

Ophthalmic Complications of Locoregional Anesthesia in Dentistry

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Abstract

Local and locoregional anesthesia (LRA) are extensively used for performing painless intraoral procedures. In rare cases, ophthalmic complications such as diplopia, blepharoptosis, mydriasis, etc., may occur. In general, symptoms disappear hours after the injection and rarely persist for a prolonged duration. The aim of this paper is to emphasize the ophthalmic complications that may occur after intraoral anesthesia injection in dentistry. Symptoms, management and prevention of the most common ophthalmic complications related to intraoral local and/or LRA anesthesia are reviewed. Despite being uncommon, ophthalmic complications may happen and lead to stressful situations. Dentists should be aware of their causes in order to prevent them.



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Introduction

Since dental procedures (implants placement, dental extractions, endodontic treatments, cavity restorations, etc.) are most of the time performed in the dental clinics, pain suppression, by intraoral anesthesia (IOA) injection is mandatory.

To achieve anesthesia of the dentition and surrounding tissues in the maxilla or mandible, local and/or locoregional anesthetic injections can be performed.

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After IOA, rare systemic or local temporary complications may occur;^{1, 2} among the latter, the ophthalmic complications (OCs) which represent 0.04 to 0.1% of the cases.^{2,4}

The first OC was described in 1936 by Brain after a tooth extraction;⁵ classically, OCs related to IOA include: diplopia (double vision), ophthalmoplegia (paralysis of eye muscles), ptosis (drooping of upper eyelid), mydriasis (pupil dilation), amaurosis (blindness), miosis (pupil contraction), accommodation disorder and enophthalmos (eyeball recession).

While the majority of these conditions present a rapid onset, and last until the anesthesia subsides,⁶ some of them can persist for 3 to 4 months after the procedure.⁵ These complications are most often attributed to the anesthetic solution reaching the orbit or nearby structures.^{6, 7}

The aim of this paper is to review the physiopathology, prevention and management of the most frequent OCs that may occur after IOA.

Ophthalmic Complications

In 2014, Von Arx *et al.*⁸ analyzed 65 case reports of OCs following IOA with 108 complications reported in those cases and found that diplopia was the most common OC (39.8%) followed by ptosis (16.7%), mydriasis (14.8%) and amaurosis (13.0%). Other OCs such as accommodation disorder, enophthalmos, miosis and ophthalmoplegia were less-reported. 45.8% of the cases were related to the inferior alveolar nerve block against 40.3% to the posterior superior alveolar nerve.

In a study investigating published reports of OCS related to IOA from 1957 to 2010, Boynes *et al.*⁶ found a total of 48 cases out of which 27 occurred after posterior or middle superior alveolar nerves block (maxillary injections) and 21 after inferior alveolar nerve (IAN) block (mandibular injections), with a female predilection (72.9% of cases).

Interestingly, 72.9% of the evaluated patients were females supporting the results of Von Arx *et al.* (72.3%).⁶

The exact physiopathology of OCs is still controversial. However, it is commonly agreed that

the anesthetic solution reaches the orbit by diffusion or throughout vascular and neurologic roots and OCs physiopathology differ for the maxillary and the mandibular injections.^{7, 9}

Proposed Physiopathology of Ocs Related to Mandibular Injections

Accidental Intra-Arterial Injection

This theory is based on the intravascular placement of the needle's tip which can never be excluded, especially when dealing with a LRA without aspiration. Studies conducted by Hidding and Khoury (1991),¹⁰ Frangiskos *et al.* (2003),¹¹ and Malamed (2004)¹² found rates of positive aspiration tests in respectively, 19.8%, 20% and 10–15% of cases.

During the IAN blocks, the anesthetic solution may unintentionally be injected into the inferior alveolar artery located posterior to the nerve, and consequently, under pressure, may be forced back into the maxillary artery followed by the middle meningeal artery and its anastomosis with the ophthalmic artery.^{1, 13-15} The lateral rectus muscle is supplied by the lateral muscular and the lacrimal arteries, branches of the ophthalmic artery.¹⁶ Hence, the intra-inferior alveolar artery injection of the anesthetic may attain and paralyze the lateral rectus muscle, thus causing diplopia.^{17, 18}

Additionally, the ophthalmic artery gives off the central artery of the retina which can explain the transient amaurosis following the passage of the anesthetic into this vessel.¹⁹ It is important to note that in many cases, amaurosis was permanent, and despite being unclear, for many researchers, the mechanism of permanence may be due to the ischaemia/necrosis of the retinal tissue caused by the reflex vasospasm of the central retinal artery.²⁰

Moreover, it has been reported that the accessory meningeal artery, which is a branch of either the maxillary artery or the middle meningeal artery, presents intracranial terminal branches to the cavernous sinus.^{21, 22} Thus all nerves located within the sinus (the oculomotor nerve - CN III, the trochlear nerve - CN IV, and the abducent nerve - CN VI) may become anaesthetized by the anesthetic reaching the venous structure. This could lead to mydriasis, ptosis and loss of accommodation.¹

Accidental Intravenous Injection

The unintentional intra-inferior alveolar vein injection following an inferior alveolar nerve block, may diffuse the anesthetic into the pterygoid venous plexus and therefore into the cavernous sinus thus anesthetizing the third, fourth and sixth cranial nerves as described above.^{1, 13, 23}

Proposed Physiopathology of Ocs Related to Maxillary Injections

Anesthetic Diffusion

Contrary to mandibular injections located far from the orbit, maxillary injections present a higher risk of anesthetic diffusion into the orbital area.⁶ This is the most possible physiopathology of OCs related to maxillary nerve blocks. In fact, during a posterior superior alveolar nerve block a diffusion of the anesthetic solution from the pterygopalatine fossa to the orbit through the inferior orbital fissure may occur resulting in anesthesia of the abducent nerve located close to the fissure thus affecting the lateral rectus muscle of the eye.²⁴

In the case of the maxillary nerve block through the greater palatine canal extending from the oral cavity to the pterygopalatine fossa,²⁵ anesthetic solution may also reach the orbit through the inferior orbital fissure.²⁶

Accidental Intra-Vascular Injections

The same theory concerning the accidental injection into the inferior alveolar artery applies to the superior one, with retrograde flow to the maxillary artery followed by the middle meningeal artery.¹⁹

As for the venous network, an unintentional injection into the pterygoid venous plexus while anesthetizing the posterior superior alveolar nerve block may facilitate the access of the anesthetic solution to the orbit through the cavernous sinus.¹⁷

Proposed Physiopathology of Ocs Related to Autonomic Dysregulation

Kronman *et al*²⁷ suggested a different hypothesis for OCs physiopathology. For them, even a simple trauma to either the inferior or posterior superior alveolar arteries may lead to trauma to the sympathetic plexus usually surrounding these

vessels thus activating the plexus by creating vasospastic impulse that passes the deep petrosal nerve or the internal carotid plexus and reach the orbit through the ophthalmic artery.^{1, 18}

Prevention and Treatment

It is mostly agreed that the intravascular injections are the most probable causes of OCs related to IOA. Therefore, to prevent these stressful situations, all LRA must be preceded by aspiration to make sure the anesthetic solution is not injected into a vessel. Moreover, injection must be performed slowly and without any pressure.^{1, 6, 18}

As for OCs management, the guidelines suggested by Van der Bijl and Meyer⁹ and Lee (13) can be applied. They consist on: a) postponing the dental treatment and informing and reassuring the patient, b) monitoring the patient's vital signs, c) Covering the affected eye with gauze dressing for cornea's protection, d) safely sending home the patient, e) referring the patient to an ophthalmologist for special evaluation in case of OCs lasting more than 6 hours, and f) regularly following-up the case.

Conclusion

Although OCs related to LRA in dentistry are rare and temporary, they should not be underestimated. To achieve a safe and effective local anesthesia, knowledge of the possible complications that may occur, their causes and mostly their preventive measures (patient's history, aspiration test, slow and without pressure injection) are required.

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Conflict of Interest

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