Ocular complications with dental local anaesthesia – a systematic review of literature and case report

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ABSTRACT

Introduction: Intraoral local anaesthetics are commonly administered in Dentistry and may be associated with complications. Although ocular complications are rare they may occur with both maxillary and mandibular injections.

Materials and methods: A database search was carried out in Pubmed and Ovid MEDLINE using the keywords: ocular/ophthalmic/visual, dental anaesthesia/local anaesthesia and complications/paralysis. Each case report was analyzed for age and sex of the patient, type of anaesthesia given, the anaesthetic and vasoconstrictor used, quantity given, onset and duration of complications, and type of complications. 140 case reports were included. The data were recorded on a data extraction form and statistically analyzed.

Conclusion: Complications occurred more frequently in females, and in the age range 20-40 years old. The type of complication was specific to the technique used. Although rare, such complications are distressing and the clinician must be alert to the possibility in order to minimize occurrences and to be able to reassure patients.

Keywords: dental anaesthesia, ocular complications, diplopia, amaurosis

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INTRODUCTION

The delivery of local anaesthetics is one of the most widespread procedures in dentistry and is vital to achieving pain control and cooperation in the dental patient. Although it is usually a safe procedure, several complications have been associated with its use. These complications can either be localized, such as trismus and infection, or systemic, such as anaphylaxis and reactions to overdose. Ophthalmic complications are relatively rare and account for 0.04 to 0.1% of all complications.[1,2] The most common complications include diplopia, amaurosis, ophthalmoplegia, ptosis and mydriasis.[3] These are mostly transient. Permanent complications are exceedingly rare and very few cases have been reported in the literature. Nevertheless, it is essential that the dentist be aware of such complications in order to diagnose and manage them effectively, and where applicable, to refer them without delay.

The purpose of this study was to review the literature reporting on ocular complications associated with dental local anaesthesia and to analyze whether such complications were related to a specific common variable such as technique or drug used. A case report is also presented.

MATERIALS AND METHODS

An electronic database search was carried out in Pubmed and Ovid MEDLINE. The combinations of keywords used included: ocular/ophthalmic/visual, dental anaesthesia/local anaesthesia and complications/paralysis. A manual search was also carried out using the reference lists of selected articles. Abstracts of all the selected articles were screened and only those articles which specifically described cases of ocular alterations following dental anaesthesia were chosen. Reviews of literature were excluded. Each case report was analyzed for the following parameters: age and sex of the patient, type of anaesthesia given, the anaesthetic and vasoconstrictor used, quantity given, onset and duration of complications, and types of complications that occurred. Details of needle gauge, length and aspiration done prior to procedure were also noted if mentioned in the case report. All details were recorded on a data extraction form for statistical analysis.

RESULTS

From 1936 to 2014, a total of 140 cases have been reported in the literature, including the one presented in this report. Ocular complications were more frequent in females (63.5%) as compared with males (36.4%). The age of the patients ranged from 4 years to 73 years (mean 38.5 years), the majority being between 20 and 40 years of age (56.4%).

Although several techniques have been associated with ocular complications, the commonest technique was the inferior alveolar nerve block (54.2%), followed by the posterior superior alveolar nerve block (30%). The commonest anaesthetic drug used was lignocaine (68%), followed by articaine (18.5%). Few cases utilized mepivacaine (5%), procaine (5.8%), prilocaine (1.6%) and butethamine (0.8%). 90.7% of these agents contained a vasoconstrictor. The commonest vasoconstrictor was epinephrine in a dilution of 1:100000 (64.7%).

The frequency of ocular complications is given in Figure 1. It was noted that most symptoms were technique-specific. Symptoms more specific to maxillary techniques included diplopia (74.7%), lateral rectus palsy (81.8%), mydriasis (73.3%) and ptosis (76.6%). Amaurosis was more common in mandibular blocks (84.6%), as were blanching (90%) and blurred vision (72.7%). These results are in accordance with findings reported in previous literature reviews.[2-4] It was noted that all cases that reported blanching had used epinephrine as a vasoconstrictor.

Only half the cases reported mentioned onset of action. Most of these had immediate onset of action (20.9%) or within a few seconds(8%) or minutes(41.9%). Only 3% had late onset of more than 24 hrs. There was no correlation between anaesthetic technique and onset of action.

In more than half the cases, symptoms resolved within 30 minutes (57.1%). Even in cases where anaesthetics with longer duration of action were used, symptoms resolved within 120 minutes. In 7.1% of patients, symptoms lasted for few days to weeks. 5.5% of patients had permanent symptoms. There was no correlation between technique used or quantity of anaesthetic used and duration of symptoms.

CURRENT CASE REPORT

The present case involved a 30 year old healthy woman who reported to our hospital for routine extraction of the left mandibular third molar. Local anaesthetic was administered by a postgraduate student, using 2% lignocaine with 1:80000 adrenaline. Aspiration was negative and the student proceeded to inject the local anaesthetic solution. Less than 0.5ml of the solution had been injected when the patient suddenly complained of loss of vision and inability to open the eye. The eyelid was propped open with a finger, following which it was noticed that the eyeball had become completely fixed. After five minutes, the patient could keep the eye open without assistance and eye movements returned to normal in all planes except for adduction, which returned to normal in 30 minutes. No blanching of the skin or loss of accommodation was noted. As the patient was apprehensive, it was decided not to proceed with the extraction. The patient was discharged after observation for one hour. Follow-up after two days revealed no further complications. The procedure was then carried out uneventfully.

DISCUSSION

Ocular complications following local anaesthesia are uncommon and the frequency is estimated to be 1 in 1000.[3] They can, however, cause considerable anxiety to both the patient and the clinician. From the patient's point of view, this is a totally unexpected event and may be extremely alarming. The clinician, if not acquainted with the nature of these complications, may fail to diagnose such an incident,[5] and may even attribute it to a more serious event, like a transient ischemic attack.[6] It is therefore essential that the clinician understand the etiology and pathogenic mechanism of these complications.

There has been no agreement on the exact pathway that leads to these manifestations. The following theories are currently accepted:

Intra-arterial route:

Intravascular injection appears to be the main cause for these manifestations following mandibular nerve blocks. The inferior alveolar artery and vein lie in close proximity to the nerve within the inferior alveolar canal. Even if the initial aspiration is negative, as was mentioned in twelve cases of inferior alveolar nerve blocks, slight movement of the patient or operator could result in inadvertent injection into the artery. It is hypothesized that under pressure, the

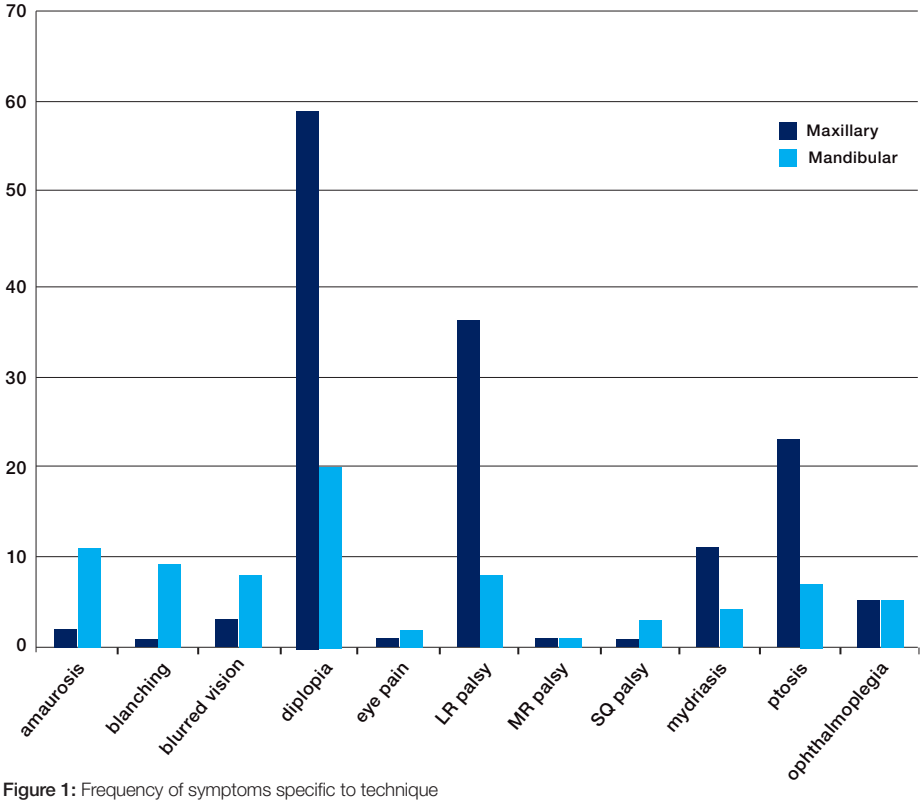

Figure 1: Frequency of symptoms specific to technique

local anaesthetic solution is forced back into the maxillary artery. It has also been reported that in 37% of the population, the maxillary artery loops downwards, lateral to the lingual and inferior alveolar nerves. Hence direct injection into the maxillary artery is also possible.[7,8]

The anaesthetic solution may pass from the maxillary artery into the middle meningeal artery or accessory middle meningeal artery. The middle meningeal artery is believed to anastomose with the ophthalmic artery, and in some cases the ophthalmic artery may even arise as a branch of the middle meningeal artery.[6,9]

Amaurosis

The central artery of the retina arises from the ophthalmic artery. If the local anaesthetic passes into this vessel, it may result in transient amaurosis.[9] In seven case reports, amaurosis was permanent. The mechanism behind permanent amaurosis is unclear. It has been suggested that reflex vasospasm of the central retinal artery could result in ischaemia and necrosis of the retinal tissue, causing permanent amaurosis.[10] It was also suggested that oil embolism could have occurred following intravascular injection of fat-based local anaesthetics.[11] While the anaesthetic used is not mentioned in five cases, two report the use of procaine hydrochloride.[12,13]

The choroidal vessels that supply the retinal cones also derive their blood supply from the ophthalmic artery. If these vessels were affected, it could affect the colour vision. The 'purple haze' described by Scott *et al* may have been precipitated by this mechanism.[14]

Diplopia and extraocular muscle palsy:

The ophthalmic branch of the middle meningeal artery may anastomose with the lacrimal artery that supplies the lateral rectus muscle. The anaesthetic may, therefore, reach the lateral rectus muscle, paralyzing it. It was noted that lateral rectus appeared to be the most frequently paralyzed muscle.

The accessory meningeal artery has terminal branches within the cavernous sinus.[15] The III, IV and VI cranial nerves are all located within the sinus and may become anaesthetized by the anaesthetic being carried into the cavernous sinus. This could be responsible for palsy of the other extraocular muscles. Palsy of the third nerve would also lead to mydriasis, ptosis and loss of accommodation.

Local diffusion:

This is the probable mechanism for ocular manifestations following maxillary nerve blocks. Over-insertion of the needle during a posterior superior alveolar nerve block could result in direct diffusion of the anaesthetic solution from the pterygopalatine fossa to the orbit via the inferior orbital fissure. The abducent nerve lies nearest to the fissure and hence the most commonly affected muscle is the lateral rectus, which accounted for 66.6% of all palsies.[16] It was noted that in 60% of posterior superior alveolar blocks given (18/30 cases), articaine was used, which is believed to have superior diffusion properties. The use of longer needles and increased depth of insertion may also be a factor. While most cases do not mention the depth of insertion, Kini *et al* have stated that they used a 1.5 inch needle (38mm).[17]

In the case of greater palatine nerve blocks, and maxillary blocks through the greater palatine canal,[18] it must be noted that the greater palatine canal opens to the inferior surface of the pterygopalatine fossa and solution may diffuse from here to the orbit.

Intravenous injection

It has been suggested that inadvertent intravenous injections could reach the cavernous sinus via the pterygoid plexus and anesthetize cranial nerves III, IV and VI as described earlier. The posterior superior alveolar nerve block is most likely to cause this, as even a minor change in position and depth of the needle could pierce the pterygoid plexus.[19,20]

Autonomic dysregulation

Several cases of ocular complications occur despite negative aspiration. Kronman *et al* suggested an alternate hypothesis.[21] Each artery is surrounded by a delicate sympathetic plexus. Trauma to either the inferior alveolar or posterior superior alveolar arterial wall could occur by the anaesthetic needle scraping against it. This sets up an impulse that travels through the plexus on the maxillary artery, via the deep petrosal nerve and internal carotid plexus to the ophthalmic artery. This hypothesis is supported by the phenomenon of blanching in some cases,[22] Campbell *et al* theorized that in their case, the stellate ganglion could have been accidentally blocked by diffusion through the fascial planes.[23] This mechanism could account for manifestations of miosis and enophthalmos seen in certain cases.[24]

Most authors agree that the likeliest mechanism is the intravascular route. There are, therefore, several ways in which such complications can be prevented. It is advisable to use self aspirating syringes. In case non-aspirating syringes are used, double plane aspiration must be performed, and subsequent movement of the patient and operator must be avoided. The anaesthetic solution must be injected slowly, giving a full cartridge over a period of 60 seconds. This would avoid injecting the solution under pressure. Anatomical landmarks must always be visualized prior to injection, especially in paediatric cases, where the mandibular foramen would be at a higher level.

The gauge of needle used for injection may play an important role in these complications. Firstly, smaller gauge needles are more likely to be deflected as they pass through tissues; secondly, a few studies have shown that aspiration of blood is more reliable through a larger lumen. Thirdly, it is likely that the anaesthetic may be injected under greater pressure when the lumen is smaller, hence chances of backflow are greater. Malamed stated that the 25-gauge needle is preferred for all injections where the risk of positive aspiration is high.[25] Although only 32 cases in this review have mentioned the needle gauge, 41% of these (13 cases) have used needle sizes narrower than 25-gauge. It is also important to control the depth of insertion as over-insertion would increase the risk of penetrating a vessel and also increase the risk of the anaesthetic spreading by local diffusion.

Once an ocular complication has occurred, the guidelines recommended by Lee, Van der Bijl and Boynes may be followed.[4,26,27] The first and most important step is to reassure the patient. The affected eye may be covered with gauze till the symptoms subside, and the patient must be escorted home, as monocular vision prevents the patient from judging distances. If the symptoms persist for longer than six hours, consultation with an ophthalmologist is mandatory. In most of the cases, clinicians have proceeded with the dental procedure despite the ocular symptoms. There is no harm in performing the procedure, however, if the patient is anxious, it may be desirable to postpone the procedure to the next visit.

Conflict of interest: None declared

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