can largely be eliminated by the preliminary lavage of the stomach, but I have seen this procedure cause very considerable exhaustion in these cases.

Case 3. Female aged 47, suffering from extensive carcinoma of the uterus filling up the whole pelvis and/

and causing acute intestinal obstruction. The general condition was very bad. Inguinal colostomy was decided on. The subcutaneous tissue was infiltrated with .5% solution of novocaine and an incision made down to the aponeurosis of the external oblique. The muscles were then infiltrated and split in the line of their fibres. Lastly an injection was made into the extra-peritoneal tissue, and the abdomen opened. The remaining steps of the operation were carried out easily, care being taken not to put any pull on the mesocolon. The patient recovered from the acute obstruction and died some weeks later of uraemia.

Case 4. Male aged 75, suffering from strangulated inguinal hernia of 24 hours duration, and not a good subject for a general anaesthetic. Infiltration with .5% solution of novocaine was done, the hernia was cut down upon and the strangulated loop of intestine returned into the abdomen. The neck of the sac was isolated, ligatured and cut across, and the inguinal canal stitched up. No pain was felt, and the patient did not suffer the least shock from the operation. He made an uninterrupted recovery.

In operations for acute appendicitis, local anaesthesia appears to be less serviceable. In these cases there is often so much dragging upon the parietal peritoneum that satisfactory anaesthesia is difficult to /



to obtain, especially as it is as a rule impossible to tell before hand what particular part of the peritoneum is involved. I have used the infiltration method of anaesthesia in only one case, preceding its use by a dose of omnopon-scopolamine, but it was found necessary to resort to general anaesthesia to complete the operation. I have used local anaesthesia with success in a case of ventral hernia following suppurative appendicitis. Omnopon-scopolamine was given. Novocaine .5% solution was injected around the scar, and the abdomen was opened painlessly. Numerous dense adhesions were found between the caecum and the abdominal wall in the region of the scar. The extra-peritoneal tissue was infiltrated with novocaine for some distance around, and after a wait of a few minutes the separation of adhesions was commenced and carried through painlessly.

#### Inguinal Hernia.

Harvey Cushing gave a full account of the use of local anaesthesia in the operation for the radical cure of hernia in a paper in the *Annals of Surgery* for January 1900. He gives a full account of the distribution of the sensory nerves in the region of the inguinal canal and their relation to the operation. The most important nerve is the ilio-inguinal which runs/

runs downwards in the canal and emerges through the external abdominal ring. Branches from the ilio-hypogastric nerve above and from the genito crural below also come into the area of operation. It is difficult in this region to inject with any certainty the sensory nerves as they run forward between the layers of the abdominal muscles, there being no exact guides either as to their ~~course~~ course or to their depth from the surface. In my cases I have infiltrated subcutaneously with .5% solution of novocaine along the line of incision, and at the same time have injected 5 ccs of 2% novocaine solution at a point opposite the anterior superior iliac spine and as nearly as I could judge in the line and at the depth of the ilio-inguinal nerve. In one or two cases this has been successful and the operation has been painlessly completed without any further use of novocaine. In others it has failed and the deeper parts have been found sensitive. As a rule the inguinal canal can be laid open painlessly after the first injection. I have often exposed the ilio inguinal nerve as it lies beneath the aponeurosis of the external oblique and have directly injected it with .5% novocaine. With the same solution the extraperitoneal tissue around the internal abdominal ring is infiltrated. It is sometimes difficult to retain the fluid in this tissue and in such cases a piece/

piece of gauze soaked in the novocaine solution may be applied for a few minutes. By this method the operation can usually be carried out quite successfully, but there is occasionally a little pain and discomfort during the isolation and tying off of the neck of the sac.

A medical man upon whom I operated told me that the sensation felt at that stage of the operation was very slight locally, but consisted chiefly of a feeling of severe rectal tenesmus. In cases of hernia I have had much better results since using omnopon-scopolamine as an adjuvant to the local anaesthesia. A procedure similar to the above can be employed in other operations in the inguinal region, such as varicocele, hydrocele, castration, and the radical cure of femoral hernia by the inguinal method of isolating the neck of the sac in the inguinal canal and drawing the body of the sac up through the crural ring.

Perineal Region. The penis is an organ particularly easy to anaesthetise with novocaine, either by the infiltration or the conduction method. I have used both methods in the performance of circumcision and prefer the latter, avoiding as it does the production of a considerable oedema in the tissues that are to be cut. The prepuce is supplied with sensation by the two dorsal nerves which run forwards on either side of the/



the middle line of the dorsum. To anaesthetise them a subcutaneous injection of 2 or 3 ccs of 2% novocaine is given at the root of the organ. I have used the method both in adults and in children, and in a recent case, that of a child suffering from whooping cough and severe balanitis, in whom it was undesirable to give a general anaesthetic, local anaesthesia was most serviceable.

I have not had any experience in anaesthetising the scrotum. Its sensory nerves are the two superficial perineal nerves and the long pudendal branch of the small sciatic nerve. The former become superficial by piercing the base of the triangular ligament, and may be blocked by infiltration along a line joining the anterior extremities of the ischial tuberosities. The long pudendal may be blocked at the point where it runs forward into the perineum, just anteriorly to the tuberosity of the ischium. Anaesthetisation of this nerve has been recommended in plastic operations upon the female perineum.<sup>1</sup>

The anal region is supplied with sensory nerves from the inferior haemorrhoidal branch of the internal pudic nerve. This branch runs transversely across the middle of the ischio-rectal fossa, and injection into this region on both sides produces anaesthesia of the anal canal and of a small zone of the surrounding skin. This anaesthesia allows of the painless stretching/

1 Ilmer. Jentralblatt f. gynak. Leipsic XXXIV, 689.

stretching of the sphincters, and may be employed in cases of haemorrhoids, fissure and fistula. Internal haemorrhoids are themselves devoid of sensation.

The circumanal skin is so sensitive that it is advisable to anaesthetise the spot at which the needle is to be inserted with a drop of pure carbolic acid. This I apply in the middle line posterior to the anus and from the one puncture inject in turn each ischio-rectal fossa.

The Lower Limb.

The gluteal region with its numerous cutaneous nerves is best anaesthetised with Hackenbruch's method, and this I have used in two cases, excision of a blood cyst and of a small sarcoma.

The Thigh. The main sensory nerve supply for the front and inner aspect of the thigh is the anterior crural nerve. Just below the inner end of Poupart's ligament there are small skin areas supplied by twigs from the genito-crural and ilio-inguinal nerves. The outer aspect of the thigh is supplied by the external cutaneous nerve and the posterior surface by the small sciatic nerve.

The anterior crural nerve may be anaesthetised as it enters the thigh beneath Poupart's ligament. The position of the common femoral artery just below Poupart's ligament is defined by its pulsation and the injection of novocaine is made at a point half an inch external to this. The depth at which the nerve lies, varies considerably with the amount of subcutaneous fat, and must be judged accordingly. In an average case I insert the needle to the depth of rather more than an inch, give part of the injection there and part after withdrawing the needle a quarter of an inch. Successful injection, and this I have obtained/



obtained in every case, produces anaesthesia not only of the front and inner aspects of the thigh but also of the inner aspect of the leg and foot, corresponding to the distribution of the internal cutaneous and long saphenous branches of the nerve.

This method is most useful in the operation for varix of the internal saphenous vein. The following case illustrates its use.

Male aged 50, who was suffering from enormous dilatations along the whole length of the vein, forming at parts pendulous tumours. Two hours before operation omnopon-scopolamine was given intramuscularly. The anterior crural nerve was injected with 5 ccs of 2% novocaine solution, and a slight infiltration was given below the inner end of Poupart's ligament, to block the branches of the genito crural nerve. Anaesthesia was established almost immediately. The dissection of the veins took more than an hour, and throughout the anaesthesia was perfect, the man dozing quietly on the table.

Injection of the anterior crural nerve is also useful in the removal of the prepatellar bursa, and in skin grafting. For both these operations I have also used the infiltration method, but I prefer the regional method.

For the infiltration method I use .5% novocaine solution, and do an extensive subcutaneous injection; areas/

areas of as much as 4 x 8 inches being anaesthetised in the more extensive cases, and from 40 to 50 ccs solution used. The injections are made in vertical lines and full anaesthesia is obtained when the lines are  $1\frac{1}{2}$  inches apart. The infiltration gives a greater resistance to the skin and facilitates the cutting of Thiersch grafts. The nutrition of the grafts taken in this method is in no way impaired and there is no delay in the healing of the cut surface.

The outer aspect of the thigh may be anaesthetised by the injection of the external cutaneous nerve at a point half an inch below and just internal to the anterior superior spine of the ilium. This also may be useful in the taking of skin grafts.

The posterior aspect of the thigh and the calf of the leg are not suitable for the use of regional anaesthesia and here the semicircular infiltration method may be employed.

The leg and Foot. The most accessible of the nerves of the leg is the external popliteal nerve where it winds round the neck of the fibula. It can be palpated through the skin and directly injected. The anaesthesia produced is in the areas supplied by its peroneal and anterior tibial branches, the skin areas including the dorsal aspect of the four inner toes, and of the tibial side/

side of the little toe, with a corresponding portion of the dorsum of the foot and the anterior aspect of the ankle.

The external saphenous nerve, which supplies sensation to the outer aspect of the foot and the fibular side of the little toe, runs in company with the external saphenous vein and anterior to it, and passes forward on to the foot by curving round the tip of the external malleolus. It is conveniently blocked by an injection made immediately behind the malleolus. The internal saphenous nerve holds a similar relationship to the internal saphenous vein, and with it passes in front of the internal malleolus to supply the inner border of the foot. The vein is used as the guide to the injection.

The sole of the foot and the plantar aspect of the toes are supplied with sensory branches from the internal and external plantar divisions of the posterior tibial nerve. This nerve can be injected behind the internal malleolus by inserting the needle close to the Tendo Achillis and directing it forwards towards the bone so that the vessels occupy the inner side (Operative Surgery, Kocher.)

The distribution of the digital nerves to the toes is exactly similar to that of the fingers, and anaesthesia can readily be obtained by Oberst's method, which I have used with success in cases of ingrowing toe/



toe nail and hammer toe. If it is desirable to use the distal regional method, the posterior tibial and external popliteal nerves are injected, and in the case of the small toe, the external saphenous nerve also. For the extraction of foreign bodies, such as needles or pieces of glass, from the sole of the foot, it is best to inject the posterior tibial nerve. Local infiltration, with the accompanying oedema of the tissues, impedes the search.

Quinine-urea as a Local Anaesthetic.

Subcutaneous injections of solutions of quinine have been much used in America in the treatment of malaria. For this purpose quinine and urea hydrochloride was found to be a readily soluble and non irritating salt. Thibault<sup>1</sup> noticed that the skin areas overlying the site of injection became quite anaesthetic, and this observation he made use of for the performance of minor operations. The drug was soon tried by other surgeons and numerous reports were published in American journals. Hertzler, Brewster and Rogers<sup>2</sup> investigated it systematically. They found that a 1% solution injected subcutaneously produced a complete anaesthesia, lasting for from 4 to 5 hours. When a solution of this strength was used it was noticed that there was often some impairment of primary union in the operation wound, an induration and thickening of the edges being present. This was found to be due to a fibrinous exudate which appeared very rapidly after injection. With .5% solution the exudate was less marked and with .25% there was practically none. With solutions of .5% and 1% the onset of anaesthesia was almost immediate, with/

1 Journ. Arkansas Med. Soc., Sept, 1907.

2 Journ. Amer. Med. Assoc. Oct., 1909.

with .25% there was a delay of a few minutes. Where a normal saline instead of a watery solution of the drug was used, the induration was less marked but the duration of anaesthesia was lessened.

These writers conclude that a .25% solution is the best to use in cases where primary union is desired, but that in septic cases such as boils and abscesses, stronger solutions may be employed with advantage. The fibrinous exudate which <sup>is</sup> poured out in reaction to the injection is stated to exercise a well marked haemostatic action, and the stronger solutions are advised in cases where haemorrhage is expected. They emphasise the value of this anaesthetic in anal operations and in tonsillectomy. The advantages claimed for it are (1) its safety, for no toxic effects have been noticed even with very large doses, (2) the duration of the anaesthesia over several days, thus preventing post-operative pain, and (3) its haemostatic power.

Hirschmann describes the use of quinine and urea hydrochloride in rectal operations. Morphia, gr  $\frac{1}{4}$ , is given 20 minutes before operation. The injection of 1% solution is made from a point in the mid line behind the anus, the needle being inserted first into one half of the sphincter muscle and then into the other. Anaesthesia becomes complete in from 3 to



4 minutes, and dilatation of the sphincters is carried out. Each pile mass is then in turn injected with the anaesthetic solution, ligatured, and removed. The anaesthetic effect is said to be prolonged for several days. The deposition of fibrinous exudate around the vessels is of service in preventing post-operative oozing.

My experience with this drug as a local anaesthetic has been disappointing. I used it only in 10 cases, and finding it very uncertain in its action and greatly inferior to novocaine, gave up its use.

In one case of haemorrhoids I obtained excellent anaesthesia, but in a second case scarcely any anaesthesia was produced.

CONCLUSION.

From the above descriptions it is seen that the range of operations in which anaesthesia can successfully be secured by the local method is very wide. Though there are many of these operations in which general anaesthesia is preferable as a routine procedure, ~~but~~ it is important, in view of special circumstances that may arise, to be fully aware of the possibilities of the local method. The special circumstances may be either upon the side of the operator or <sup>of</sup> the patient. On the side of the operator, the importance of a knowledge of the method may be emphasised in those circumstances where skilled assistance is not available, as is often the case with Ships-surgeons and practitioners in remote localities, to whom the anaesthetic is often the great anxiety in the performance of an operation. With local anaesthetics practically all the emergency operations can be carried out. A minor advantage in the use of local anaesthetics is that their cost is much lower than that of either chloroform or ether, and a considerable saving may thus be effected in hospital practice.

On the side of the patient, the first advantage, and the one that most appeals to him, is the freedom from the dangers that are inseparable from the use of general/

general anaesthetics. Novocaine appears to be an absolutely safe drug in any quantity that is likely to be required for the performance of an operation. With the exception of a few cases in which I employed quinine and urea hydrochloride, novocaine has been used throughout in my series of cases. I have found it most satisfactory and reliable in its action and have not observed any toxic effects whatever following upon its administration. I have been able to find only one case ~~was~~ recorded in which death was ascribed to novocaine poisoning. It is reported in the British Medical Journal for December 31st, 1910. The patient was a young woman who had been given an injection of .3 grammes of novocaine for tooth extraction. Death occurred from respiratory failure five hours after the injection.

The use of local anaesthesia is indicated, where possible, when the operation is complicated by the presence of cardiac and pulmonary disease, and acute or chronic renal disease.

One of the strongest arguments in favour of the use of local anaesthesia is its action in diminishing or preventing the occurrence of shock. This has been referred to above when operations for acute abdominal conditions and major amputations were discussed. Even if it is not possible to complete an operation with novocaine/



novocaine, the duration of the general anaesthesia may be much shortened, and the quantity used even more reduced, a small amount of ether by the open method sufficing as a rule.

No small advantage, as regards the comfort of the patient, can be claimed for local anaesthesia in the freedom from the nausea and vomiting which are so often the sequelae of general anaesthesia, especially if the anaesthetist is one without special experience.

The great disadvantage that may be urged against the use of local anaesthetics is the retention of consciousness on the part of the patient, and this alone in a nervous, sensitive patient will give rise to a considerable degree of psychic shock. Some discretion has therefore to be exercised and the temperament of the patient considered, when the choice of anaesthesia is made. Certain means may be used to diminish this nervous apprehension on the part of the patient, and the procedure that I have found most successful is the preliminary administration of omnopon-scopolamine, to which reference has already been made. After the dose has been given, the patient should be kept in a quiet, darkened room, and he usually falls asleep. His removal to the operating-table is carried out as quietly as possible, and special precautions are taken against the occurrence of any noise during the time that the operation/

operation is being performed. The patient as a rule remains in a state in which he is by no means acutely conscious of his surroundings, and not infrequently he falls asleep. Apart from this soporific effect, the most noticeable phenomenon is the very marked slowing of the breathing. The rate may fall to three or four per minute, deep, regular respirations. In one case there was great irregularity both in rhythm and in depth, persisting for six hours after operation, and being followed by a gradual return to the normal. The patient as a rule sleeps for several hours after the operation. When the patient awakens there is \*\* \* often much complaint of thirst, but I have not seen any of those cases of distressing sickness and vomiting mentioned by Gray. In the use of this method I have not exceeded a dose of  $\frac{2}{3}$  grain of omnopon with  $\frac{1}{150}$  grain of scopolamine. I have not met with any effects that would give rise to anxiety.

It has been said that the after pain of a wound is greater where local anaesthesia has been used, but my experience does not accord with this statement.

As regards the healing of the wound, it is, of course, in no way interfered with in cases where the regional method has been used. Where, however, the infiltration method has been used, there is often a hardness about the line of incision, that persists for some/

some weeks, but I have never seen any delay in primary union. This hardness is, I think, a result rather of the use of the adrenalin than of the novocaine. There is intense vaso-constriction in the area of operation and little primary haemorrhage, but in all probability some bleeding occurs from small vessels after the effect of the adrenalin has passed off. It is therefore important, when operating in an infiltrated area, to ligature all points that show a tendency to ooze.

In deciding the question of the anaesthetic to be administered to any particular patient, novocaine should certainly be considered, and I am sure that in many cases, with its aid, operations can be carried out with greater safety than with general anaesthesia.



Synopsis of operations performed with Local  
Anaesthesia.

A. Head and Neck.

Excision of sebaceous cysts of scalp.	9
" " papillomata of scalp.	1
" " fibroma of the auditory meatus.	1
" " dermoid cyst of forehead.	1
" " rodent carcinoma of forehead.	1
" " epithelioma of lip.	1
" " carcinoma of tongue.	1
" " enlarged tonsils.	2
" " carbuncle of neck.	1
" " tuberculous cervical glands.	3
Drainage of Antrum of Highmore.	1
Tracheotomy.	2

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B. Thorax.

Resection of ribs for empyema.	4
Excision of simple tumours of the breast.	4

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8

C. Upper Limb.

Compound diastasis of lower end of humerus.	1
Excision of olecranon bursa.	1
Incision of osteomyelitis of radius	1
Plating/	

Plating of fractured radius.	1
Excision of ganglion of wrist.	10
"    " compound palmar ganglion.	1
"    " tuberculous metacarpal bone.	1
Incision of cellulitis of the hand.	5
Removal of foreign bodies from hand and arm.	7
Suture of cut tendons.	2
Amputation of fingers.	23
	<hr/>
	53

D. Abdomen.

Excision of lipoma of abdominal wall.	2
Gastrostomy.	1
Closure of perforated gastric ulcer.	1
Appendectomy.	1
Colostomy.	1
Ventral hernia.	1
Inguinal hernia.	5
Strangulated inguinal hernia.	2
Circumcision.	4
Haemorrhoids.	3
Opening of ischio-rectal abscess.	2
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	23

E. Lower Limb.

Opening of abscess of buttock.	1
Excision of blood cyst of buttock.	1
"    " sarcoma of buttock.	1
"    " inflamed glands of groin.	1
"    " varicose veins.	2
"    " prepatellar bursa.	11
Skin grafting.	5
Incision of cellulitis of leg and foot.	4
Removal of foreign bodies from foot.	3
Hammer toe.	3
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	32
Total number of cases	140.

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