



## Anesthesia: Its Advantages and Risks for Human Health



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### Correspondence Author <sup>a</sup> Abstract



All the types of anesthesia that are applied, it is the local one of the most interesting, because it is most often used in medical practice. As any procedure has its risks and is that you have to take into account the area of application, as well as the adverse and toxic effects that would bring its administration in inappropriate doses. In this sense, the purpose of the research is to promote an academic reflection related to the use and proper application of local anesthetics to avoid possible complications in the health of patients. To this end, a thorough bibliographic review was carried out, where 65 bibliographic documents containing scientific articles were analyzed, as well as updated literature on the subject. It was concluded that it is necessary for the health professional to have a vast knowledge about the correct use and proper application of local anesthetics to avoid unwanted effects on human health. The scientific value of the work lies in the very nature of the subject studied, since its study is an urgent challenge for health professionals, while the results offered can be a valid starting point to undertake new research to deepen and expand the knowledge related to the use and application of anesthetic agents in medical practice.

### Keywords

*anesthesia;*  
*human health;*  
*local anesthesia;*  
*medical practice;*  
*risk;*

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## 1. Introduction

In medicine, *local anesthetics (LA)* are drugs universally used by a multitude of health professionals on a daily basis that, in sufficient concentrations, temporarily avoid sensitivity in the place of the body of their administration. Ever since man made his appearance on Earth, he has had to face pain, whether due to traumatism of his wandering life and of fighting against nature, or the product of a pathological condition.

In the most remote times, the solution was sought through the gods to give an explanation to the natural phenomena that surrounded him and for which there was no solution. After the time appeared in the tribe's sorcerers and shamans, who took for themselves the search for a solution to the diseases and pains that afflicted primitive man.

While continuing to rely on the mystical aspects, the practice led them to try to find in the plant's active substances that were able to produce pain relief. Thus, they made their appearance to treat it, the opium poppy, the mandrake, the henbane, alcoholic beverages, and many others. They also used some rudimentary techniques, such as performing compression of the vessels of the neck to produce cerebral hypoxia and therefore unconsciousness, to practice brief operations, such as circumcision for religious purposes. Those were the times in which the main basis of the success of the surgeon was the speed to operate and his skill.

At the beginning of the thirteenth century, the soporific sponge was applied with good results, which produced real inhalational anesthesia and then began to operate after the patient was asleep. It was around this time that the word anesthesia was coined, to designate the act of producing the dream for surgical purposes, with the same sense that is used in our days, although not with the same success (Rodriguez *et al.*, 2018). By the year 1824 animals were anesthetized with the use of nitrous oxide as an anesthetic agent to remove tumors. But the real surgical anesthesia was performed with the use of ether, which laid the foundations for the development of this specialty and provided a good to humanity that divided surgery into two periods: before anesthesia and after anesthesia, as happened with asepsis and with antibiotics.

In 1847, the first anesthesia with ether was performed in Cuba, by Dr. Vicente Antonio de Castro, with such success that all the operations carried out in that year were performed under ether anesthesia, marking a milestone in the history of Cuban medicine and especially surgery (Sainz, 2017).

Rapidly continued his progress improved the anesthetic agents, techniques and equipment until the present, which have reached unsuspected levels in its practice and scientific basis, allowing in turn that the various surgical specialties advance on par with it and in the Currently, operations can be carried out that some years ago were only a dream in the mind of man and in many cases could not even conceive the possibility of its realization (Sainz, 2017).

At the same time that we have worked with dedication to achieve safe general anesthesia for surgical purposes, in other ways we have continued to delve into the scientific knowledge and inventions that have made local and regional anesthesia possible. Throughout the years, Cuba has been honored by the fact that a Cuban in the 1940s was the first anesthesiologist in history to place a catheter in the epidural space for aesthetic purposes (Sainz, 2017).

## 2. Materials and Methods

The research is non-experimental and its study corresponds to the investigative, analytical and descriptive, in order to analyze, expose and illustrate the analysis related to the use and application of anesthetic agents in medical practice. The analytical study was used to perform the analysis of the results obtained. Of descriptive type, because it manages to describe in a general way what is related to the emergence, use, and application of anesthetic agents, specifying the forms of administration and the impact they have on human health.

The method of bibliographic review for the search, review, and study of the bibliographic documents that were useful for the work, managing to locate 65 bibliographies, of which 14 were chosen and referenced by their level of updating, which guarantees an adequate contextualization to the results of the investigation.

The inductive-deductive method was used, starting from the study of the theoretical perspectives of different authors, making a brief journey from the historical evolution related to the emergence and application of anesthetic agents, especially those of local use. All the above was applied in order to reveal the essence of the scientific problem, in the processing of information and the definition of the system of central and operational categories. In addition to reaching the corresponding conclusions, which were useful in terms of academic reflection related to the use and application of anesthetic agents in medicine.

### 3. Results and Discussions

#### 3.1 Development of anesthesiology in Cuba

Quantitative material resources have been invested for the development of anesthesiology in Cuba, modernizing the operating rooms and acquiring new equipment; With this, it was possible to solve the problem of the poor quality and shortage of the equipment of the past, as well as the centralization of resources, expanding the assistance network to all the municipalities of the nation. It also took the teaching of the specialty to all the provinces of the country, promoting postgraduate courses and scientific research (Fordham, 2016).

In a few years, Cuba developed high-level specialists in anesthesiology, enough to cover the teaching, assistance and research needs of the country in its 3 profiles and has even managed to collaborate in other countries of the world (Fordham, 2016). Currently, the specialty has more than 900 specialists and about 350 residents in a 4-year program. In Cienfuegos, there are currently 40 specialists and 15 resident doctors in training for an approximate population of 400,000 inhabitants, covering the 3 profiles of anesthesiology and resuscitation: surgical anesthesia; pain treatment and; critical medicine (Fordham, 2016).

Within the scientific results, 6 congresses and 6 national conferences have been held, coinciding with the V National Congress with the XXIII Latin American Congress and the II Latin American Ibero Congress in 1995, as well as the VI Congress of the year 2000; Congress of the 50th anniversary of the Society with the II International Pain Symposium.

The serious difficulties created by the collapse of the socialist camp aggravated the effects of the economic blockade imposed by the United States, which induced some slowness in the development of anesthesiology in Cuba, caused by the lack of materials, shortage of drugs and coadjuvants, the slow introduction of new features and the deterioration or deterioration of technical and monitoring equipment (Fordham, 2016).

However, it is fair to say that anesthesiology has not stopped in Cuba, today's professionals hold up the humanism and scientific greed of their predecessors and work every day to provide more secure and dignified care. Subsection should be written without a bold type. The result and analysis are presented in the present form. Please avoid too many paragraphs in this section.

#### 3.2 Some concepts and characteristics of local anesthetic agents

Anesthesia is a controlled medical act in which drugs are used to block the tactile and painful sensibility of a patient, either in whole or in part of his body and with or without the commitment of conscience. In its purely surgical aspect, it is classified into two main branches: general anesthesia and local anesthesia. Each of these is subdivided in turn into other sub-branches (Fordham, 2016b).

General anesthesia is defined as the loss of sensitivity in all or part of the body, as a result of the effects of a morbid agent or the use of substances that have the property of producing insensitivity. When it occurs for surgical purposes, it produces a temporary or definitive loss of sensibility, whether tactile, thermal, painful or otherwise (Fordham, 2016b).

On the other hand, local anesthesia is when the loss of sensibility is limited to a part of the body as a result of the effects of some drug, being reversible or not. Some researchers raise the possibility that this type of anesthesia may be irreversible, because, in the treatment of the pain of certain diseases, it is sometimes

necessary to produce the destruction of nerve roots and specific agents are used for this purpose, although from the point of view Surgical anesthesia must always be reversible (Fordham, 2016b).

In medicine the use of local anesthesia is done through anesthetics that act locally, being substances that prevent or relieve pain by interrupting nerve conduction. They attach themselves to some specific receptor site within the pore of the sodium channels in the nerves and prevent the passage of this ion through the said pore. The action is due to its direct interaction with Na<sup>+</sup> channels of voltage gate. As the anesthetic action develops progressively in a nerve, the threshold for electrical excitability is increased, the rate of increase of the action potential is reduced, the conduction of the impulse is delayed and the safety factor for conduction decreases; these factors reduce the probability of propagation of the action potential and nerve conduction fails (Fordham, 2016a).

The site in which the local anesthetics act is accessible only from the inner surface of the membrane, therefore, local anesthetics applied externally they must first cross the membrane before exerting their blocking action. In general, the action is restricted to the application site and reversed rapidly as it diffuses from the application site in the nerve. They can be administered by various routes, including topical, spinal or epidural, depending on the clinical circumstances (Fordham, 2016a).

When applied locally to nerve tissue in appropriate concentrations, they act on any part of the nervous tissue and on any type of nerve fiber, so that a local anesthetic in contact with a nerve trunk can produce both sensory and motor paralysis in the innervated region. Its action is reversible in concentrations of clinical importance and its administration is followed by a complete recovery of nerve function without injury of fibers or nerve cells (Fordham, 2016a).

The duration of action of a local anesthetic depends on the time during which it is in contact with the nerve. Cocaine causes constriction of blood vessels by enhancing the action of noradrenaline, so it prevents its own absorption. Local anesthetics have a vasoconstrictor that has a double function: by decreasing the rate of absorption, localizes the anesthetic at the desired site and allows the rate at which it is destroyed in the body to be parallel to the rate at which it is absorbed in the circulation. This decreases its general toxicity (Guyton, 1984); (Ocampo, 2018).

Part of the vasoconstrictor agent can be absorbed by the general way and sometimes there can be adverse reactions. Late cicatrization of wounds, tissue edema, or necrosis may also occur after local anesthesia (Guyton, 1984).

The application of local anesthetics containing vasoconstrictors during surgical interventions of fingers, hands or feet, which produce prolonged constriction of the arteries in the presence of limited collateral circulation, could produce irreversible hypoxic injury, tissue necrosis and gangrene (Guyton, 1984).

The main characteristics that define local anesthetics are the anesthetic power that is determined mainly by the lipophilicity of the molecule, since, to exert its pharmacological action, they must cross the nerve membrane constituted by 90% by lipids. There is a correlation between the liposolubility coefficient of the different local anesthetics and their anesthetic potency (Ocampo, 2018).

One of the characteristics that affect the anesthetic power is the vasodilator and redistribution power to the tissues, intrinsic property of each local anesthetic (lidocaine is more vasodilator than mepivacaine and etidocaine more liposoluble and captured by fat than bupivacaine) (Guyton, 1984).

Another very important aspect is the duration of action that is primarily related to the capacity of binding to the proteins of the local anesthetic molecule. A factor that contributes significantly to the duration of action of a local anesthetic is its vasodilator capacity. And finally, the latency in which the onset of action of local anesthetics is conditioned by the pKa of each drug (Guyton, 1984).

The percentage of a given local anesthetic present in a basic, non-ionized form, when injected into tissue at pH 7.4 is inversely proportional to the pKa of that local anesthetic. Therefore, drugs with low pKa will have a rapid onset of action and drugs with higher pKa will have it more delayed (Guyton, 1984).

Another factor that influences latency is the concentration of local anesthetic used so that drugs with low toxicity and that can be used at high concentrations, such as 2-chloroprocaine, have a faster onset of action that would be expected with a pKa of 9.6 (Guyton, 1984).

For the execution of minor surgical procedures requires the use of local anesthetics, for which it must be taken into account that an incorrect administration can cause serious adverse effects since they intervene with the function of all the organs in which it occurs driving or transmission of impulses.

It is important to consider that local anesthetics have important effects on the central nervous system, cardiovascular system, autonomic ganglia, neuromuscular junction and all forms of muscle. The danger of these adverse reactions is proportional to the concentration of the anesthetic that is reached in the circulation.

### 3.3 Ways to administer

In local medical practice local anesthesia is indicated in all cases in which it is necessary to block the sensitivity in a limited area, either to perform some minor surgical intervention, such as suturing a wound, performing the exegesis of a small superficial tumor, taking samples of superficial tissue for biopsy, that is, procedures that can be carried out in a body of guard or in a healing room, that is, when procedures of less complexity are carried out (Drasne, 2017).

In this sense, patients who will undergo minor surgical interventions, the preoperative evaluation is one of the fundamental links of clinical activity, considered as the phase in which the search and finding of information related to the patient and their environment, they form a strong pillar on which a large part of the perioperative period is based. From the analysis and interpretation obtained from it, the corresponding guidelines can be drawn up in order to obtain good results, aimed at reducing perioperative morbidity and mortality (Drasne, 2017).

Every perioperative evaluation is aimed at knowing the state of functional reserve of the main systems of the organism, states of compensation and their reaction capacity against the action of anesthetic agents and surgery. It is important to emphasize that for all patients there are common instruments that are essential and that is grouped into a clinical record that constitutes the official document with the greatest legal implication, on which data obtained and provided by the patient himself will be obtained and contributed. in some cases by the companion.

The record of the clinical history should always accompany all surgical patients, in view of the need for an immediate consultation at a certain moment and should collect the studies corresponding to the patient's diseases, including non-surgical ones, so it is essential to have a history complete clinical, knowing the evolutionary status of the associated disease before applying any anesthetic procedure, this will make it easier to diagnose the appearance of any disorder that may be related to a state of decompensation, a complication caused by the anesthetic procedure or by the surgery itself and then act in correspondence with it.

On the other hand, we have the anesthetic sheet, which uses techniques for the collection of information such as the interrogation aimed at collecting all information of greater interest that allows us to foresee as much as possible the impact that certain situations of the patient could have on our work. , in this way associated diseases are collected, previous medications, toxic habits, allergic history and anesthetic history, which allows us to draw up a consistent work strategy, when establishing a balance between risks and benefits, and that the chosen procedure contributes to the patient improvement, including quality and life expectancy (Martin et al., 2018).

In this sense, local anesthesia has two main advantages (Martin et al., 2018): they

- 1) Avoid physiological disturbances typical of general anesthesia;
- 2) They can beneficially modify the neurophysiological reactions to pain and stress.

The choice of an appropriate local anesthetic and care in its application are the primary determining factors to reduce the toxicity of the anesthetic.

Local anesthetics can be classified into three categories (Sabiston, 2011):

- 1) those with short action (20 to 45 minutes) on mixed peripheral nerves such as procaine;
- 2) those with intermediate action (from 60 to 120 minutes) such as lidocaine and mepivacaine;
- 3) long-acting (from 400 to 450 minutes) such as bupivacaine, etidocaine, ropivacaine, and tetracaine.

Local anesthetics can be classified according to the method of administration in topical anesthesia; infiltration anesthesia; field blocking anesthesia; nerve block anesthesia; intravenous regional anesthesia; spinal anesthesia and; Epidural anesthesia (Stevens, 2017):

- a) Topical anesthesia: those of the mucous membranes of the nose, mouth, throat, tracheobronchial tree, esophagus, and genitourinary tract, can be achieved through the direct application of aqueous solutions of local anesthetic salts or suspensions of anesthetics poorly soluble local 2% tetracaine, 2%, and 10%



lidocaine, and 1% to 4% of cocaine are most commonly used. The maximum total safe dosages for topical anesthesia in the healthy adult of 70 kg are 500 mg in the case of lidocaine, 200 mg with cocaine and 50 mg with tetracaine. This type of anesthesia should not be used on mucous membranes or skin with abrasions since rapid absorption through these surfaces can cause poisoning.

- b) Infiltration anesthesia: administered by the direct injection of a local anesthetic into the tissues, without taking into account the trajectory of the cutaneous nerves. This can be so superficial that it includes only the skin, or it can also include deeper tissues, such as the intra-abdominal organs. Solutions containing adrenaline should not be injected into tissues irrigated by terminal arteries, for example, fingers and toes, ears, nose, and penis. The intense vasoconstriction produced by adrenaline can cause gangrene. For the same reason, adrenaline should be avoided in solutions that are injected intracutaneously. As it is also absorbed in the circulation, it should be avoided in those who do not desire adrenergic stimulation. The most used are 0.5 and 1% lidocaine, 0.5 to 1% procaine and 0.125 or 0.25% bupivacaine. When administered without adrenaline you can infiltrate up to 4.5 mg / Kg of lidocaine, 7mg / Kg of procaine and 2mg / Kg of bupivacaine. When adrenaline is added, they can increase by a third ([Minzter et al., 2017](#)).
- c) Field Blocking Anesthesia: it is produced by subcutaneous injection of a local anesthetic solution so that the region distal to the injection site is anesthetized. For example, subcutaneous infiltration of the proximal portion of the palmar surface of the forearm results in an extensive area of cutaneous anesthesia that begins at a site 2 to 3 centimeters distal to the site of injection. The same principle can be used with particular benefit in the scalp, anterior abdominal wall, and lower limb. The most used are the same as in infiltration anesthesia; with the advantage that less drug can be used to provide a larger area of anesthesia, than when anesthesia is used for infiltration. Of course, neuroanatomy must be considered in order for this anesthetic technique to result ([Hardman et al., 2016](#)).
- d) Nervous Block Anesthesia: Consists of the injection of a local anesthetic into or inside individual nerves or nerve plexuses, producing even greater areas of anesthesia than in the two techniques described above. The blockage of mixed peripheral nerves and nerve plexuses also anesthesia, usually to the somatic motor nerves, with which striated muscle relaxation occurs, a phenomenon useful in some surgical procedures. The sensorial and motor block areas usually start at a site several centimeters distal to the injection site. The brachial plexus blocks are useful for upper limb and shoulder procedures, intercostal nerve blocks are effective for anesthesia and relaxation of the anterior abdominal wall. Cervical plexus block is appropriate for neck operations. The blockages of the sciatic and femoral nerves are useful for operations at sites distal to the knee. To avoid pain, the drug is deposited as close as possible to the nerve ([Sabiston, 2011](#)).
- e) Intravenous Regional Anesthesia (Bier Block): this technique is based on the use of blood vessels to bring anesthesia to the trunks and nerve endings. For its application, the limb is left ischemic with an elastic bandage and a tourniquet located at the proximal level is insufflated, up to a pressure of 100 to 150 mmHg on the systolic blood pressure. The elastic bandage is removed and the anesthetic is injected into a previously channeled local vein. Characteristic is the achievement of complete anesthesia in the limb after 5 to 10 minutes. The pain produced by the tourniquet and the danger of ischemic nerve injury limits the insufflation of the tourniquet to two hours or less, however, should be kept insufflated for at least 15 to 30 minutes to prevent toxic amounts of anesthetic from entering the circulation. local after disinfecting it. The preferred drug for this technique is lidocaine, in doses of 40 to 50 ml of 0.5% solution without adrenaline. The dose administered should not exceed 4 mg/kg. Prilocaine could also be used because it has a wider therapeutic index. It is most often used in forearm and hand operations but can be adapted for foot and distal leg ([Washintong, 2018](#)).
- f) Spinal Anesthesia: is applied by injecting a local anesthetic into the cerebrospinal fluid (CSF), is one of the most common forms of anesthesia for producing anesthesia of a considerable part of the body with doses that produce insignificant plasma concentrations. In most adults, the spinal cord ends above the second lumbar vertebra. Between this point and the termination of the thecal sac, at the level of the sacrum, the lumbar and sacral roots are bathed in CSF, therefore, in this region, there is a relatively large volume of said liquid within which the drug can be injected. The most commonly used drugs are lidocaine, tetracaine, and bupivacaine. Lidocaine for short procedures, bupivacaine in the procedures of intermediate to prolonged and tetracaine for prolonged. The most important pharmacological factors

are the amount, volume and baricity of the injected compound. The rapidity of the local anesthetic solution can also influence the height of the block, as well as the position of the patient (Washintong, 2018). Its utility is maximum in operations that are performed in the lower abdomen, lower extremities, and the perineum. It is advisable to combine intravenous drugs to cause sedation and amnesia (Paladino *et al.*, 2019).

- g) Epidural anesthesia: administered by an injection of the local anesthetic into the epidural space, which is limited by the yellow ligament behind, the spinal periosteum by the sides and the dura mater by the front. This technique can be administered in the sacral hiatus (caudal anesthesia), or in the lumbar, thoracic or cervical spine. It is applied by epidural localization catheter with continuous or intermittent administration of bupivacaine in concentrations of 0.5 to 0.75% when the long-term surgical block is desired. Due to its toxicity, it is not used in pregnant women. In general, lower concentrations of this compound are used to provide analgesia during delivery. You can also use etidocaine in concentrations of 1 to 1.5% which can also provide excellent long-term muscle relaxation. The most commonly used intermediate local anesthetic is lidocaine in 2% concentration. Chloroprocaine in concentrations of 2 to 3%, with early onset anesthesia and short duration. An important difference between epidural and spinal anesthesia is that the doses of local anesthetic used can produce high blood levels after absorption from the epidural space. Another important difference is that there is no differential sympathetic blocking zone with epidural anesthesia; therefore, the level of sympathetic blockade approaches sensory block. It should not be used in obstetrics (Paladino *et al.*, 2019).

It is important to consider that adverse reactions to local anesthetic agents are much more frequent than is usually thought. These reactions can have two fundamental causes:

- 1) Hypersensitivity or idiosyncrasy to the chemical and;
- 2) Overdose poisoning, either absolute or relative

The local anesthetic agents usually produce alterations in the central nervous system causing a stimulation of the cortex and brain centers, although at higher plasma concentrations there is depression of the bulb and bulge. Reactions to local anesthetic agents manifest clinically as agitation, disjointed speech, verbiage, loquacity, restlessness, euphoria, nausea, vomiting, disorientation, paresthesias (peri-oral and lingual), tremors, seizures, coma, and respiratory arrest. In general, the more powerful the anesthetic, the easier it will be to produce convulsions. Central stimulation is followed by depression; in critical cases, death usually occurs due to respiratory failure.

In the cardiovascular system after its absorption by the general way, they act in this device. The primary site of action is the myocardium, in which the electrical excitability, the conduction frequency and the force of contraction decrease, and most of them produce arteriolar dilatation. These manifestations are observed after having reached high concentrations in blood and alterations appear in the central nervous system.

The adverse cardiovascular effects of local anesthetics may be the result of inadvertent intravascular administration, especially if there is also adrenaline. On the other hand, in the smooth muscle, they depress the contractions of the intact intestine, they also relax the vascular and bronchial smooth muscle, although the low concentrations can initially produce contraction of them.

Spinal and epidural anesthesia, as well as the installation of anesthetics within the peritoneal cavity, produce sympathetic nervous system paralysis that may result in an increased tone of the gastrointestinal musculature, whereas in the striated muscle they affect the transmission in the neuromuscular plate. Sometimes the administration of local anesthetics is accompanied by a semiology compatible with an IgE-mediated immune reaction, with urticaria-angioedema, rhinitis, bronchospasm and anaphylactic shock.

#### 4. Conclusion

By way of conclusion, it can be stated that local anesthetics are drugs that produce reversible nerve block, by preventing the transmission of impulses by peripheral nerves, spinal roots or nerve endings, Local

anesthetics are drugs with narrow therapeutic margin, their toxicity is determined by the passage to the bloodstream that depends on the form of application and the drug used, as well as the doses applied.

The toxicity of anesthetic agents usually affects especially the central nervous system and the cardiovascular system, which is why the mastery of knowledge about the subject, help to reduce the rates of morbidity and mortality, as well as complications and adverse effects.

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