



LOCAL ANESTHETIC TECHNIQUES IN DERMATOLOGY

Monica Dărmănescu¹, V. Trifu², Sorina Chivu², Rodica Sotcan²

¹ Dermatology, The Institute of Mother and Child Healthcare (IOMC "Alfred Rusescu"), Bucharest

² Dermatology, Central Emergency University Military Hospital, Bucharest

Abstract. Local anesthesia is preferred for most cutaneous surgical procedures, because it reliably provides effective anesthesia. Several local anesthetics with various methods of delivery are available for the expanding field of cutaneous surgery. Understanding the pharmacological properties, different applications and proper technique of administration of local anesthetics allows for an efficient anesthesia and patient safety. The use of combined techniques of topical anesthetics, nerve blocks, local infiltration and tumescent anesthesia allows for effective cutaneous surgical procedures avoiding the increased risk of morbidity and mortality associated with general anesthesia.

Keywords: local anesthesia, pharmacologic properties, technique of administration

Introduction

In the field of dermatologic surgery, proper administration of local anesthetics provides anesthesia necessary for a variety of diagnostic and therapeutic procedures, from biopsy techniques to advanced oncologic, cosmetic and reconstructive techniques. In recent years, new anesthetic formulations and intelligent and efficient techniques of administration have accompanied advances in surgical dermatology.

Local anesthesia is preferred for most cutaneous surgical procedures, because it provides effective anesthesia and avoids the increased risk of morbidity and mortality associated with general anesthesia. The effective use of local anesthetics with various methods of delivery depends on understanding the pharmacologic properties, different applications and proper technique of administration.

Mechanism of action

Local anesthetics exhibit their clinical effects on peripheral nerves by temporarily inhibiting the in-

flux of sodium ions required for the generation and propagation of action potentials across the nerve cell membrane, thus preventing the conduction of nerve impulses.

Structurally, local anesthetic agents are composed of three distinct sections: a tertiary amine, an aromatic group, and an intermediate chain that connects the two. Modifications of any of these components can affect the pharmacological properties of the anesthetic agent. The aromatic component provides most of the lipophilic properties of the compound. It facilitates the diffusion of the anesthetic through membranes, which correlates to the potency of the anesthetic [1]. The hydrophilic component, a tertiary amine, is involved in binding within the sodium channel which provides the solubility and diffusion through aqueous environment [2]. The nature of the bond within the intermediate chain divides the local anesthetics into two biochemical groups: amino-esters and amino-amides. The former group includes procaine, chlorprocaine, benzocaine, cocaine and tetracaine, while the latter group includes bupivacaine, lidocaine, ropivacaine, prilocaine, mepivacaine, etidocaine, dibucaine and levobupivacaine.

The solubility, lipophilic properties (which determine the potency of the agent) and protein binding activity (dictates the duration of action)

Monica Dărmănescu

120 Lacul Tei Blvd., Bucharest, Romania

E-mail: monicasorina27@yahoo.com

determines the relative anesthetic properties of the different anesthetic molecules [3]. The selection of the proper anesthetic agent is made based on intraoperative needs such as the desired onset of action, duration of action and the possible toxicity. Duration of action is perhaps the factor of greatest importance to the clinician. Short acting agents (procaine, chlorprocaine) are ideal when only a short duration of action is needed (15-30 min). For longer procedures (30-90 min) agents such as lidocaine, mepivacaine and prilocaine are ideal. Long acting agents (bupivacaine, ropivacaine) will give 2-4 h of anesthesia, often providing analgesia in the postoperative period.

The pharmacological properties of ester and amide anesthetics are outlined in Table I.

Anesthetic	Onset (min)	Duration (min)	Maximal dose(mg/kg) in adults
Procaine	5	15-30	10
Chlorprocaine	5-6	30-60	10
Tetracaine	7	120-240	2
Lidocaine	<1	30-120	5
Bupivacaine	2-10	120-240	2
Mepivacaine	3-20	30-120	6
Prilocaine	5-6	30-120	7
Etidocaine	3-5	200	4.5
Ropivacaine	1-15	120-360	3.5
Levobupivacaine	2-10	120-240	2.1

Table I. Local anesthetics

To increase the safety and the ease of the surgery, the patient's comfort, and to augment analgesia, some substances are frequently added to local anesthetics: vasoconstrictors, sodium bicarbonate, hyaluronidase, and other anesthetics.

Vasoconstrictors are added to local anesthetics to decrease bleeding, retard the absorption of anesthetics, decrease systemic toxicity and prolong the duration of anesthesia [3].

Epinephrine (adrenaline) is the most common vasoconstrictor added; full vasoconstriction requires 7-15 minutes. The maximum dose should generally not exceed 1 mg (100 mL of 1:100000 solution) [4].

Sodium bicarbonate 8.4% added to local anesthetic reduces the pain on infiltration because it increases the pH, bringing it closer to physiologic pH [5]. In addition, alkalization of local anesthetics allows for increased amounts of uncharged, lipid-soluble base, which readily crosses the nerve membrane, leading to a faster onset of action [2].

Hyaluronidase, an enzyme that depolymerizes hyaluronic acid, facilitates diffusion of injectable solutions through tissue planes, helping hydrodissection with undermining in the subcutaneous tissue [6]. Hyaluronidase has disadvantages that

limit its use in cutaneous surgery: it decreases the duration of anesthesia and increases the risk of anesthetic toxicity by increased absorption [6,7].

Other anesthetics can be mixed together to obtain the maximum benefit of each drug. For example, a long-acting anesthetic with a delayed onset of action, such as bupivacaine, can be mixed with a quicker-onset anesthetic such as lidocaine [8,9], providing optimal anesthesia when a prolonged procedure is anticipated.

The choice of the local anesthetic depends of the type of intervention. For simple, rapid procedures, a short acting anesthetic is preferred; for difficult procedures a long-acting anesthetic is a better option. Local anesthesia for most cutaneous procedures is achieved by local infiltration using lidocaine 1% or 2%, with or without epinephrine. When longer procedures are needed, longer-acting anesthetics such as bupivacaine can be added.

Techniques of administration of local anesthetics

Topical anesthesia

Local anesthesia with topical application finds its utility in certain application areas of the dermatological surgery such as biopsies, superficial laser procedures, electrocautery for epidermal lesions. The most used cream is **EMLA** cream 5%, eutectic mixture of lidocaine and prilocaine in an oil-in-water emulsion cream, applied for 60 minutes occlusively for an adequate dermal anesthesia (depth 3 mm for 60 min, 5 mm for 120 min) [10].

LMX (ELA-Max) 5% contains lidocaine with liposomal release facilitating penetration and sustained activity [11]. A 30-minute application time before the procedure is recommended.

Topicaine-4% lidocaine in a gel microemulsion - 30-60 minutes occlusively [11]. **Tetracaine** solution 0.5% is used mainly for ophthalmic procedures, or more recently 4% gel (60-minute occlusion period) [11].

Infiltrative techniques

Local infiltration is the most used technique in cutaneous surgery. This is administrated intradermally and/or subcutaneously. The intradermal injection results in a rapid onset with a prolonged duration of anesthesia, although it is more painful and can lead to tissue distortions. Subcutaneous injection with minimal tissue distortion is less painful, but has a slower onset and lasts less due to increased diffusion and absorption.

There have been described various techniques to reduce pain with a good tolerance from the patient. Providing a calm and comfortable environment,

the use of small diameter 30-gauge needles, the application of topical anesthetic at the injection site, ice or other cooling device (cryoanesthesia, liquid nitrogen), warming the anesthetic to body temperature, the re-introduction of the needle in the area pre-anesthetized, represent techniques that help decrease pain perception during anesthesia.

Tissue distention with infiltration of the anesthetic causes pain, therefore it is injected slowly also in the amount necessary to ensure high quality anesthesia [12]. Also, using those small diameter needles decreases the rate of infiltration, with a slower tissue distension and less pain. Research has in view computerized devices with controlled administration of the anesthetic as well as needle-free devices, whose clinical utility in the dermatologic surgery remains to be determined and verified [13,14].

Regional blocks (ring-block anesthesia) involve circumferential administration around the operative site, especially when direct infiltration into the surgical field is not desirable and when a large area that would require a greater amount of anesthetic through infiltrative procedure needs to be anesthetized. In this type of anesthesia, the substance must be injected both in the superficial and deep levels [12].

Tumescent anesthesia involves the administration of large volumes of dilute anesthetic (usually 0.05 to 0.1% lidocaine with 1:1000000 adrenaline) in the *subcutaneous fat* until the tissue distends. It has been widely used in liposuction, in the technique of tumescent liposuction [7] (table II). The solution used is administered by multiport infiltration cannula or blunt-tipped spinal needle with a 18-20-gauge diameter. The concentrations of lidocaine and adrenaline may be modified depending on the injection site and nature of the proceedings [12].

Component	Concentration	Quantity per liter of normal saline
Lidocaine	500 mg/L	50 mL of 1% lidocaine
Adrenaline	0.5 mg/L	0.5 mL of 1:1000000 adrenaline
Sodium bicarbonate	10 mEq/L	10 mL of 8.5% sodium bicarbonate

Table II. Klein's tumescent anesthetic solution [15]

The tumescent technique allows procedures with minimal bleeding, avoiding the risks of general anesthesia, longer duration of action providing postoperative analgesia. Thus, there appeared a new concept in local anesthesia, the *subcutaneous* and *intradermal* tumescent technique with immediate benefits on the operation technique in terms of achieving minimal intraoperative bleeding by mechanical pressure on the vessels and the use

of lower concentrations of anesthetic to decrease potential side effects.

Another advantage resides in the possibility of rearranging the differences in tissue planeity by intumescence, (fig. 1, fig. 2, fig. 5, fig. 6) which is part of the sophistication of the interventionist technique by anticipating, ever since the surgery time of preoperative planning, of the adequate incision lines to allow a correct closure without tension and deformities. Also, the undermining in the subcutaneous plan for the different kinds of flaps is facilitated, with minimal bleeding, easy and safe undermining, avoiding vessels and peripheral nerves. The intumescent solution will make a hydrodissection in the tissue plan of the least resistance (N.B. All nerve, vascular structures lie below that level, except when a tumor tissue fixes by infiltration the superjacent tissues) [16,17,18].

Subsequently, the undermining is facilitated by this hydrodissection through the intumescent technique, allowing a constant level of the undermining (fig.3, fig.7), which ensures a uniform tissue rearrangement for the flaps movement, with proper wound edges approximation (fig.4, fig.8).

Regional blocks

Knowing the anatomical distribution of sensory nerves of the face allows facial nerve blocks, using smaller amounts of anesthetic agents for the anesthesia of large areas. Another advantage is to avoid the tissue distortion, because the injection site is not in the anesthetized territory. It is a difficult technique, as it requires the precise identification of the nerve trunk at the emergence from the skull, not being without risks, such as nerve fibers dilacerations intravascular injection or the appearance of a hematoma. The distribution of the trigeminal nerve and of its branches allows direct and selective anesthesia by troncular anesthesia of the central portion of the face [19,20].

The areas (foraminal) by which the supra-orbital, infra-orbital and mandibular branches are distributed at the facial level are easily palpated for identification and then injected. Approximately 2-3 ml of anesthetic are injected adjacently to the emerging area of the skull for each branch for regional blockade.

The *supraorbital nerve* has its emerging point 2.5 cm away from the midline on the supraorbital

bottom line on the pupillary line. The injection of this branch and of the supratrochlear branch on the superomedial orbit provides anesthesia of the frontal region.



Figure 1. Frontal tumescent anesthesia



Figure 2. Tumescent technique allows adjusting differences in tissue planeity



Figure 3. Minimal bleeding with undermining at a constant level



Figure 4. Proper wound edges approximation on the frontal convex surface



Figure 5. Preoperative planning (incision lines)



Figure 6. Tumescent anesthesia allowed excision and hydrodissection for easy undermining

The lower eyelid, cheek, lateral nasal pyramid can be anesthetized by injecting the *infraorbital nerve*, 1 cm below the infraorbital rim of the orbit on the mid pupillary line.



Figure 7. Extensive undermining under tumescent local anesthesia with minimal bleeding



Figure 7. Extensive undermining under tumescent local anesthesia with minimal bleeding



Figure 8. Flap in place

The lower lip and the chin area are anesthetized through the block anesthesia of the *mental nerve* on the mid-pupillary line at the jaw level. The anesthesia onset is usually after 5-10 min, the duration depends on the type of substance that is used.

This type of anesthesia does not offer the advantage of effective hemostasis, therefore in those

interventions where large underminings are carried out, the anesthesia is completed with the infiltrative technique mentioned above, with intradermal and subcutaneous tumescence anesthesia, thus avoiding general anesthesia.

Conclusions

Local anesthesia is an ideal approach for interventions in the field of dermatologic surgery. Proper knowledge of the pharmacological properties, potential side effects, various applications and techniques of anesthetics administration is essential in the practice of dermatologic surgery. Used correctly, the local anesthetics allow efficient anesthesia and analgesia.

Although local infiltration remains the most commonly used method, other techniques of drug delivery have expanded the use of local anesthetics in the expanding field of cutaneous surgery.

Using the additive and complementary techniques of regional blocks, serial infiltrative and tumescent anesthesia allows interventions in the field of cutaneous surgery, thus avoiding the risks related to general anesthesia.

References

1. Covino BG. Local anesthesia. *N Engl J Med* 1972;286:975-983.
2. Tetzlaff JE. The pharmacology of local anesthetics. *Anesthesiol Clin North Am* 2000;18:217-231.
3. Covino BG. Pharmacology of local anesthetic agents. *Br J Anesth* 1986;58:701-716.
4. Gekin RC, Auletta MJ. Local anesthesia in dermatologic surgery. *J Am Acad Dermatol* 1988;19:599-614.
5. Stewart JH, Cole GW, Klein JA. Neutralized lidocaine with epinephrine for local anesthesia. *J Dermatol Surg Oncol* 1989;15:1081-1083.
6. Clark LE, Mellette JR. The use of hyaluronidase as an adjunct to surgical procedures. *Dermatol Surg* 1994;20:842-844.
7. Klein JA. Pharmacology of lidocaine in: Klein JA Tumescent technique, tumescent anesthesia and microcannular liposuction. St Louis: Mosby; 2000:127.
8. Dinehart SM. Topical, local, and regional anesthesia. In Wheeland R, ed. *Cutaneous surgery*. Philadelphia: WB Saunders;1994:105-110
9. Galindo A, Witcher T. Mixtures of local anesthetics: bupivacaine-chloroprocaine. *Anesth Analg* 1980;59:683-685.
10. Huang V, Vidimos A. Topical anesthetics in dermatology *J Am Acad Dermatol* 2000;43:286-298.
11. Friedman PM, Mafong EA, Friedman BS, et al. Topical anesthetics update: EMLA and beyond. *Dermatol Surg* 2001;27:1019-1026.
12. Auletta MJ, Grekin RC. Local anesthesia for dermatologic surgery. New York: Churchill Livingstone; 1990.
13. Hawkins JM, Moore PA. Local anesthesia: advances in agents and techniques. *Dent Clin N Am* 2002;46:719-732.

14. **True RH, Elliot RM.** Microprocessor-controlled local anesthesia versus the conventional syringe technique in hair transplantation. *Dermatol Surg* **2002;28:463-468.**
15. **Klein JA.** Anesthetic formulation of tumescent solutions. *Dermatol Clinics* **1999;17:751-759.**
16. **Hot P, Motley R, Field L.** Tumescent technique for anesthesia in skin surgery. *Br J Dermatol* **1995;133 (suppl 45):46-8.**
17. **Field L, Ho HP, et al.** Tumescent anesthesia combined with blunt dissection: fulfillment of the safe surgeon's dream. *Cosm Surg* **1995;8:43-5.**
18. **Field L.** Surgical demonstration of bilevel anesthesia including tumescent hydrodissection for skin tumors. *Superficial Anatomy and Cutaneous Surgery Course, University of California, San Diego and Scripps Clinic, La Jolla, California, July 1996-1999.*
19. **Hawkins JM, Moore PA.** Local anesthesia: advances in agents and techniques. *Dent Clin N Am* **2002;46:719-732.**
20. **Eaton JS, Grekin RC.** Regional anesthesia of the face. *Dermatol Surg* **2001;27:1006-1009.**