

REGIONAL ANESTHESIA FOR OPERATIONS ABOUT THE NECK AND UPPER EXTREMITY

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OPERATIONS ON THE NECK

THERE are few, if any, operations about the neck that may not be performed successfully with the patient under the influence of local or regional anesthesia. The possible exceptions are operations in the presence of diffuse infectious processes and on highly nervous and uncooperative patients. Inhalation anesthesia in which an intratracheal tube is employed likewise produces satisfactory and well-controlled anesthesia, but for many operations in this region, such as operations on the thyroid gland and larynx, many surgeons prefer to have the patient awake. The success of regional anesthesia for operations about the neck lies in the fact that a skillfully performed cervical block, with suitable infiltration, produces complete and sustained anesthesia of this region. The results are consistent, and the duration is sufficient to permit completion of operations requiring two hours or even longer. Mousel (1), in a recent paper in this journal on "Regional Anesthesia for Operations About the Head and Neck," has presented in detail various methods of regional anesthesia for operations about the head and has reviewed the anatomy of the cervical nerves (Figs. 1, 2, and 3) and part of the technic of block of these nerves, so to speak, for certain types of operations. The reader is referred to this article for such details; in this paper further and more detailed consideration will be given to the scope of cervical block anesthesia.

Preoperative preparation of the patient is especially important (2). Preliminary medication should be administered in amounts sufficient to render the patient definitely drowsy. If this has not been accomplished by the time the patient arrives in the operating room, supplemental premedication by the intravenous route is advocated. This may take the form of the intravenous administration of morphine sulfate or pentobarbital sodium. When the nature of the operation is such that a feeding problem may result postoperatively, it may be advisable to insert a feeding tube into the stomach preoperatively. Many patients who have a pre-existing laryngeal obstruction already will have undergone tracheotomy. The site at which this operation was performed should be checked for patency of the airway. Turning of the patient's head during production of block anesthesia may result in coughing due

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to irritation caused by movement of the tracheotomy tube. The instillation of a few drops of a 10 per cent solution of cocaine into and around the tracheal stoma will minimize the cough reflex. The local anesthetic agents referred to in the present article are procaine hydrochloride and benzoyl-gamma-(2-methylpiperidino)-propanol hydrochloride (metycaine). For the block of large groups of nerves, such as the deep cervical and brachial plexuses, 2 per cent solutions of the aforementioned agents are used. One per cent solutions are employed for anesthetization of individual nerves such as the median, ulnar and

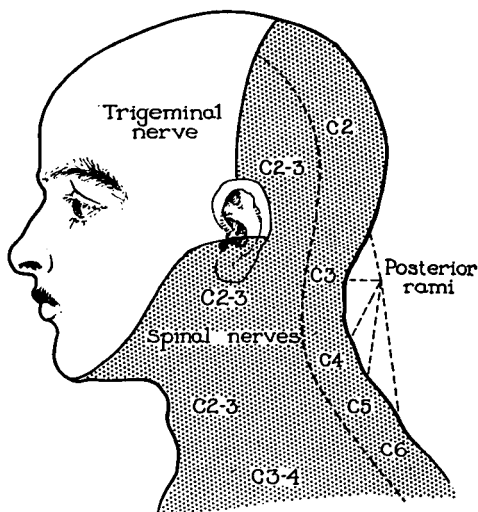


FIG. 1. Distribution of the cervical nerves on the surface of the neck.

radial. Intradermal and subcutaneous infiltrations require 0.5 per cent solutions, but for highly sensitive parts, such as the fingers, small amounts of a 1 per cent solution are employed. A vasoconstricting drug such as epinephrine usually is mixed with local anesthetic solution, although it should be omitted when the fingers are being injected. One cc. of a 1 in 2600 solution of epinephrine hydrochloride is added to 50 cc. of a 2 per cent solution of the local anesthetic agent, or to 100 cc. of a 1 per cent solution, or to 200 cc. of a 0.5 per cent solution. Metycaine, being more potent than procaine, can be used in smaller quantities than the latter.

Deep Cervical Block, Posterior Route.—The technic of deep cervical block anesthesia will be described first, since block of the deep and

superficial cervical nerves forms the basis of regional procedures. The site of injection and the extent of local infiltration vary according to the site and nature of the operation. Deep cervical block may be performed by either of two routes: posterior or lateral. In both methods the object is to place the local anesthetic solution close to the tips of the transverse processes of the second, third and fourth cervical vertebrae in the vicinity of the cervical nerves. The posterior route is used less

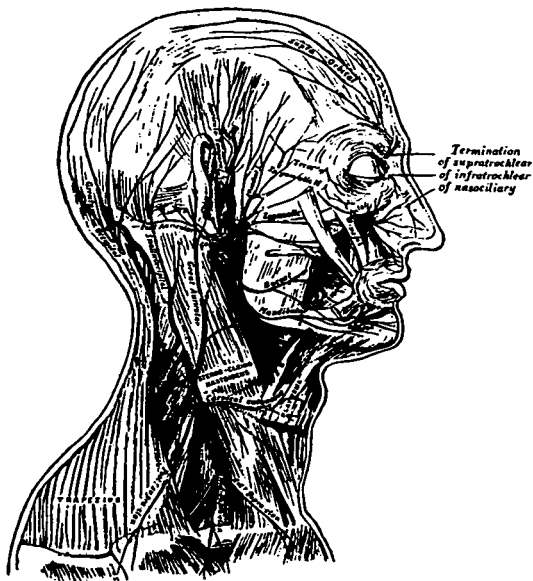


FIG. 2. Distribution of the superficial branches of the cervical plexus as they wind forward from beneath the posterior border of the sternocleidomastoid muscle (after Gray, Henry: *Anatomy of the Human Body*, ed. 23, Philadelphia, Lea & Febiger, 1936, 1381 pp.).

often than the lateral. The main indications for its use are operations on the posterior portion of the neck, such as cervical laminectomy, bone grafts, or in instances in which the lateral route is contraindicated by the presence of some infective process or deformity. Posterior deep cervical block anesthesia is produced with the patient in the prone position, the thorax being supported by pillows. Wheals, situated 2 cm. from the midline, are raised opposite the spinous processes of the second, third and fourth cervical vertebrae, bilaterally. A needle of 80 mm. size is inserted through these wheals until the point touches the transverse processes of the vertebra. The needle is then withdrawn

and redirected more lateralward, until the point slips just past the lateral aspect of the vertebral arch. It is advanced 1 cm. past this point, and the solution is then injected.

Deep Cervical Block, Lateral Route.—Deep cervical block anesthesia (Fig. 4) by the lateral approach is produced with the patient flat on the back, or with one or two small pillows placed under the shoulders to

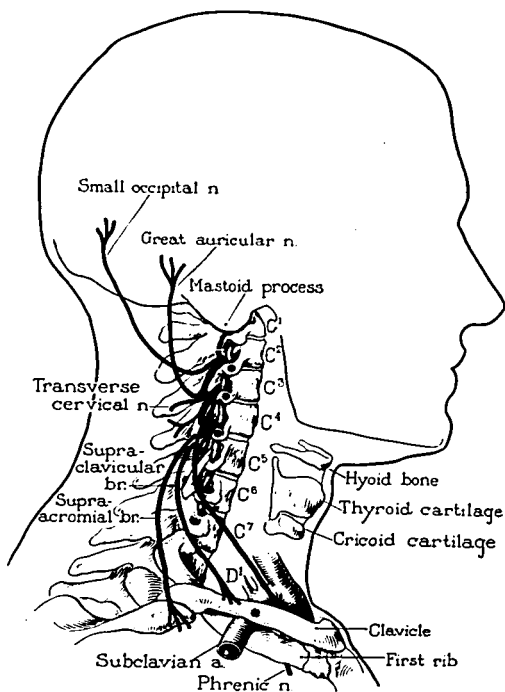


FIG. 3. The deep cervical nerves are shown in relationship to the cervical vertebrae. Note the relationships of the phrenic nerve in the lower portion of the neck.

hyperextend the neck. With the patient's head turned sharply to the side, a wheal is raised 1 cm. below, and 1 cm. posterior to, the tip of the mastoid process. Through this wheal an 80 mm. needle is inserted to block the second cervical nerve. The fourth cervical nerve is blocked through a wheal raised at a point 1 cm. posterior, and 1 cm. superior, to the point at which the external jugular vein crosses the posterior border of the sternocleidomastoid muscle. A wheal produced midway

between the two wheals described previously is used for approach to the third cervical nerve. In block of the second cervical nerve an 80 mm. needle is introduced through the upper wheal in a slightly downward and backward direction, and is cautiously advanced until the point impinges on bone. As Tovell (3) has pointed out, the point of the needle should rest on the most superficial point of the transverse process. In a similar manner, 50 mm. needles are inserted to the tips of the third and fourth transverse processes. Accurate insertion of the needles is facilitated by palpation of the transverse process of the sixth cervical vertebra with the fingers of the free hand during insertion of the needles.

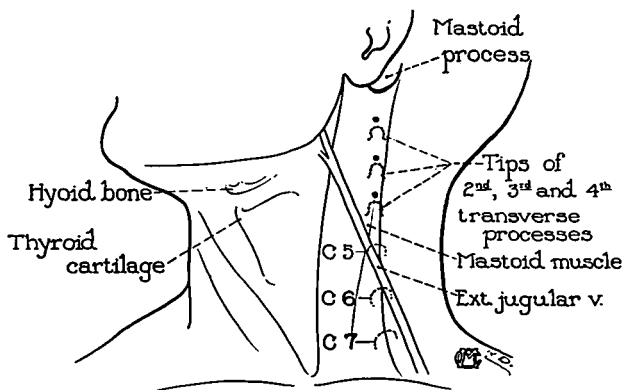


FIG. 4. Landmarks for performance of deep cervical block anesthesia. Note the relationship of the transverse processes of the second, third and fourth cervical vertebrae to the mastoid process, the posterior border of the sternocleidomastoid muscle and the external jugular vein. The dots represent the points at which the three wheals are raised in performance of deep cervical block anesthesia.

Ten cc. of a 1 per cent solution of procaine hydrochloride or metycaine with epinephrine is injected at each transverse process. A warm solution produces more satisfactory anesthesia than does a solution which is not warm. The chief danger which may accompany this procedure is injection of the solution into a blood vessel or into the subdural space, referable to faulty position of the needles. Frequent aspiration is essential before each injection is made.

Superficial Cervical Block.—This type of block anesthesia usually is performed routinely with deep cervical block for many operations on the neck. Ten to 20 cc. of a 1 per cent solution of procaine hydrochloride or metycaine with epinephrine is injected along the posterior border of the sternocleidomastoid muscle to block the branches of the superficial cervical plexus as they wind anteriorly around the muscle.

For certain operations on the neck, bilateral superficial cervical block anesthesia alone, together with suitable infiltration, is performed. When extensive operative procedures are contemplated, deep and superficial cervical block anesthesia is performed as a basic procedure. To this are added subcutaneous and intradermal infiltrations of a 0.5 per cent solution of procaine hydrochloride or solution of metycaine with epinephrine. The site and extent of such infiltrations will vary with the type and situation of the operative procedure.

The Scope of Cervical Block Anesthesia.—Operations about the neck performed with the patient under the influence of regional anesthesia necessitate thorough preliminary medication of the patient, since many nervous patients may complain of discomfort, if not actual pain, if this



FIG. 5. Regional anesthesia for thyroidectomy; a, the region of infiltration employed to permit elevation of the skin flap; a single wheal is raised at the substernal notch and from this point the solution is injected along the clavicles and fan-wise across the neck; b, distribution of the local anesthetic solution after superficial cervical block has been performed.

is not done. During the course of some operations, supplementation of cervical block anesthesia with anesthesia of limited extent produced by pentothal sodium injected intravenously is most satisfactory. For thyrotoxic or laryngectomy it is often desired to have the patient awake and cooperative throughout the operation. If preliminary medication is not entirely adequate, the use of small doses of morphine sulfate administered intravenously will render the patient more comfortable and cooperative during the course of the operation.

For laryngectomy, bilateral deep and superficial cervical block anesthesia is performed together with infiltration, which is done in a diamond-shaped region about the larynx, extending from the point of the patient's chin to the suprasternal notch. In addition, the superior laryngeal nerves are blocked bilaterally by the injection of 5 cc. of a 1 per cent solution of procaine hydrochloride or solution of metycaine

just through the lateral portion of the thyrohyoid membrane. Among patients who do not have a tracheal stoma, this type of block anesthesia may result in respiratory obstruction if the solution is injected too deeply into the mucous membrane of the larynx, thereby increasing the obstruction which may already be present.

For surgical operations on the thyroid gland complete cervical block anesthesia is rarely employed, although its use is sometimes indicated when the gland is large or when it is considered inadvisable to supplement superficial cervical block with general anesthesia. The more common procedure is to produce bilateral superficial cervical block, in which 10 cc. of a 1 per cent solution of procaine hydrochloride or solution of metycaine is introduced on each side and in which the line of incision is infiltrated with 60 to 80 cc. of an 0.5 per cent solution of one of these agents (Fig. 5). Corbasil (4) (cobefrin) is preferred to epinephrine as the vasoconstricting agent, if one is to be used at all. Although this routine frequently produces adequate anesthesia, it may be necessary also to administer nitrous oxide and oxygen as the lobes of the gland are being enucleated or during periods in which traction is exerted on the gland. Sometimes the descendens hypoglossi nerves are blocked bilaterally. These nerves supply the sternohyoid and sternothyroid muscles and the injection is made through a wheal raised just anterior to the sternocleidomastoid muscle on a line passing through the thyroid notch and the point at which the external jugular vein crosses the posterior border of the sternocleidomastoid muscle, on each side. Five cc. of a 1 per cent solution of the local anesthetic agent is used on each side.

Extensive dissection of the glands of the neck—submental and submaxillary—and block dissection, require both the deep and superficial types of block anesthesia, and thorough infiltration well wide of the line of incision. Additional infiltration is carried out along the line of the jaws and the line of the clavicles, together with several 5 cc. injections of a 0.5 per cent solution of procaine hydrochloride or metycaine into the floor of the mouth. Excision of cysts of the thyroglossal duct necessitates both deep and superficial block anesthesia, produced bilaterally, and suitable infiltration about the region of incision, including deep injection of sufficient extent to permit work about the base of the tongue. For excision of an esophageal diverticulum or ligation of an external carotid artery, unilateral deep and superficial cervical block anesthesia and infiltration produce adequate anesthesia.

BLOCK ANESTHESIA FOR INTERRUPTION OF THE PHRENIC NERVE

In the neck the phrenic nerve (5) runs obliquely across the anterior aspect of the scalenus anterior muscle and beneath the sternocleidomastoid muscle, the inferior belly of the omohyoid muscle and the transverse cervical and transverse scapular vessels. To expose the nerve, a transverse incision is made which is begun just lateral to the

lateral border of the sternocleidomastoid muscle, about 1 inch (2.5 cm.) above the clavicle. Infiltration over the line of incision produces adequate anesthesia, but superficial cervical block sometimes is performed as well. The phrenic nerve is crushed temporarily to limit diaphragmatic movement prior to the operation for repair of diaphragmatic hernia. It is preferable to withhold injection of the anesthetic solution from the tissues around the nerve itself, so that the distribution of the pain produced by the crushing will serve as further identification of the nerve.

Comment.—A few points concerning regional anesthetic procedures about the neck bear emphasis. Insertion of the needles for deep cervical block anesthesia should be done with extreme caution, because of the proximity of the great vessels of the neck and the possibility that the spinal canal may be entered. Solution should not be injected unless the anesthetist is assured that the point of the needle is resting on or near the most superficial point of the transverse process. To guard against inadvertent intravenous or intra-arterial injection, aspiration carried out with the plunger of the syringe should be done before each injection. As a further safeguard against the effects of an intravascular injection of the local anesthetic solution, 3 cc. of solution should be injected at each transverse process as a preliminary step. After a pause for a short interval, the rest of the solution should be injected, if no untoward effects have been observed. If, on aspiration, blood can be withdrawn into the syringe, the position of the point of the needle on the transverse process should be slightly altered, until blood cannot be aspirated. The local anesthetic solution used for deep cervical block must be warm at the time of injection or the percentage of patients for whom the block is unsatisfactory will be increased.

OPERATIONS ON THE UPPER EXTREMITY

Block of the Brachial Plexus.—Successful block of the brachial plexus produces anesthesia of the whole upper extremity below the insertion of the deltoid muscle. The method is applicable for various operations on the upper extremity, such as repair of tendons and nerves, plastic operations and the like. When regional anesthesia is preferred to general anesthesia, block of the brachial plexus has advantages over other types of regional block anesthesia in that the distortion ordinarily produced by local infiltration is thereby obviated. In addition, the procedure is less painful than certain other types of block anesthesia of the upper extremity. The anatomic aspects of the brachial plexus and the variations in the technic of the procedure itself have been reviewed by Tuohy (6), and only the salient features need be repeated herein.

A thorough knowledge of the anatomy of the plexus itself, its relationship to surrounding structures and to certain topographic structures

at the base of the neck (Fig. 6), is an essential prerequisite to performance of successful block of the brachial plexus. The relationship of the main trunks of the brachial plexus to the first rib is primarily important, since it is in this region that the trunks are most closely approximated and most easily blocked. In this region the main trunks of the brachial plexus obliquely cross the anterior aspect of the midportion of the first rib, and are bounded externally by the clavicle and internally by the subclavian artery and below by the first rib. The pulsations of the subclavian artery are easily palpable above the inner midportion of the clavicle.

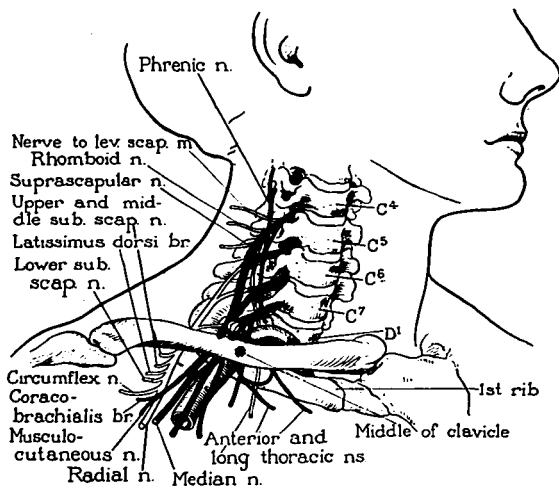


FIG. 6. Anatomic aspects of the brachial plexus. Note the components of the plexus and their relationships to the first rib, the subclavian artery and the clavicle, of which latter the middle portion has been indicated. The wheal through which the needle is passed in performance of block of the brachial plexus is situated one fingerbreadth above the midpoint of the clavicle, as indicated.

Although the brachial plexus may be blocked by the axillary, infraclavicular and paravertebral methods of approach, the supraclavicular method is generally preferred, since it is not technically difficult and produces successful results in a high percentage of cases. The technic of supraclavicular block of the brachial plexus varies somewhat according to various authors in the method of approach, the number of needles employed and so forth. The injection is made with the patient in the supine position; the head of the patient is turned away from the side to be injected, and the arm on the side to be injected is held close to the patient's body to depress the clavicle fully. The midpoint of the clavicle

is estimated and a wheal is raised 1.5 cm. above the point. Through this wheal a 50 mm. needle is cautiously introduced, downward, backward and inward to a depth of 2.5 to 3 cm., at which level its point should contact the upper surface of the first rib. If paresthesia to the arm or hand is elicited, 20 cc. of a 2 per cent solution of procaine hydrochloride or metycaine with epinephrine is injected without change of the position of the needle. During insertion of the needle the subclavian artery is pressed downward by the index finger of the anesthetist's opposite hand. After a successful injection, anesthesia should be complete within fifteen to twenty minutes, and should last from one to two hours. When paresthesia is not obtained, Lundy (7) has suggested the insertion of a second needle through the original wheal while the first one is left in place. This needle is directed toward the portion of the lateral surface of the upper surface of the clavicle opposite to that of the first needle, so that the shafts of the two needles are crossed above the surface of the skin. With both needles in place, 10 to 15 cc. of the 2 per cent solution of procaine hydrochloride or metycaine is injected through each needle. The purpose of this maneuver is to distribute the solution more thoroughly across the surface of the first rib, thereby extending its region of distribution about the plexus.

Another technic which has proved to be most successful involves the use of three needles. A point on the clavicle corresponding to the junction of the middle and inner third portions is ascertained and skin wheals are raised one-half, one and two fingerbreadths, respectively, above this point. Needles of 50 mm. size are inserted, one through each wheal, inward and downward, until the points of the needles rest on the upper lateral surface of the first rib. Whether or not paresthesia has been elicited, 10 cc. of a 2 per cent solution of procaine hydrochloride or metycaine with epinephrine is injected through each needle. Knight (8) has made the additional suggestion that the solution be injected during the withdrawal of these needles from the surface of the first rib so that the solution will be distributed widely about the region of the brachial plexus.

The complications associated with block of the brachial plexus include the inadvertent intravenous or intra-arterial injection of the local anesthetic solution, perforation of the pleura and transient paralysis caused by injury to the plexus by the needle. Care in the placing and manipulation of the needle will minimize the occurrence of these untoward effects.

Comment.—Block of the brachial plexus might be performed more often than it is for operations on the upper extremity, since its margin of safety is high and the anesthesia it produces is successful in about 80 per cent of cases. The danger of intra-arterial injection must always be borne in mind. The procedure is contraindicated when evidence of previous nerve damage exists or when there is infection present in the region of injection or about the region of the plexus. Epinephrine

should be withheld from the solution of the local anesthetic agent for patients who have either hypertension or hyperthyroidism. When block of the brachial plexus is performed for operations about the upper or midportions of the humerus, a bracelet type region of intradermal and subcutaneous infiltration may be carried out on the arm at the level of the axilla to interrupt sensory innervation from the cervical nerves.

Block of the Median Nerve.—The median nerve can be blocked at either the elbow or the wrist.

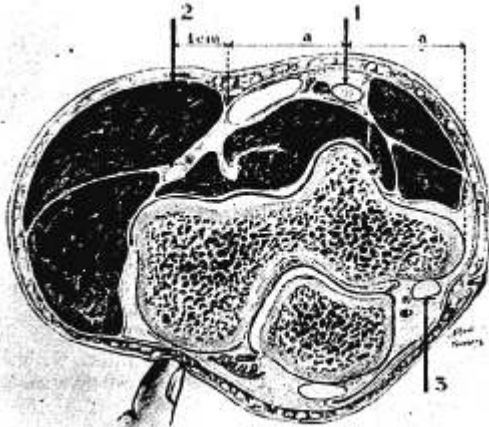


FIG. 7. Block of the median ulnar and radial nerves at the elbow; cross section at the level of the elbow. Note the position of the median nerve, no. 1; the radial nerve, no. 2, and the ulnar nerve, no. 3. The ulnar nerve is seen to lie in a groove formed by the internal epicondyle of the humerus and the olecranon process. Note the position of the median and the ulnar nerves in relationship to the internal condyle of the humerus and the tendon of the biceps (after Labat, Gaston: *Regional Anesthesia: Its Technic and Clinical Application*, Philadelphia, W. B. Saunders Company, 1922, p. 210).

At the elbow.—The landmarks for block at the elbow are the line of flexure and the tendon of the biceps (Fig. 7) (9). Injection is made with the patient in the prone position; the arm is in complete abduction with the forearm extended and supinated. On the line corresponding to the bend of the elbow, a wheal is raised midway between the medial aspect of the internal condyle and the inner side of the biceps tendon. A needle, 50 mm. in size, is inserted through the wheal, perpendicular to the skin and past the deep fascia. When paresthesia is obtained, 3 to 5 cc. of 1 per cent solution of procaine hydrochloride or a solution of metycaine is injected. If paresthesia is not obtained, 5 to 10 cc. of the solution is distributed across the path of the nerve, beneath the deep

fascia; then the region is massaged. The onset of anesthesia should occur within five minutes.

At the wrist.—The identifying landmarks for block of the median nerve at the wrist are the styloid process of the ulna and the tendons of the palmaris longus muscle and the flexor carpi radialis muscle. These tendons will be more easily identified if the patient is asked to flex the hand at the wrist against the resistance of the anesthetist's hand. The palmaris longus muscle is the medial tendon. With the palm of the patient's hand facing upward, a wheal is raised on the anterior portion of the wrist, between these two tendons, and on a line passing transversely across the wrist at the level of the styloid process of the ulna. A needle, 50 mm. in size, attached to the syringe, is inserted through the wheal, perpendicular to the skin, and is introduced slightly past the deep fascia. Four to 5 cc. of a 1 per cent solution of one of the local anesthetic agents previously mentioned is injected, whether or not paresthesia has been elicited, and an additional 3 cc. is injected laterally under the tendon of the flexor carpi radialis; the region is then lightly massaged. Block of the median nerve usually is associated with block of the radial and ulnar nerves for operations on the forearm, wrist and hand, although for operations on the ulnar side of the hand, ulnar block alone may be adequate.

Block of the Radial Nerve.—The radial nerve may be blocked along the lateral aspect of the humerus (lateral route) as the nerve pierces the external intermuscular septum, but the anterior route is more commonly employed, because of its usual association with block of the median and ulnar nerves. The line of the bend of the elbow and the tendon of the biceps are identified as in preparation for block of the median nerve, and through a wheal raised 1 cm. lateral to the biceps tendon a 50 mm. needle is inserted perpendicular to the skin. The anesthetist places the index finger of the opposite hand (that is, opposite to the one occupied with the syringe) on the posterior aspect of the external condyle of the humerus and directs the needle toward this point; it is advanced until it contacts bone. Five to 7 cc. of a 1 per cent solution of procaine hydrochloride or a solution of metycaine with epinephrine is injected at this point if paresthesia has been elicited; otherwise, the solution is distributed transversely along the anterior surface of the condyle.

Block of the Ulnar Nerve.—At the elbow.—At the elbow the ulnar nerve is blocked as it lies in the groove between the internal condyle of the humerus and the olecranon process. The patient lies on the side opposite to that to be injected, with the arm to be injected resting on the body. With the forearm in extension, the nerve is fixed, just above the groove, between the thumb and index finger of the anesthetist's opposite hand to prevent movement. Through a wheal raised at the upper part of the fold of the skin thus produced, a 50 mm. needle attached to the syringe is passed and is directed nearly parallel to the

nerve. When paresthesia has been obtained, 3 to 5 cc. of a 1 per cent solution of procaine hydrochloride or a solution of metycaine with epinephrine is injected.

At the wrist.—When the ulnar nerve is blocked at the wrist, the same landmarks that are employed for block of the median nerve are used. On the transverse level previously described for median block at the wrist, a wheal is raised on the radial side of the flexor carpi ulnaris tendon. A 50 mm. needle is inserted through this wheal, perpendicular

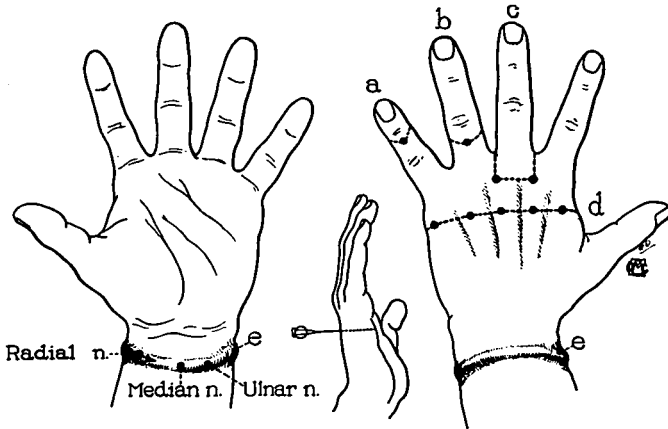


FIG. 8. Block anesthesia for operations on the hand. The figure on the left shows the points at which the wheals are raised on the dorsum of the wrist for block of the median, ulnar and radial nerves. The center figure indicates how the palm of hand is infiltrated by solution injected from the needle which is passed through from the dorsal surface. The right-hand figure shows the situation of the points of injection for various segments of the fingers, including the metacarpal bone.

to the skin, and is advanced at a tangent to the tendon and to a point slightly behind it, unless paresthesia previously has been elicited. Three to 5 cc. of the 1 per cent solution of local anesthetic is injected.

When a combination block of the median, radial and ulnar nerves is employed for operations on the forearm, wrist and hand, it will be necessary to infiltrate intradermally and subcutaneously with an 0.5 per cent solution of procaine hydrochloride or solution of metycaine with epinephrine in the form of a ring around the extremity at a point proximal to the field of operation. This procedure blocks any cutaneous innervation arising above the site of the previous region of anesthesia. When the operation involves the hand only, this sort of infiltration is carried out subcutaneously and subfascially at the wrist in the form of a so-called wrist bracelet.

For removal of the bursa of the olecranon process a U-shaped field block is used. Two wheals are raised on the posterior surface of the elbow joint: one on the lateral side and one on the medial side, slightly above the condyles of the humerus. These are joined by a line of infiltration; then lines of infiltration are made distally from each wheal at right angles to the previous line to a point well below the site of operation. The lines are parallel, one on the lateral and one on the medial aspect of the dorsum of the elbow and upper part of the forearm. A 5 per cent solution of procaine hydrochloride or metycaine with epinephrine is used, the injection being both intradermal and subcutaneous. This type of field block is applicable to many operations on the arm and forearm involving the skin and superficial structures.

Metacarpal and Phalangeal Blocks.—For operations on individual fingers or metacarpal bones, field blocks may be performed (Fig. 8). For more extensive procedures, such as amputation, it may be preferable to block the median and ulnar nerves at the wrist, together with "wrist-bracelet" infiltration. This also applies to operations on the palm of the hand. A field block similar to that described previously for excision of the bursa of the olecranon process in which an 0.5 per cent solution of local anesthetic agent is used is suitable for operations involving the skin on the back of the hand.

Individual phalanges or portions of phalanges are injected from individual wheals, one being raised on each side of the dorsum of the phalanx (10). These wheals are raised about one fingerbreadth proximal to the field of operation, and the injection is carried around the finger from the skin down to the bone. Five to 10 cc. of a 1 per cent solution of procaine hydrochloride or metycaine, without epinephrine, is used, followed by gentle massage. If the whole digit is involved, as in amputation, infiltration is carried out at the root of the finger at the level of the interdigital folds. When the region of operation includes the corresponding metacarpal bone as well as the digit, the interosseous spaces on either side are infiltrated with the 1 per cent solution of local anesthetic agent. Wheals are raised over the interosseous spaces to be injected, well proximal to the site of operation, and the injections are carried down to the palm. In a similar manner, the injections may be extended to include one or more phalanges or metacarpal bones. The thumb may be blocked by infiltration of its whole circumference at its root, from two wheals raised on either side of the dorsal aspect of the thumb at the level of its first phalanx.

Comment.—Since the hand and in particular the fingers are richly supplied with sensory nerves, it is important to ascertain that anesthesia is absolutely complete before surgical intervention is begun. The operative field should be carefully and thoroughly tested (particularly that portion of it which is most distal, such as the tips of the fingers). After completion of the injection, thorough massage will hasten the onset of anesthesia and will increase its effect. When in-

filtration of the hand and fingers, particularly, is being done, use of large quantities of the solution of the local anesthetic agent is to be avoided. Vasoconstricting agents, such as epinephrine and corbasil (cobefrin), should be withheld from the solution of local anesthetic agent when infiltration of the fingers is being carried out, since in the region of the fingers serious interference with the circulation may result. Injection should never be made through the palmar surface of the hand. The palm should be approached from the dorsum of the hand, and the anesthetist should use the fingers of the opposite hand to palpate the tip of the needle under the palmar skin. If it is necessary to employ regional anesthesia when an infective process exists, the site of injection should be as far as possible from the operative site. Under such circumstances block of the median, ulnar and radial nerves at the elbow, with supracondylar bracelet infiltration, should be performed, or, if the site of this procedure necessarily is too near to the infective site, it will be preferable to block the brachial plexus.

Occasionally, anesthesia may not be complete in the deeper structures, or, if the operation is particularly long, sensation may begin to reappear. Anesthesia produced by the intravenous administration of pentothal sodium forms a satisfactory supplementary method (11) under these circumstances. Small amounts of the intravenous agent will suffice and the patient usually is awake before returning from the operating room.

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