Complications in local anesthesia

Associate prof. Elitsa Deliverska, PhD
Department of Dental, Oral and Maxillofacial surgery, FDM, MU-Sofia

Local anesthetics are used routinely in oral and maxillofacial surgery and the practitioner should be aware of the preoperative and postoperative complications associated with the local anesthetics. In clinical oral surgery practice is obligatory to maintain safe and effective local anesthesia. It has been used in clinical dentistry to eliminate pain associated with different procedures and it is mandatory to have a preoperative evaluation of the patient and choosing the proper local anesthetic agent to prevent drug-related complications such as hypersensitivity, allergy, overdosage, toxicity, paresthesia, etc. Different complications can be observed during practice while performing different local anesthesia techniques. The local anesthetics are reliable and efficient drugs, but the clinician should be aware about the risks in this procedure and the prevention of measures and treatment of the complications during or after the of local anesthesia.

Complications associated with local anesthetics can be evaluated systematically and locally.

Systemic reactions due to local anesthesia are reported as psychogenic reactions, systemic toxicity, allergy, methemoglobinemia etc.

Common local complications associated with local anesthesia are reported as pain at and after injection, needle fracture, various sensory disorders, lack of effect, trismus, infection, edema, hematoma, gingival lesions, soft tissue injury, vascular and ophthalmologic complications.

Systemic reactions due to local anesthesia

Psychogenic reactions

This psychogenic answer is associated with the patient’s body counterbalance to an anxiety-inducing situation. As a result of mood changes, heart rate, respiratory rate, and blood pressure are altered and patients often have a blush or erythema hyperventilation, nausea, and vomiting which can mimics allergic reactions. It is important to understand the patients and make them relax. In more severe cases, these reactions should be maintained as syncope and hyperventilation. For preventing psychogenic reactions, the patient should be relaxed before local anesthetic injections. Management include sympathetic management but in severe cases we can use oral sedatives ss an efficacious method to manage dental fears. Initial dosage should be dependent on patient health, age, weight, and duration of the operation. For healthy adult patients:

- in short-term operations antihistamine-diphenhydramine (Benadryl) 50 mg 1 hour prior to the operation,
- for moderate length (1–2 hours) and for longer duration (2–4 hours) could be prescribed benzodiazepine such as lorazepam (Ativan) 1–4 mg or triazolam (Halcion) 0.125–0.5 mg 1 hour before the operation.

Pharmacologically, mildly and moderately anxious dental patients can be managed using sedation but extremely anxious or phobic patients are indicated for general anesthesia.

**Systemic toxicity**

Local anesthetic systemic toxicity develops when a toxic concentration of anesthetic drug in the blood level reaches the central nervous system and cardiovascular system. Local anesthetics depress the central nervous system in a dose-dependent manner. They cross the blood-brain barrier, producing CNS depression as the blood pressure rises. Higher concentrations of LA induce seizure activity. Convulsive seizures are the principal life-threatening consequence of local anesthetic overdose. Presumably this is due to selective depression of central inhibitory tracts, which allows excitatory tracts to run amuck. To neural blockade, peripheral actions of most local anesthetics include varying degrees of vasodilation, and this contributes to the hypotension observed after administration of large doses. It is essential that local anesthetics be respected as central nervous system depressants, and they potentiate any respiratory depression associated with sedatives and opioids. Serum concentrations required to produce seizures are lower if hypercarbia (elevated carbon dioxide) is present. There are documented catastrophic consequences of this drug interaction in pediatric patients receiving preoperative sedation, along with excessive doses of local anesthetics. When managing pediatric patients, maximum doses are conventionally expressed in mg/kg, and this should be followed as a precaution.

Cardiovascular system depression—bradycardia, vasodilatation, cardiac arrest.

Initial symptoms are characterized by central nervous system signs such as excitation, convulsions, followed by loss of consciousness and respiratory arrest. These symptoms are often accompanied by cardiovascular signs such as hypertension, tachycardia, and premature ventricular contractions. The clinical signs and symptoms usually start symptoms such as quick talking, flicker, and tremor in the extremities.

Predisposing factors are associated with age, weight, gender, current medication (other drugs interaction), the presence of diseases, genetics, vasoactivity, concentration, dose, route of administration, the rate of injection, vascularity of the injection site, presence of vasoconstrictors.

To prevent systemic toxicity, the patient should be evaluated meticulously.

- the max. dosage should be estimated,
- accurate and slow injection technique,
- adjustment of dosage divided administration and aspirating technique,
- using agents with low toxicity,
- performing an aspiration test.
Key features:

- Occurs due to systemic absorption of an excessive amount of the drug.
- Because local anesthetics block conduction in many tissues in addition to the peripheral nerve, toxicity could result if sufficient amounts of the anaesthetic reach the heart or brain.
- High blood levels of the drug may be secondary to repeated injections or could be a result of a single intravascular administration- aspiration prior to every injection is important.

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**Serum concentration of Lidocain**

- [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1693664/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1693664/)

Dentists should be aware that excessive doses of topical anesthetics while these agents are more concentrated to facilitate infiltration may lead to toxic effects, particularly in children.

**Manifestations**

**Mild to moderate toxicity:** Restlessness, anxiety, slurred speech, nystagmus, tremors, headache, dizziness, blurred vision, drowsiness, metallic taste, elevated BP, elevated heart rate, elevated resp. rate, disorientation: failure to follow commands / reason
Severe toxicity: seizure, cardiac dysrhythmia or arrest.

Treatment at the office includes:

- airway support, and place in supine position
- administration of oxygen,
- monitor vital signs
- start IV
- in the event of seizure activity, protect from nearby objects and suction oral cavity if vomiting occurs
- treating convulsions (benzodiazepines - administer diazepam 5-10 mg slowly or midazolam 2-5 mg slowly or thiopental; propofol cannot be used in patients with unstable blood pressure, heartbeat)
- Transport to emergency care facility

Allergy

Allergy is also known as hypersensitive reactions, initiated by immunological mechanisms acquired through exposure to a specific allergen and reexposure to which produces a heightened capacity to react. The prevalence of allergic reactions to amide group local anesthetics is rare. It is predicted that less than 1% of all complications are caused by an allergy. Some of the complications doubt to be allergic are actually anxiety-induced reactions.

Ester-type local anesthetics are more allergenic than amide-type local anesthetics- amide-type anesthetics are broadly used, among which articaine, mepivacaine and lidocaine are the most commonly used for dental anesthesia. Lidocaine and articaine could be in epinephrine involving form. Adverse reactions to local anesthesia may be caused and by preservatives (e.g., methyl-p- hydroxybenzoate), antioxidants (e.g., bisulfate), antiseptics (e.g., chlorhexidine), vasoconstrictor (e.g., sulfites), and other antigens in dental office.

Composition:

Local anesthetic drug
Vasoconstrictor
Antioxidant – sodium bisulfite or sodium metabisulfite Sodium chloride or ringer’s solution
Distilled water

General preservatives
(a) methylparaben 1 mg (b) thymol 0.4 mg
(c) chlorbutol 5 mg

Allergic reactions might include mild symptoms, such as urticaria, erythema, and intense itching, or severe reactions in the form of angioedema and/or respiratory distress. More severe life-threatening anaphylactic responses can include symptoms of apnea, hypotension, and loss of consciousness.

Allergy – signs and symptoms
Respiratory:
Laryngeal edema
Bronchospasm, wheezing
Use of accessory muscles
Distress
Dyspnea
Anxiety
Cyanosis or flushing
Tachycardia

Dermatologic:
Urticaria - wheals, pruritis
Angioedema
Minor rash

In order to diagnose allergies, the skin prick test is the most endorsed. When skin prick test results are determined to be negative, intradermal testing should be performed for patients who have a history of allergy to local anesthetics intradermal tests become obligatory according to some authors.

The initial treatment for an allergic reaction in office at the first step should be the removal of the causative agent. For the management of mild symptoms, oral or intramuscular antihistamine could be administered.

In severe cases cases intramuscular or subcutaneous **epinephrine 0.3–0.5 mg**, and hospitalization services should be given. In the World Allergy Organization survey, **glucocorticoids** were reported to be the second most widely available medications (after epinephrine) for anaphylaxis treatment globally.

**First step of treatment must be epinephrine additionally glucocorticoids and antihistamines may use to treat severe systemic reactions.**

**Adverse drug reaction includes**

Side effects
Overdose
Local toxic effect

**Altered recipient:**
- Disease process
- Emotional disturbances
- Genetic aberrations
Idiosyncrasy

**IDIOSYNCRASY** - effect from unusual and abnormal drug response / idiosyncrasia

- The term idiosyncrasy is often assigned to a bizarre type of reaction that cannot be classified as toxic or allergic.
- Unexplained by any known mechanism of the drug’s action
- Neither overdose nor allergic reaction
- Genetic predisposition associated to enzyme pseudocholinesterase
- Unpredictable; treat symptoms

**Methemoglobinemia**

Methemoglobinemia is a unique dose-dependent reaction where the iron in hemoglobin is stabilized in the ferric (Fe3+) form, unable to attach oxygen, leading to tissue hypoxia and causing a varying degree of cyanosis. Methemoglobinemia can be either inherited or acquired. The risk of methemoglobinemia increased in:

- infants and the elderly patients.
- patients with underlying health problems; liver cirrhosis, with underdeveloped hepatic and renal function; heart disease; and pulmonary disease (chronic obstructive pulmonary disease, pneumonia)
- when administered in excessive doses,
- local anesthetics mostly prilocaine and benzocaine (90% of reported cases) and barely lidocaine and articaine may also lead to methemoglobinemia

Symptoms of cyanosis will be observed in nail beds and mucous membranes and more severe cases, headache, dizziness, fatigue, dyspnea, and tachycardia are seen. For diagnosis in the dental clinic, pulse oximetry and in-hospital arterial blood analysis play an essential role.

Management of methemoglobinemia begins with supplemental oxygen (100%) immediately. As a guideline, methylene blue, which is a heterocyclic aromatic chemical compound increasing the rate of conversion of methemoglobin to hemoglobin, may be given to a symptomatic patient. For severe cases, hyperbaric oxygenation may also be used. Methylene blue should be administrated in 1 to 2 mg/kg doses, given as 0.1 mL/kg of a 1% solution (10 mg/mL) intravenously over 5–10 minutes every hour up to a 7 mg/kg maximum. Repeated doses may be necessary within 30–60 minutes of the initial dose. In a specific patient group, in children younger than 6 months, in pregnant women, or in patients taking other oxidizing drugs, prilocaine should not be used. The dose should be limited to 2.5 mg/kg (Guay J. Methemoglobinemia related to local anesthetics: A summary of 242 episodes. Anesthesia and Analgesia. 2009;108(3):837-845. DOI: 10.1213/ane.0b013e318187c4b1 )

Key features:

- Pathophysiology: The oxidation of heme groups within deoxyhemoglobin (Fe2+) results in methemoglobinemia (Fe3+), which cannot transport oxygen and thus produces a functional anemia and cyanosis.
• Common local anesthetics that cause methemoglobinemia include prilocaine (an ingredient of EMLA cream), which is metabolized to o-toluidine in the liver and oxidizes hemoglobin to methemoglobin, and benzocaine, which is found in topical use.
• Patient with hereditary methemoglobinemia the contraindication is the use of prilocaine.
• Treatment is with methylene blue (1 to 2 mg/kg intravenously over 5 minutes), which converts methemoglobin back to reduced hemoglobin.

Vasoconstrictors

The cardiovascular influences of epinephrine are mediated via alpha, Beta-1, and Beta-2 receptors and are altered in patients medicated with nonselective beta blockers.

Beta blockers are used for their ability to block sympathetic influences on cardiac Beta\textsubscript{1} receptors. Older agents are nonselective and also block Beta\textsubscript{2} receptors on systemic arteries. This offsets the tendency of epinephrine to dilate and instead increases systemic vascular resistance. Blood pressure increases dramatically and is followed by a reflex slowing of heart rate. Numerous reports of stroke and cardiac arrest have been reported in medical literature warning of this potential interaction. It is significant that this interaction will not occur in those patients receiving selective beta\textsubscript{1} antagonists because, at conventional doses, these have little or no affinity for vascular beta\textsubscript{2} receptors. But caution is still advised because putative selectivity for beta\textsubscript{1} receptors may not be absolute, especially in patients medicated with high doses.

Avoid the use of vasopressors, if reasonable!

Peak serum levels of epinephrine after submucosal injection are generally achieved within 5 minutes and decline rapidly due to inactivation by catechol-o-methyltransferase. The hemodynamic influences of epinephrine are witnessed within minutes of injection and have completely subsided in 20 minutes. A dose of 40 \( \mu \)g (approximately 2 cartridges containing epinephrine 1 : 100,000) is the most conservative and frequently cited dose limitation for epinephrine in patients with cardiovascular disease.

If for any reason the medical status of a patient is in question, reassess vital signs within 5 minutes after the administration of each cartridge. If the patient is stable, additional doses may be administered followed by a similar pattern of reassessment.

Pain on injection

Pain on injection can be due to specific circumstances such a temperate of the solution, pH of the anesthetic solution, velocity of injection, dull needles, needles with barbs, or aggressive insertion of the needle damaging soft tissues, blood vessels, nerves, or the periosteum and causing more pain and other complications. Switching to a fresh needle when you have to inject multiple times or when you have multiple injection sites, and injecting slowly and with low pressure which reduces pain are done. A rate of 30 seconds per mL of solution is recommended.

Prevention
Using fresh anesthetic storing at room temperature with no or little vasoconstrictor.
- By buffering the anesthetic solution just before infiltration using sodium bicarbonate
- By injecting slowly 1ml/min

Local complications associated with local anesthesia

Needle breakage

Needle fracture in the oral cavity during local anesthesia procedure is a rare complication, since the establishment of non-reusable, stainless steel dental local anesthetic needles. In most cases, needle fracture happened with 30-gauge needles and during inferior alveolar nerve block (IAN), as a result of either incorrect injection technique, improper choice of hypodermic needle magnitude, or unexpected motion of the patient or assistants. In order to prevent needle fracture:

- the injection needles should be checked;
- 30-gauge and short needles should not be used for inferior alveolar nerve block in adults or children (25–27 should be chosen).
- needles should not bend while inserting them into soft tissue.

In the case of a broken needle, if visible, it should be removed immediately with a hemostat. If this is inaccessible, computed tomographic (CT) scanning should be taken to visualize the location of the needle, and under general anesthesia, the patient should be operated. For the removal of the fragment, mostly superficial mucosal incision perpendicular to the trajectory of the needle followed by blunt supra-periosteal dissection to spare vital structures is recommended.

Key features

CAUSES:

- Sudden unexpected movement of the patient
- Small needle size
- Bent needles
- Defective needles
- Forceful contact with bone.

Prevention

- Use long needles for deep injection (>18mm), i.e for inferior alveolar nerve block in adults or older children.
- Avoid using 30-gauge needles for IAN block in adults or children.
- Do not bend needles when inserting them into soft tissue .
- Do not insert the needles till its hub.
- Redirect only when adequately withdrawn

Management
- Remain calm and don’t explore
- Ask the patient keep opening wide
- Remove needle if it is visible with help of a small haemostat or Magill forceps.
- If not visible take radiographs of the region.
- If needle is lost into the tissue spaces assure the patient and send for 3D CT scanning.
- Refer to an Oral and Maxillofacial Surgery Department

**Prolongation of anesthesia and various sensory disorders**

When the needle penetrates or touches a nerve, the patient may also feel a sudden “electric” shock, suddenly moving the head, with the risk of self-inflicted damage.

Prolonged anesthesia, paresthesia, or other sensory disorders may occur following dental local anesthetic blocks. This may be temporary, where after a few days, weeks, or months, sensation returns or it may be permanent.

The nerve may be damaged during injection:

- by direct injury trauma to any nerve
- Intraneural injection: the needle may damage the intraneural blood supply, resulting in a hematoma, hemorrhage around the neural sheath also causes pressure on the nerve, leading to paresthesia.
- the needle may traumatize the medial pterygoid muscle which results in trismus.
- Neurotoxicity of the local anesthetic is another theory for nerve damage (Articain in IAN block): articaine and prilocaine are more likely than other anesthetics to be associated with paresthesia and have commonly affected the lingual nerve.

Paresthesia or hypoesthesia complication is mostly transient but may also be permanent if the anesthetic solution is injected directly into the nerve. Due to a numb feeling, the patient may have discomfort such as tongue biting, drooling, loss of taste, and speech impediment.

**Treatment**

The use of a daily dose of multivitamin B to regaining nerve healing and function, corticosteroids and NAIDS has been recommended.

**Lack of effect**

Reasons for unsuccess in obtaining local anesthesia can be dependent on anatomical variants, pathological and psychological factors, choice of technique and solution, poor technique.

- Anatomical factors comprise accessory nerve supply, anastomosis, alteration in foramen location, atypical development of the nerves (bifid mandibular canals), and bone density.
- Pathological reasons for the failure of anesthesia are trismus, infection, inflammation, and previous surgery or trauma. Inflammatory diseases altering the pharmacokinetics and pharmacodynamics of local anesthetics cause a response to decrease and unfavorable effects to increase.

- Local anesthetic failure or difficulty to obtain satisfactory analgesia commonly occurs in the situations with inflammations such as pulpitis and apical periodontitis acute periodontal abscess or pericoronitis.

- Psychological determinants such as anxiety can also cause local anesthesia failure.

- Poor technique failure mostly occurs to obtain mandibular anesthesia.

**Facial nerve paralisis**

- Caused by the induction of local anesthetic into the capsule of the parotid gland which is located at the posterior border of mandibular ramus clothed by medial pterygoid and masseter muscles.

- Needle positioned inadvertently in the posterior direction

If the needle is inserted and advanced too deeply and too far dorsally, the terminal branches of the facial nerve within the deep lobe of the parotid gland are affected in IAN block. The patient suffers by unilateral paralysis of mimic muscles for one to 7 hours. In most cases, paralysis occurs immediately after mandibular anesthesia injection, but there are also some cases in which paralysis starts lately.

**Prevention**

- **BONE CONTACT** when injecting
- Avoid over penetration
- Avoid arbitrary injection

**Direct anesthesia to the branches of facial nerve** can force a rapid onset that occurs while the anesthetic agent is being injected; reflex vasospasms of the external carotid artery can lead to ischemia of the facial nerve, so facial nerve palsy occurs. The patient is unable to wrinkle the forehead, raise the eyebrow, close the upper eyelid, retract the commissure of the lips to smile, and turn down the lower lip on the affected side. The removal of contact lenses and closing of the eye on the affected side in Bell’s palsy prevent corneal abrasion or drying.

- If the needle is inserted too high and deep, N. auriculotemporalis will be affected, and the feeling of “numbness” will occur.

- There has been a report of sudden unilateral deafness following inferior dental nerve anesthesia.

**Trismus**

Trismus is defined as a painful circumstance with inability to open the mouth normally. Several factors cause trismus:
- multiple injections in a short period of time in the same area (Trauma to muscles or blood vessels),

- intramuscular injections inside the muscle or trauma to muscles (either the medial, lateral pterygoid muscle or the temporal muscle) which cause hematoma formation and fibrosis,
- needle fracture in the muscles inserting near to styloid process,
- inaccurate positioning of the needle when giving the inferior nerve block
- inflammation of the masseter and other masticatory muscles
- excessive volumes of local anesthetic solution deposited into a bounded region which cause expansion of tissues.
- Injection of local anesthetic directly into muscle may cause a mild myotoxic response, which can lead to necrosis.

The symptoms of trismus, often associated with pain, arise anywhere from 1 to 6 days following an injection. Infection may produce hypomobility through increase pain, increase tissue reaction and scarring. In the acute phase, pain from hemorrhage leads to muscle contraction and limitation of motion. Once trismus develops in most of cases it has resolved spontaneously. Progression of trismus to chronic hypomobility may be prevented by the early institution of treatment consisting of:

- heat therapy; soft diet;
- prescription of analgesics, anti-inflammatory drugs,
- muscle relaxants (to manage initial phase of muscle spasm);
- physiotherapy.
- Trismus caused by an infection needs to be treated by antibiotics, incision and drainage if needed.

Usually, trismus will resolve in 4 to 6 weeks.

Prevention- methods for avoiding trismus via local anesthesia.

- Awareness of the anatomical landmarks and muscles/clinical anatomy of the region,
- palpation of bony anterior ramus for temporalis muscle, pterygomandibular fold for pterygoid muscle,
- appropriate angulation of the needle and bone contact before injecting are good
- Sharp and disposable needles
- Proper care and handling of cartridges
- Septic technique and clean injection site
- Atraumatic insertion
- Avoid repeated insertion- minimal injections and volume

Intraorally La Guardia or Vazirani-Akinosi technique, the closed-mouth mandibular nerve block techniques are indicated as well as extraoral techniques which can provide local anesthesia to trismus patients.

Infection
Infection as complication is very rare since the usage of disposable needles and glass cartridges. Infection may extend to tissues by penetration of the needle through a contaminated tissue, because of the needle being contaminated before an operation or improper preparation of local anesthetic diluted solutions. On the other hand, a latent viral infection may be reactivated due to the trauma of the procedure which may be responsible for neural sheath inflammation.

The area to be penetrated should be cleaned with a topical antiseptic prior to insertion of the needle. Antiseptic mouthwash solutions such as chlorhexidine gluconate or Cetylpyridinium chloride should be considered for all regional techniques. The local anesthesia should not be injected through the infected area.

Edema

Swelling of tissues can be due to:

- trauma during injection,
- infection,
- allergy/angioedema,
- hemorrhage,
- injection of irritating solutions.

The management of edema is dependent on the cause. Trauma-induced edema should be managed as a hematoma.

Hematoma

Hematoma formation as a complication of local anesthesia is a result of a venous or arterial laceration/puncture; intra-arterial/venous blood pressure increase causes effusion of blood into the surrounding soft tissues. The size of a hematoma depends on the density and compactness of the affected tissue; intra- vessel blood pressure: when a vein rupture is concerned, hematoma is not so large or does not necessarily occur. Discoloration on the area may accompany hematoma. From the anatomical point of view, different nerve blocks can cause hematoma on specific regions such as posterior superior nerve block (pterygoid plexus of veins), anterior superior alveolar (infraorbital) nerve block, mental nerve block, IAN block etc.

Prevention

- Hematoma formation can be prevented by meticulous technique, aspirating before injecting the anesthetic solution, by using a short needle and a minimum number of needle penetrations into tissues.

Management

When swelling forms immediately after injection:

- localized pressure should be applied with a minimum of 2 minutes and this will help to stop the hemorrhage.
- Ice packs should be held for the first 12-24 hours after surgery following which intermittent hot moist packs can be used to resolve the condition.
- Antibiotics should be prescribed if the hematoma is large in order to prevent the development of a wound infection.
- NAIDS.
- Local application and massage with heparin cream.
- Physiotherapy.

Both swelling and discoloration usually subside in 7 to 10 days.

**Gingival lesions**

Gingival lesions consist of recurrent aphthous stomatitis and herpes simplex can occur intraorally after a local anesthetic injection or after any trauma to the intraoral tissues. The exact mechanism is unknown, but any trauma to tissues may activate the latent form of the disease process that was present in the tissues with previous injection.

**Causes**

- Application of topical anesthesia for prolonged period
- Heightened sensitivity to topical or injectable LA
- Secondary to prolonged ischemia; use of LA with vasoconstrictor (mostly on hard palate)

**Management**

No management is necessary until there is severe pain.

- In order to relieve pain, topical anesthetic and antiseptic solutions
- A concoction of identical amounts of diphenhydramine and milk of magnesia rinsed in the mouth effectively covers the ulcerations and provides relief from pain.
- In severe cases is indicated Triamcinolone acetonide

**Soft tissue injury**

Lip or tongue biting or chewing can occur on children or patients with special needs, following dental local anesthesia with the unfamiliar sensation of being numb.

- Self-inflicted trauma to the lips and tongue is frequently caused by the patient inadvertently biting or chewing this tissue while still anesthetized.
- Can lead to swelling and significant pain.
- A cotton roll can be placed between the lip and the teeth if they are still anesthetized at the time of discharge.
- Shorter-acting local anesthetics such as plain mepivacaine should be chosen.
- The patient or the guardian should be warned about eating, drinking hot fluids, and biting on the lips or tongue to test for anesthesia; cotton rolls can be placed between the teeth and soft tissues to prevent chewing. In order to
accelerate recovery time for sensation, an alpha-adrenergic receptor, phentolamine mesylate (OraVerse), may be injected in adults.

Ophthalmologic complications

All these complications are transient and disappear on interruption of the anesthetic effects. The most common complications include diplopia (dual vision), ophthalmoplegia (paralysis or weakening of eye muscles), ptosis, and mydriasis (dilatation of pupil). Intraarterial injection or perforation of the vascular wall would stimulate the sympathetic fibers running alongside the internal maxillary artery until reaching the orbit. The intravenous injection could reach the cavernous sinus via the pterygoid plexus and anesthetize the oculomotor, trochlear, or abducens nerves.

Prevention

In order to minimize the possible complications, visualization of the regional anatomy, numerous aspirations while injection, and aspiration on at least two planes before administration local anesthetic are performed.
Ischemic zone

There are some reports about the presence of itching and burning sensations, blanching, pain, and face ischemia during the IAN block.

The skin blanching and mucosal ischemia could be due to the epinephrine vasoconstrictor effect on the alpha-adrenergic receptors of the blood vessels that irrigate the skin and mucosa as well as to a sympathetic effect from the impact of the needle on sympathetic fibers of the tunica adventitia of the artery, causing a vasospasm in the sympathetic plexus around the internal carotid artery. This would trigger a general vascular reaction to the arterial branches of the maxillary artery, manifesting peripherally with skin blanching and/or mucosal ischemia. (vasoconstrictor effect on the perivascular sympathetic plexus of the branches of the maxillary artery)

Some authors suggested that the intravascular deposit of the drug could have generated an ascendant diffusion from the inferior alveolar artery to the maxillary arterial branch placed deep in the infratemporal region and then extend its branches to the facial region and oral or orbital cavity.

Another theoretical explanation could be anatomic variations that approach the maxillary artery in the pterygomandibular region, which would serve as a precedent to explain the intravascular injection directly into the maxillary artery and the observed ischemia that coincides with the topographic distribution of its branches.

The intravascular injection on an IAN block is variable, reporting a frequency of 0.5% to 20% of the cases and 31.3% after the first positive aspiration.
Doses of local anesthetics should be always strictly assessed with body weight (especially in children), and the maximum recommended dosages should be considered. While administrating anesthesia, the painless injection should be performed, avoiding intravascular or intramuscular or direct trauma to the nerve.
Propriate technique should be followed by the practitioners to reduce possible complications associated with the local anesthesia.

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