Ocular Complications after Inferior Alveolar Nerve Block

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It has been more than 120 years since Carl Koller used cocaine as a local anaesthetic agent. Nowadays, administration of local anaesthetic is one of the commonest and most important procedures in dentistry. Although there may have some rare systemic complications after intra-oral local anaesthesia, most complications are local and temporary. These complications include haematoma formation, tissue blanching, pain due to nerve impingement or injection into muscle, trismus and facial nerve paralysis. A rare but serious complication, permanent damage of the inferior alveolar nerve and lingual nerve, may result from inferior alveolar nerve block (IANB) but the exact mechanism is still unknown.1 Ocular complications after intra-oral dental anaesthesia are infrequently reported in the literature and these complications include strabismus, ptosis, diplopia, ophthalmoplegia and amaurosis (blindness).2 Walsh (1957) described a case of permanent amaurosis after dental anaesthesia of upper teeth and he attributed this to the oily nature of the local anaesthetic solution containing procaine hydrochloride which resulted in the embolism of retinal artery.3 For the past 45 years, ocular complications after middle or posterior alveolar nerve block were reportedly twice more frequent than IANB.4 A literature review by the author of the present paper reveals more than 20 cases of ocular complications after IANB. About two third of cases had ocular complications of diplopia while one half of cases had amaurosis. Most cases had the complications disappeared within one to several hours. However, there were three cases in which the complications persisted after the local anaesthetic effect wore off. van der Bijl and Lamb (1996) reported that, after an IANB, a 14-year-old girl had blurred vision which lasted for 24 hours.5 O'Connor and Eustace (1983) described that a 61-year-old woman had diplopia, marked esotropia and dilated pupil immediately after IANB.6 An ophthalmic examination three days later revealed that the ocular movements were normal except that there was limitation of abduction of the affected eye with horizontal diplopia in dextroversion. Four weeks after the incident, the ocular movements returned to normal but the pupil remained dilated. A catastrophic accident happened to a 21-year-old woman who received an IANB for restoration of teeth.7 Immediately after IANB, the patient complained of complete hemifacial sensory and motor paralysis and an ophthalmic examination a few hours later revealed reduction in visual acuity. A six-month review showed that there was atrophy of the optic nerve.

Hypothesis of ocular complications

Hitherto, there is no agreement to the exact aetiology of ocular complications after IANB. However, it is generally agreed that the local anaesthetic solution reaches the orbit through vascular, neurological and lymphatic network.8

1. Arterial system

This hypothesis is supported by the presence of transient dizziness, blanching of the skin, and anaesthesia of the lateral parts of the upper and lower eyelids which are supplied by the lacrimal nerve that is dependent upon the lacrimal artery.9 The inferior alveolar artery runs posteriorly to the nerve and therefore, local anaesthetic solution may accidentally be injected into the artery. Although initial aspiration may show a negative finding, minor movement of the patient or the needle may cause the penetration of the arterial wall and subsequently the local anaesthetic solution will be injected into the arterial system. Since the local anaesthetic solution is injected under pressure, the solution is forced back into the maxillary artery. The origins of middle meningeal artery and inferior alveolar artery are closely situated and the solution may gain access to the middle meningeal artery which may enter the cranial cavity through the foramen spinosum and gives off many branches. The ophthalmic branch of the middle meningeal artery may anastomose with the lacrimal artery. The blood supply of the lateral rectus muscle derives from the lacrimal artery and from the lateral muscular trunk of the ophthalmic artery. Therefore, the intra-arterial injection of the local anaesthetics may reach and paralyse the lateral rectus muscle and cause diplopia. However, Fish and co-workers (1989) proposed that the accessory meningeal artery has intracranial terminal branches to the cavernous sinus and its content.10 Since the cranial nerves III, IV, and VI are in close proximity with the cavernous sinus, the authors explained that the complete paralysis of the right eye after a mandibular nerve block in a 29-year-old man using Gow-Gates technique was due to the temporary paralysis of cranial nerves III, IV, and VI. Singh and Dass (1960) studied 106 human orbits and found that the blood supply to the ophthalmic artery originated from the middle meningeal artery in six cases.11 The central artery of the retina is a small branch of ophthalmic artery and the anaesthetic solution passing from the middle meningeal artery to the ophthalmic artery may then reach the eye, causing amaurosis (blindness) and loss of the pupillary...
light reflex. In cases of permanent amaurosis, it was postulated that reflexive vasospasm of the central retinal artery resulted in ischaemia and necrosis of the retinal tissue.\(^1^\) Blaxter and Britten described three cases of transient ocular complication after mandibular nerve block.\(^1^\) The first case involved a 16-year-old girl who was affected by blanching of skin lateral to the eye and above the eyebrow of the ipsilateral side, numbness of the face, loss of vision and diplopia. The second case had diluted pupil and loss of vision of the affected side while the third case had diplopia. The authors suggested that the different clinical manifestations were due to different degrees of the vascular anomaly.

2. Venous system

It has been suggested that the local anaesthetic solution, after an inadvertent entry into the venous system, will drain into the pterygoid venous plexus and thereby into the cavernous sinus through emissary veins traversing bony foramina.\(^1^\) It will be more vulnerable when the patient is in the supine position. The abducens nerve may be more susceptible than other cranial nerves because it travels through the cavernous sinus. Therefore, it has been suggested that the venous spread of the local anaesthetic solution will explain the isolated ocular complications of diplopia resulting from the paralyzation of lateral rectus muscle which is innervated by abducens nerve.

3. Sympathetic nervous system

Campbell and co-workers\(^1^\) described a case with a Horner-like syndrome with ptosis, vascular dilatation of the conjunctiva, miosis and generalised rash over the left neck, face, shoulder and arm. They suggested the local anaesthetic misadventure resulted in a stellate ganglion block which explained the above symptoms and also the hoarseness of voice.

Management and prevention

Although it is rare to have ocular complications after IANB, the occurrence is alarming to both the dentist and patient. van der Bijl and Meyer\(^1^\) suggested the following management guidelines:

1. Reassure patients as to the usually transient nature of these complications.
2. Cover the affected eye with a gauze dressing to protect the cornea for the duration of anaesthesia.
3. Functional monocular vision will be restored by covering the affected eye. The patient should be escorted home by a responsible adult, since monocular vision is devoid of distance-judging capability.
4. Should the ocular complications last longer than 6 hours, refer patients to an ophthalmologist for evaluation.

In order to prevent the ocular complications, injection into the vascular system must be avoided. It should not be overemphasised that the procedures of inferior alveolar block in children are different from adult and the craniofacial growth and the mandibular growth should be taken into consideration. The needle insertion point should be higher in old age children. It has been suggested that the inferior nerve block should be administered 6mm above that the occlusal plane in 7 to 8 years old children but 10mm for 9 to 10 years old children.\(^1^\) Moreover, it has been stated that aspiration of blood was significantly more common in patients aged 9-19 years old with 36% of 28 patients affected, than in patients of other age groups.\(^1^\) In another study, there were 20% of positive aspirations in IANB in children of age group 7-12 years but only 10% in the age group of 15 to 16 years.\(^1^\) Aspiration prior to injection and slow injections are mandatory. Frequent aspiration during the process of injection is encouraged. In the literature, only very few cases of ocular complications after IANB were reported in children. This may be due to the temporary effect of the complication and its rapid recovery without sequelae but it has been queried that these complications are under-reported.\(^3^\) Moreover, it has been suggested that sudden monocular amaurosis may pass unnoticed by the patient and cases of visual disturbance following local anaesthesia in dentistry occur more often than are recognised.\(^1^\) The author of the present paper had witnessed a case of ocular complications in a child who just cried suddenly after IANB but did not complain or even speak to the operator. It would be difficult to diagnose the ocular complications especially when the child was too young to comprehend and the child patient was wearing a sunglass during dental treatment. Therefore, the dentist treating child patients must be vigilant and beware of the ocular complications when performing IANB. More importantly, the clinicians should be able to diagnose and understand these rare complications and prepare to manage.

References