Nerve Blocks

A MANUAL OF REGIONAL ANESTHESIA FOR PRACTITIONERS OF MEDICINE

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PREFACE

Heretofore, nerve blocks were used almost exclusively for operative procedures in situations in which satisfactory surgical anesthesia was not available. Present day interest in nerve blocking is no longer confined to surgery but has spread to many other phases of medical practice. The current trend to use nerve blocks for diagnostic and therapeutic purposes, as well as for surgical anesthesia, appears to be increasing. Physicians in all walks of medical practice are performing specialized blocks pertaining to their particular fields.

As is the case with other skills, there must be a beginning or starting point in the mastery of nerve blocking. This manual has been prepared for those who are beginners in the study of regional anesthesia. It is also designed for those whose chief interest is not regional anesthesia but who are called upon to perform an occasional block. The manual is by no means comprehensive or complete. Only the most important and commonly used blocks are described. Its outline form is designed for those who desire at a moment's notice the substance of a given topic together with all pertinent details concerning hazards, precautions and causes of failure. Obviously, those who wish to master the subject of regional anesthesia and become experts must pursue their studies further in the anatomy laboratory on cadavers, manikins and on prepared dissected specimens, or in more detailed text books on the subject.

Originally these procedures appeared under the Section on Regional Anesthesia in the author's text book *Techniques and Procedures of Anesthesia,* first published by Charles C Thomas, Publisher, in 1946. At the suggestion and recommendation of students and friends, the section has been set apart, completely revised, greatly enlarged, and illustrated for the use of those whose interest in anesthesia is principally regional anesthesia.

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A MANUAL OF REGIONAL ANESTHESIA
FOR PRACTITIONERS OF MEDICINE

GENERAL CONSIDERATIONS OF REGIONAL ANESTHESIA

Definition

Anesthesia produced by applying a drug at a point along the course of a nerve and abolishing conduction of afferent and efferent impulses through the segment affected.

Synonyms

Conduction anesthesia; block anesthesia.

Types

Regional anesthesia is subdivided into various types classified according to the site of application of the drug (Fig. 1).

1. *Spinal:* The spinal nerves are blocked at the anterior and posterior roots in the subarachnoid space (Fig. 1A).
2. *Epidural:* The spinal nerves are blocked in the epidural space (Fig. 1B) after acquiring a dural sheath.
3. *Paravertebral:* The spinal nerves are blocked as they emerge from the intervertebral foramina, or in the vicinity of the vertebrae (Fig. 1C).
4. *Nerve:* The somatic nerves are blocked at some point along their course to the periphery of the body before they divide into their terminal branches (Fig. 1D).
5. *Field:* The large terminal branches are blocked by injecting a wall of local anesthetic drug at the border of the area they supply just as they branch (Fig. 1E).
6. *Infiltration*
7. *Topical*

   } The nerve endings are anesthetized by injecting or spreading the drug in the area they supply (Fig. 1F).

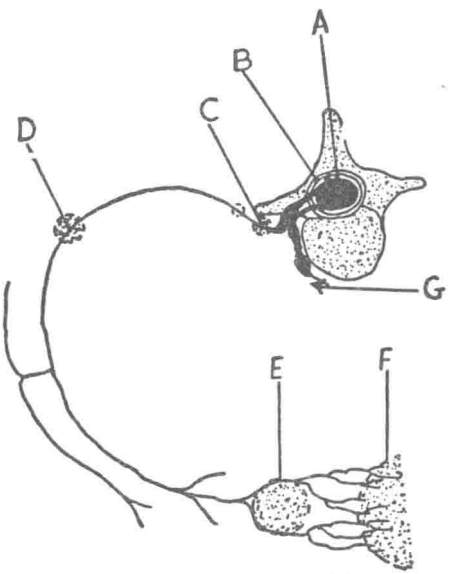

FIGURE 1. Types of regional blocks. (A) Subarachnoid or spinal. (B) Epidural. (C) Paravertebral. (D) Nerve block. (E) Field block. (F) Infiltration. (G) Sympathetic block. Note that in field block the nerves are anesthetized as they divide into terminal branches. In infiltration, and topical the nerve endings are anesthetized.

LOCAL ANESTHETIC DRUGS

Although numerous local anesthetic drugs have been prepared and are in use, all in current use possess certain common physical, chemical, and physiological properties. The most important of these may be summarized as follows:

Physical and Chemical Properties

1. They are synthetic substances (except cocaine).
2. They are basic substances possessing complex molecular structures. The majority are amines. Most of them are esters.
3. They form salts with mineral and organic acids. The salts of hydrochloric acid are the most common. The salt is more stable and soluble in water than the free base. Aqueous solutions of salts are acid in reaction. (pH 6±)
4. The base is more soluble in oils and other lipoids. Aqueous solutions are alkaline. The free base is easily precipitated by alkalis from aqueous solutions of salts.
5. They are incompatible with salts of mercury, silver, and other metals.

Physiological Properties

1. The critical effective concentration of a drug which penetrates a nerve is higher than the blood concentration which gives rise to toxic manifestations. Consequently, the drug must be localized in as small an area and as close to the nerve as possible to prevent systemic absorption and toxic reactions.
2. Excessive amounts in the systemic circulation give rise to toxic reactions manifested by circulatory collapse or central nervous system stimulation.
3. Toxic reactions occur when the rate of absorption exceeds the rate of elimination or detoxification. A large amount slowly absorbed may produce a less severe reaction than a small amount quickly absorbed or intravenously administered. The response obtained varies with blood levels.
4. Systemically small amounts are violent central nervous system stimulants or cardiac depressants; large amounts are profound central nervous system depressants and cause paralysis. Sedative drugs, particularly the barbiturates, antagonize the stimulation of the nervous system but do not protect the heart.
5. The duration of action, local tissue reactions, and effect upon various components of the nervous system vary with and are dependent upon

CURRENTLY EMPLOYED LOCAL ANESTHETIC DRUGS

Name	Synonym	Salt	Use				
			Spinal Block	Epidural Block	Nerve Block	Field Block and Infiltration	Topical
Procaine U.S.P.	Neocaine Novocaine	Hydro-chloride	Widely employed 50–150 mg.	Recom-mended 50 cc. 2%	Widely employed 50 cc. 2%	Widely employed 100 cc. 1%	Possesses no action
Cocaine U.S.P.		Hydro-chloride	Not employed	Not employed	Not employed	Not employed	Useful (with caution!) 4%
Pontocaine N.N.R.	Tetracaine U.S.P. Pantocaine	Hydro-chloride	Widely employed 5–20 mgm.	Employed 50 cc. 0.10%	Employed with caution 75 cc. 0.10%	Not employed 100 cc. of 0.1%	Useful (with caution!) 2%
Nupercaine N.N.R.	Percaine Dibucaine	Hydro-chloride	Widely employed 2½–15 mgm.	Not employed	Not recom-mended 0.1%	Not recom-mended 0.05–0.1%	Useful (with caution!)
Butyn U.S.P.	Butacaine	Sulphate	Not employed	Not employed	Not employed	Not employed	Useful 2%
Metycaine N.N.R	Neothesine Piperocaine	Hydro-chloride	Widely employed 75–125 mgm.	Widely employed 50 cc. 1.5%	Widely employed 50 cc. 1.5%	Widely employed 75 cc. 1%	Useful 3%
Benzocaine U.S.P.	Anesthesin	Not employed	Ineffec-tive	Ineffec-tive	Ineffec-tive	Ineffective	Useful 5%
Benzyl Alcohol N.N.R.		None	Not useful	Not useful	Not useful	Not useful	Useful 4%
Monocaine		Formate	Recom-mended 50–100 mgm.	Useful 1.5%	Useful 1%	Useful 1%	Not employed
Intracaine		Hydro chloride	Useful 50–100 mgm.	Useful 1%	Useful 1.5%	Useful 1%	Not employed
Apothesene N.N.R.		Hydro-chloride	Useful	Not employed	Useful 1%	Useful 0.5%	Not useful
Diothane N.N.R.		Hydro-chloride	Not employed	Not employed	Not employed	Useful 0.5%	Recom-mended 1%
Butesin		Picrate	Not employed	Not employed	Not employed	Not employed	Useful
Lidocaine N.N.R.	Xylocaine	Hydro-chloride	Not employed	2% 25–35 cc.	30 cc. 2%	50 cc. 1%	5%
Hexylcaine	Cyclaine	Hydro-chloride	20–50 mgm.	2% 25–35 cc.	30 cc. 2%	50 cc. 1%	5%
Pipetho-caine	Lucaine	Hydro-chloride	50–100		2%	1%	

the chemical nature of the drug. The properties vary from drug to drug.

6. Each possesses a latent period which varies with the chemical nature of the drug and the concentration. Time interval between moment of application of drug on nerve until blockade is completely established is greater for longer lasting drugs as a rule.
7. They are potentiated by proteins, potassium ion, xanthines and numerous other substances.
8. The action is reversible. The conduction in the nerve fibre is restored to normal when the drug is removed or eliminated.
9. They are detoxified by the liver. The more easily and quickly they are detoxified the less toxic the drug.
10. The effective concentration varies with the size of nerve fibre. Sensory fibres are smaller and affected before motor fibres. Stronger concentrations are necessary for penetration into sheathed and myelinated fibres.

The comparative toxicity and potency of local anesthetic drugs are difficult to establish because these factors not only vary from one species to the ext, but also with the mode of administration, rate of administration, concentration employed, and rate of absorption within a given species.

Characteristics of a Suitable Anesthetic Drug

1. Onset of action should be rapid, consuming not more than a few minutes.
2. Duration of action should allow sufficient time to complete the operation.
3. There should be freedom from local irritation to the nerves or tissues.
4. Systemic toxicity should be low.
5. The drug should be soluble in water.
6. The drug should be stable and boilable.
7. It should be compatible with vasoconstrictors and with components of tissue fluid.

Approximate values for toxicity and potency of some common drugs cocaine = 1).

Drug	Toxicity	Potency
Cocaine Hydrochloride	1	1
Procaine Hydrochloride	$\frac{1}{4}$	$\frac{1}{5}$
Metycaine Hydrochloride	$\frac{1}{4}$	$\frac{1}{4}$
Pontocaine Hydrochloride	3	2
Butyn Sulphate	$\frac{3}{4}$	$\frac{4}{5}$
Nupercaine Hydrochloride	3 to 5	$2\frac{1}{2}$

USE OF PROCAINE IN REGIONAL ANESTHESIA

Procaine hydrochloride is the least toxic and most useful of all the local anesthetic drugs, and, therefore, the drug of choice. The duration of action averages approximately one hour. The hydrochloride is dissolved in aqueous physiological saline or distilled water.

Concentration	Uses	Maximum Amount	Average Dose
0.5%	Infiltration, skin wheals, subcutaneous injection	225 cc.	200 cc.
1.0%	Infiltration, field blocks	125 cc.	100 cc.
2.0%	Nerve, epidural, and paravertebral blocks	60 cc.	50 cc.
5.0%	Spinal anesthesia	4 cc.	2 cc.
10.0%	Spinal anesthesia	2 cc.	1.5 cc.

Comment

1. Decrease the dose for debilitated, cachetic, or aged subjects.
2. Boil sterile physiological saline, add the desired weight of procaine hydrochloride crystals, and boil three minutes longer to prepare a sterilized solution of the drug.

COMPARATIVE DOSAGE OF LOCAL ANESTHETICS

	CC's of Drug Equivalent to 1 cc. Procaine			
Procaine Maximum Volume	2% 50 cc.	1% 100 cc.	.5% 200 cc.	.25% 400 cc.
Pontocaine	.15% 1 cc.	.1% 1 cc.	.05% 1 cc.	.02% 1 cc.
Metycaine	1.5% 1 cc.	.75% 1 cc.	.50% 1 cc.	.25% 1 cc.
Xylocaine	2% ½ to 1 cc.	1% ½ to 1 cc.	.5% ½ to 1 cc.	.25% ½ to 1 cc.
Intracaine	2% ¾–1 cc.	1% ¾–1 cc.	.5% ¾–1 cc.	.25% ¾–1 cc.
Cyclaine	2% ¾ cc.	1% ¾ cc.	.5% ¾ cc.	.25% ¾ cc.
Monocaine	2% ¾ cc.	1% ¾ cc.	.5% ¾ cc.	.25% ¾ cc.

USE OF VASOCONSTRICTOR DRUGS IN REGIONAL ANESTHESIA

Purpose

1. To produce local vasoconstriction for the prevention of rapid absorption of local anesthetic drugs. Toxicity is decreased and the action is prolonged thereby.

2. To overcome hypotension caused by vasomotor disturbances resulting from regional anesthesia.

Drugs available: The sympathomimetic amines are the most useful vasopressor drugs. *For infiltration,* epinephrine and cobefrin are preferred. *For hypotension,* ephedrine, neosynephrine, epinephrine, oenethyl, methedrine, and mixtures of pituitrin and ephedrine are employed.

Uses

1. To prolong anesthesia:

Epinephrine: a stock solution, 1:1000 (U.S.P.), is added to the local anesthetic solution. The dilution employed varies from 1/10,000 to 1/100,000, depending upon the physiological status of the patient and the preference of the surgeon. Usually 1:100,000 is ample.

Cobefrin: 1/200 is diluted to 1/1000 to 1/10,000. Cobefrin is less pronounced in its action than epinephrine and produces less systemic disturbances.

2. To relieve hypotension: See spinal anesthesia.

Indications

1. When injection of local anesthetic drug is made into highly vascular areas (scalp, genitalia, etc.).
2. When concentrated solutions of anesthetic drugs are employed.
3. When local anesthetic drugs of relatively high toxicity are employed.

Contra-indications

a. When hypertension or cardiac disease exists.
b. If the subject is emotionally disturbed (thyrotoxicosis).
c. For anesthesia of the extremities, particularly if peripheral vascular disease is present.
d. In obstetrics—labor may be delayed by use of epinephrine.
e. During combined local and inhalation anesthesia, particularly if cyclopropane, chloroform, or ethyl chloride are employed.

OVERDOSAGE OR TOXIC REACTION OF LOCAL ANESTHETIC DRUGS

Causes of Overdosage

1. Accidental intravascular injection of a drug.
2. Injection of excessive quantities of the drug at one single time.
3. Injection of a concentrated stock solution through error.
4. Injection of a solution into highly vascular areas without the addition of vasoconstrictor substances.
5. Use of highly toxic drugs or drugs whose margin of safety is narrow.
6. Topical application of excessive quantities or concentrated solutions to mucous membranes.

7. Use of average quantities in subjects who are debilitated, cachetic, or otherwise possess an impaired detoxifying mechanism.

Types of Reactions

Two types of systemic reactions from local anesthetic drugs are recognized: NEUROLOGICAL or STIMULATING and CIRCULATORY or DEPRESSANT types.

1. Neurological type

Cause: If local anesthetic drugs gain access to the systemic circulation. they cause intense stimulation of the nervous system. If the dose is large or stimulation is prolonged, depression follows. The reaction may be divided into an early or stimulating phase and a delayed or depressed phase. The most common symptoms are those which occur in the following physiological systems:

Phase	Central Nervous System	Circulatory System	Respiratory System
Early part of stimulating phase.	Excitement, apprehension, or other symptoms of emotional instability. Sudden headache. Nausea or vomiting Twitchings of small muscles, particularly of face, finger, etc.	Pulse varies, slowing of pulse more common than an increase Either an elevation or fall in blood pressure but a change does occur. Pallor of skin.	Increased respiratory rate and depth.
Advanced part of stimulation phase.	Convulsions.	An increase in both blood pressure and pulse rate.	Cyanosis, dyspnea, and rapid respiration.
Depressed phase.	Paralysis of muscles. Loss of reflexes. Unconsciousness.	Circulatory failure. No palpable pulse.	Respiratory failure. Ashen grey cyanosis.

Treatment

1. Inhalation of oxygen. If respiratory movements have failed, inflate the thorax by use of the mask and bag or other suitable method of artificial respiration.
2. Inject a barbiturate intravenously. Any barbiturate is suitable, but an ultra-short-acting drug such as pentothal or evipal is preferred. Observe the following precautions:
   a. Inject enough drug to control the convulsions.
   b. Start injection as soon as possible.
   c. Support the airway and administer oxygen or artificially respire the patient if respiratory failure ensues.

Prophylaxis

1. Always administer a therapeutic dose of a barbiturate in addition to other premedication when contemplating the use of a local anesthetic drug.