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Case Report

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Neuro-Ophthalmological Emergencies. Are They Always Innocent? A Case Report and a Literature Review

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ABSTRACT

Neuro-ophthalmogical complications are rare but can be serious after regional block. We present a case of a 54-year-old diabetic patient who was scheduled for pars plana vitrectomy of his right eye due to tractional retinal detachment, under a peribulbar block with a mixture of lidocaine and ropivacaine. He presented with tachycardia, hypertension, seizures, respiratory distress and apnea. He was intubated for less than 24 hours. He was discharged with no neurological deficit. A review regarding these rare but serious neurological complications of ophthalmic surgery is presented, to raise awareness of neurologists, who are called to evaluate and treat these patients.

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Introduction

Most ocular surgeries are performed under topical or regional anesthesia. Regional anesthesia may be complicated by both ophthalmic and systemic side effects. The neurological signs of confusion, agitation, focal or generalized seizures, cranial nerve paresis, aphasia, apparent shivering and unconsciousness may also result from the passage of anesthetic through blood brain barrier, leading to blockage of inhibitory pathways and secondary central nervous system (CNS) excitation [1]. Neural damage is a possible consequence of general anesthesia, and regional anesthesia. Damage may be caused by pro-ischemic, mechanical or chemical factors, which may occur either alone or in combination [2]. CNS is especially vulnerable to local anesthetic toxicity and signs of overdose must always be sought in an alert patient. Early symptoms include perioral numbness, tongue paresthesia, dizziness, tinnitus and drowsiness, while there have been reports of potentially life-threatening events, including brainstem anesthesia/depression, dysrhythmias and cardiovascular depression [3, 4].

The peribulbar block is one of the most commonly used anesthetic techniques in ophthalmic surgery. In this block, anesthetic agents are administered into the extraconal compartment of the eye, thus avoiding the risk of optic nerve damage. This type of block is frequently preferred for its low rate of complications [5]. The rate of major complications in patients undergoing ophthalmic surgery with peribulbar anesthesia has been reported to range from 0.006% to 0.066% Other series, though, report the incidence of brainstem anesthesia/depression necessitating cardiopulmonary resuscitation to range from 1 in 350 to 1 in 700 retrobulbar injections [4-7, 8]. Eke's et al. retrospective study in United Kingdom reported an incidence of serious adverse events during peribulbar anesthesia as low as 0.007%; however, they concluded that this percentage is underestimated [9].

The CNS manifestations following local anesthesia injection depend on the amount of the injected anesthetics, the depth of needle insertion, the force with which it is injected, the concentration of the anesthetic, and the area into which it spreads. Typically, symptoms appear 5–10 min after the injection, but can take as long as 40 min to manifest [5].

Case Report

A 54-year-old Caucasian man was scheduled for pars plana vitrectomy of his right eye due to a long-standing tractional retinal detachment. His medical history included a poorly controlled type 2 diabetes mellitus and chronic renal failure. A year before, he had undergone an uncomplicated combined phacoemulsification and pars plana vitrectomy due to tractional retinal detachment in his left eye.

His medication included glimepiride tablets and insulin injections. His blood tests were unremarkable and his electrocardiogram (ECG) demonstrated sinus bradycardia. There was no previous history of allergic reactions.

The patient was prepared to be monitored intraoperatively: ECG recording, blood oxygen, heart rate and blood pressure monitoring. Preoperatively, he received an 8 ml peribulbar injection of a

mixture of 4ml (10mg/ml) lidocaine and 4ml (3.75mg/ml) ropivacaine. Prior to the infusion of the anesthetic, an aspiration test for blood and cerebrospinal fluid (CSF) was performed, which was negative. Almost immediately following the injection, the patient developed tachycardia, hypertension, right sided deviation of the eyes and head, and a generalized tonic-clonic seizure. The patient was unresponsive, his blood oxygen saturation fell and became apneic. He was supported for about 40 minutes with an Ambu breathing bag, but failed to recover. He was intubated, placed on mechanical ventilation, with additional placement of a central venous catheter, and an urgent no contrast brain CT (NCCT), which was unremarkable, was performed. The patient was transferred to the intensive care unit.

The next day, he regained his consciousness. His Glasgow Coma Scale (GCS) was 15/15, the blood oxygen saturation was 98%, the blood pressure was 145/67 mmHg and the respiration rate was 24 breaths/min. The neurological examination did not reveal any focal pathological signs or symptoms. A second brain CT (NCCT due to chronic renal disease), which was also unremarkable, was performed 24h later. An electroencephalogram (EEG) was performed 24h following weaning from the ventilator. This was mildly abnormal due to rare delta waves in fronto-temporal areas, without epileptic or epileptiform discharges. A triplex of the carotid and vertebral arteries was also performed that demonstrated no significant hemodynamic alterations.

The patient was discharged and his surgery was rescheduled a few weeks later under general anesthesia.

Method

A literature review was performed in March 2021, across a number of different electronic databases, including Medline (via PubMed), Science Direct, Google Scholar, and Cochrane Database, from 1/1/2000 to 1/1/2021. The major search words and word combinations included the following: peri/retrobulbar anesthesia and CNS complications, peri/retro orbital anesthesia and CNS complication, peri/retro bulbar/orbital anesthesia and "brainstem anesthesia", peri/retro bulbar/orbital anesthesia and seizures, peri/retro bulbar/orbital anesthesia and apnea. Literature database search was independently made by INC, EC, PA and AT. The collected articles were case reports, case series, and reviews in humans while cadaveric studies, animal case reports and technique descriptions were excluded. Articles in English, Spanish, German and French were included (see Figure 1).

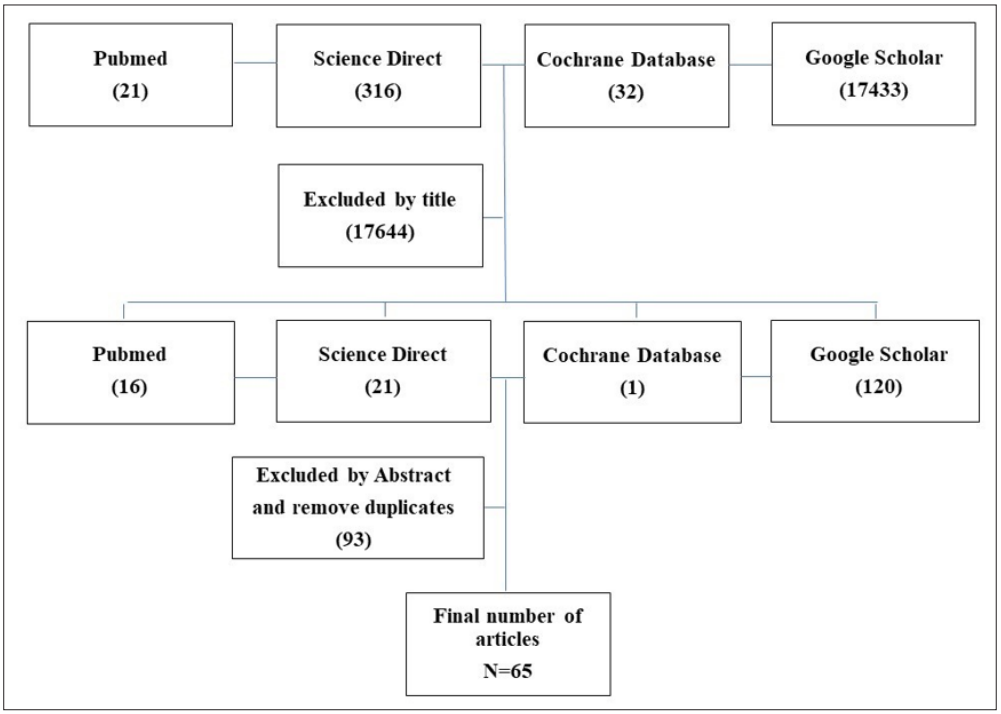

Figure 1: The flowchart of study selection

Discussion

Neuro-ophthalmogical complications are rare, as assessed by a systematic review of Alhassan et al but can be serious following regional block [10]. To the best of our knowledge, 163 cases with serious complications during ocular surgery have been reported in literature (see Table 1) over the past 20 years. However, since regional anesthesia is one of the most commonly used anesthetic techniques in ophthalmic surgery, it is reasonable to assume there is a significant minority of unreported cases. Of note, while these cases are exclusively reported in Anesthesiology and Ophthalmology journals, it is the Neurologist who is often asked to evaluate such patients. Therefore, it is imperative to inform Neurologists about these complications provide them with a better understanding of this entity [11].

Table 1: Cases with Neurological Complications during Ophthalmological Operations

Cases/Cases Series	Ophthalmic Operation	Anesthesia	CNS complication
Ashaye et al 2002 [39]	Cataract Surgery	Retrobulbar block, 3ml 2% xylocaine with 1:100.000 adrenaline	Respiratory arrest
N El-Hindy et al 2009 [4]	Cataract Surgery (n =38 058 eyes)	Regional block	Eye deviation- Confusion
Gupta et al 2019[1]	Cataract Surgery	Peribulbar block 6 ml of 2% lidocaine and 4 ml of 0.5% bupivacaine with hyaluronidase.	Confusion/agitation/bradycardia/apnea
Moorthy et al. 2003[8]	Cataract surgery	Retrobulbar block 5 mL of a mixture: 2.5 mL of 0.75% bupivacaine, 2.5 mL of 2% lidocaine, and 35 U of hyaluronidase	N=2 apnea (1 of them, cardiorespiratory arrest) N=2 seizures
Bensghir et al. 2014 [32]	Cataract surgery	Peribulbar block with: lidocaine 2% and bupivacaine 0.5%.	Seizures
Basu et al 2020[5]	Cataract Surgery	Peribulbar block with: 7 ml of 2% lignocaine	Convulsion and respiratory arrest
Kazancıoğlu et al 2017[25]	Cataract Surgery	Peribulbar block with: 6 mL of 2% lidocaine hydrochloride	Confusion, hypotension and dilatation of the contralateral pupil rapidly progressed to loss of consciousness and respiratory arrest
Jaichandran et al 2013 [24]	Cataract surgery	Peribulbar block with: 4 mL of 2% lignocaine solution and 4 mL of 0.5% bupivacaine solution with hyaluronidase 25 IU/mL	Contralateral third nerve palsy
Eke et al 2007[9]	Cataract surgery	Peribulbar block	8 reports/ 115700 cases (0.7 per 10 000) 1 grand mal fit, 5 min after Local anesthesia (LA) 1 grand mal fit, pulse 32/min (timing not stated) 1 apnea for 10 min, unresponsive to speech for 20 min, pulse 130/min, 2 min after LA 1 numb legs, variable BP, pulse 50/min, felt ‘‘strange’’, 5 min after LA 1 drowsy, reduced oxygen saturation, 1 min after LA *1 angina, 5 min after LA (possibly caused by IV sedation)* *1 Cerebrovascular accident, BP 224/112, pulse 90/min, 15 min after LA; died later* CVA confirmed on MRI *1 nausea, sat up during operation, 20 min after LA*
Eke et al 2007 [9]	Cataract Surgery	Retrobulbar block	2 reports/13200 cases, 1.5 per 10 000 1 unresponsive to speech for 30 min, irregular breathing with oxygen saturation 85%, pulse 35/min, 5 min after LA; thought to be brainstem anesthesia 1 grand mal fit, 30 min after LA (retro/peribulbar LA)
Paul et al 2017[22]	Cataract Surgery	Peribulbar block with: two injections of 3 ml each (anesthetic mixture of lidocaine 2%, mixed with hyaluronidase 50 IU/ml and adrenaline 1:200,000)	Generalized tonic-clonic seizure-hypotension-bradycardia
Islam et al 2009 [3]	Bilateral cataract surgery	Peribulbar block with: 3 ml 2% lignocaine and 2 ml 0.5% (plain) bupivacaine	Unconscious- unresponsive to painful stimuli, HR was 110bpm, BP 220/110 mmHg, respiration- normal, hemoglobin- saturation was 97% detected by oximetry
Boret et al 2002 [40]	Pupilloplasty	Peribulbar block with: 6 ml mixture of lidocaine- 120 mg and 45 µg clonidine.	Hypertension followed by bradycardia, hypotension, apnea, seizures

Pujari et al. 2015[33]	Cataract Surgery	Peribulbar block with: mixture of bupivacaine 25 mg, lidocaine 100 mg and hyaluronidase 500 IU mixture (10 ml volume)	Grand-mal seizures
Pragt et al 2006 [41]	Cryocoagulation	Retrobulbar block injection	Focal seizures of the ipsilateral face) and Contralateral hemiparesis
Kostadinov et al. 2019[23]	Elective trans-scleral laser cyclo-photocoagulation	Retrobulbar block with: 2 mL of 0.5% levobupivacaine and 2 mL of 2% lidocaine.	Apnea, cardiovascular collapse, loss of consciousness, bilateral gaze paresis and bilateral pupillary dilation two minutes after the retrobulbar block.
Kim et al 2016 [16]	Bilateral cataract surgery	Retrobulbar block with: 1 cc lidocaine hydrochloride 2% and bupivacaine hydrochloride 0.5%	Horizontal diplopia - Large exotropia
Song et al 2019 [42]	Pars plana vitrectomy	Retrobulbar block with: 2% lidocaine and 0.75% bupivacaine	Generalized tonic-clonic seizures
Ahmad et al. 2013 [43]	Cataract surgery	Retrobulbar block with: 4 ml of 1% lignocaine and 2% ropivacaine	Transient bilateral visual loss
Krilis et al 2013 [44]	Cataract surgery	IV sedation with 50 mg of propofol. Peribulbar block with: 8 mL of ropivacaine	Nausea, transient bradycardia and hypotension. Contralateral vision loss and oculomotor nerve palsy
Leme et al 2018 [45]	Cataract surgery	Peribulbar block	Amaurosis and contralateral cranial nerve pairs III and VI paralysis
Schönfeld et al. 2000 [46]	Cataract surgery	Retrobulbar block	Cranial nerves deficits, respiratory distress- loss of consciousness, respiratory arrest, hypotension-bradycardia
Carneiro et al. 2007 [47]	Cataract surgery	Retrobulbar block with: 1 mL de lidocaína a 2% e 4 mL de bupivacaína a 0,75%.	Apnea and loss of consciousness.
Rozentsveig et al. 2001 [48]	Cataract Surgery	Peribulbar block with: 10mL syringe and contained 5 mL lidocaine 2%, 5 mL bupivacaine 0.5%-, and 2-mL hyaluronidase (150 IU/mL).	Agitation and confusion-seizures -respiratory distress -respiratory arrest.
Bandivadekar et al 2016 [49]	Open-sky penetrating keratoplasty		Intraoperative suprachoroidal hemorrhage 4/543 cases N=2 best-corrected visual acuity of counting fingers N=1 corrected visual acuity of light perception N=1 no light perception
Shalini et al 2019 [26]	Strabismus Surgery	General Anesthesia (n=18) Peribulbar block (n=6) 2% lignocaine with 0.5% bupivacaine	24/84 cases Oculocardiac reflex- nausea and vomiting
Zhang et al. 2013 [15]	Glaucoma, Cataract, Vitreoretinal surgery	Retrobulbar block	Amaurosis Fugax
Ghadiali et al.2018 [50]	Pars plana vitrectomy	Retrobulbar block with: 5 mL of a mixture of 2% lidocaine (45%), 0.75% bupivacaine (45%), and 150 units of hyaluronidase (10%)	2 cases 1st Case: Contralateral partial 3rd cranial nerve paresis 2nd Contralateral vision loss (cranial nerve 2) and partial 3rd cranial nerve paresis.
Sharma et al 2003 [51]	Cataract surgery	Retrobulbar block with: 3 mL lidocaine hydrochloride 2% (Xylocaine)	Loss of vision and necrosis of right eyelid due to total ophthalmic artery occlusion
McFate et al. 2014 [19]	Oculoplastic surgery	Local anesthesia	32 cases of orbicularis myotoxicity. 6/32 permanent Orbicularis oculi dysfunction
Dahle et al 2006 [52]	Trabeculectomy	1 mg of midazolam- 50 mg of propofol - 20 mg of lidocaine Retrobulbar block with: 4 mL of 0.75% bupivacaine mixed with an unknown concentration of lidocaine.	Unresponsiveness-seizures (generalized tonic-clonic activity) – Apnea

Tayab et al 2019 [29]	Combined glaucoma and cataract surgery	Peribulbar block with: 8 ml mixture of equal volume of 1% lignocaine and 0.5% bupivacaine with 50 IU/ml hyaluronidase. The	Slurred speech, and nystagmus in both the eyes. Tachycardia (150 beats/min) and hypertension (190/120 mmHg). Grand mal seizure twice
Lee et al 2008 [53]	Cataract and other eye surgeries	Peripheral nerve blocks	N=159 Temporary injuries N=7 related to death or brain damage.
Vohra et al 2019 [54]	Cataract surgery	Peribulbar block with: a mixture of 3ml of plain 2% lignocaine and 3ml of 0.75% levobupivacaine with 300 units of hyaluronidase	Slurred speech, unresponsive, and, apnoeic. Contralateral pupil dilation.
Altieri et al. 2005 [55]	Anterior segment surgery	N.D.	11/200 Aponeurotic blepharoptosis
Milstein et al 2000 [56]	Cataract Surgery	7 General Anesthesia 3 Local Anesthesia	10/197 (5.1%) Post-operative Delirium
Wakeman et al 2017 [17]	Cataract Surgery	Retrobulbar block	Vertical diplopia. Paresis of left inferior rectus
Calleja et al 2013 [57]	Cataract surgery	Retrobulbar block-5ml of 0.5% bupivacaine and 2% lidocaine with a 22G needle	Transient disorientation, agitation, cyanosis, sweating, arterial oxygen desaturation, elevated blood pressure levels and lack of response to stimuli. Pupil dilation and blepharoptosis, involving 3rd nerve palsy.
Al Mahmoud et al 2009 [58]	Cataract surgery	Peribulbar block with: 4 mL mixture of equal amounts of 2% lignocaine and 0.375% bupivacaine, in addition to hyaluronidase	Uncooperative and unresponsive to commands but withdrawal to noxious stimuli.
Williams et al 2019 [59]	Pars plana vitrectomy for epiretinal membrane	Retrobulbar block with: 6 cc of a 1:1 mixture of 0.75% bupivacaine and 2.0% lidocaine.	Contralateral amaurosis
Cosgrove et al 2020 [60]	Chlorpromazine injection for a blind painful eye	2 Retrobulbar injections: 1st: 6 mL of 50:50 mixture of 2% xylocaine and 0.75% bupivacaine with 50 units of hyaluronidase 2nd : 1 mL of 25 mg/mL chlorpromazine mixed with 1 mL of preservative-free 1% xylocaine	Drowsiness and difficult to arouse.
Dettoraki et al. 2015 [61]	Retinal detachment (Pars plana vitrectomy)	Retrobulbar, 6ml ropivacaine 7.5 mg/ml	Face twitching, seizures, hemiparesis
George et al 2005 [62]	Proliferative Diabetic Retinopathy with Tractional retinal detachment and vitreous hemorrhage (Pars plana vitrectomy)	Retrobulbar block with: 9ml 1% xylocaine, 0.375% bupivacaine, followed by second injection of 5ml 2% xylocaine	Slurred speech, confusion, bilateral hearing loss, apnea
Gunja et al 2006 [63]	Cataract Surgery	Retrobulbar block with: 5ml 0.5% bupivacaine, 2% lignocaine (equal parts) plus 150IU hyaluronidase and 1:200.000 adrenalin	Apnea, loss of consciousness, coma
Lee et al 2002 [64]	Cataract Surgery	Retrobulbar block with: 6ml lidocaine 4%, bupivacaine 0.75% (equal parts) with epinephrine	Cardiovascular compromise, Oxygen Desaturation (50%), unresponsive
Tolesa et al 2016 [65]	Trabeculectomy	Retrobulbar block with: 3.5ml lidocaine 2% (2 injections)	Apnea, loss of consciousness
Silva et al. 2015 [66]	Vitreoretinal surgery	Retrobulbar block with preoperative sedation	23/113 Apnea
Present case	Pars plana vitrectomy	Peribulbar block with: 8ml of a mixture of (10mg/ml) 1% lidocaine and 3.75mg/ml ropivacaine	Hypertension- seizures- apnea- respiratory arrest

ND Not Described

The complications of neural injury and local anesthetic toxicity are common to all regional anesthesia techniques, and individual techniques are associated with specific complications [12-14]. Permanent neurological damage is rare, however transient injuries do occur and are more common [2, 15–19]. Typical plasma concentrations of lidocaine vary between 3 and 5μg/ml. Signs of toxicity may be observed when plasma concentrations reach 6μg/ml, but convulsions and cardiovascular collapse do not usually manifest until plasma concentrations exceed 10μg/ml and 30μg/ml, respectively. Toxicity depends on the dose of the drug, systemic absorption, and accidental intravascular injection. Recommended maximum 'safe' doses are rough estimations only, since other factors are involved. Maximal safe dose for lidocaine is 4.5mg/Kg and 2 mg/kg for bupivacaine [3, 20].

In CNS, the amygdala is thought to be the site of action of local anesthetic drugs, since seizures are not observed in animals from which the amygdala has been experimentally removed [18]. Obviously, there is a continuum of sequelae, depending on the amount of drug reaching the CNS and the specific area of the brain to which the drug spreads [21].

In one-fifth of patients, an abrupt mean decrease in regional cerebral oxygenation (rSO2) has been observed on the side where the block was performed, 3–5 min subsequent to anesthetic injection, followed by a return toward baseline values 15 min following ropivacaine administration [21]. It is well known that neural cells are extremely sensitive to oxygen deprivation and seizures can be the result of acute hypoxia.

Several mechanisms may lead to CNS spread of local anesthetics during peribulbar anesthesia. Clinical signs typically have a rapid onset and can range from loss of consciousness to cardiac arrest [22]. Firstly, an inadvertent intra-arterial injection in the ophthalmic artery or into one of its branches can occur. It is estimated that in 15% of the cases, an anatomical variation of the location of the inferior ophthalmic artery occurs, making it prone to this inadvertent injection. Reversal of the direction of blood flow in the artery due to injection pressure causes the anesthetic solution to flow back into the internal carotid artery and be delivered to the brain. Secondly, there is a risk of injecting the anesthetics into the subdural space via puncturing the dural optic nerve sheath, the latter being most common. Upon injecting the local anesthetic solution into the subdural or subarachnoid space, the agent travels through the ipsilateral optic nerve, optic chiasm and the contralateral optic nerve, ultimately reaching the upper brainstem. Moreover, due to the close proximity of the ophthalmic vessels to the brain, in case of optic nerve sheath perforation by the needle tip, central spread can occur. Thirdly, the possibility of systemic absorption of local anesthetics is proposed. Lastly, another postulated mechanism is the absorption of anesthetics by the arachnoid villi and the subsequent spread to cerebral structures, which may occur due to the manual compression following the block and the use of hyaluronidase [5, 23–25].

The symptoms of central spread vary and depend upon the area of the CNS being affected by the local anesthetic. Both the cardiovascular and respiratory systems can be affected, giving rise to a number of different signs and symptoms, such as temperature dysregulation, vomiting, temporary hemiplegia, aphasia and generalized convulsions. Palsy of the contralateral oculomotor and trochlear nerves with amaurosis are typical signs of CNS spread [6]. Sympathetic hyperactivity can also develop due to involvement of the medulla oblongata, leading to excitatory stimulation of vasomotor, respiratory and vomiting centers [1].

Convulsions following peribulbar block could be attributed to the oculocardiac reflex, hypoglycemia, hypoxia, or pro-stroke toxicity of local anesthetics [7, 22, 26]. Although the mechanisms of seizures are not known, it is speculated that there is a selective blockage of inhibitory synapses. Excitatory synapses are not incriminated in those mechanisms since they are more resistant to local anesthetic depression. The amygdaloid nucleus plays a central role. The amygdala is a complex subcortical structure, connected to the reticular formation, hypothalamus, septal area, and olfactory areas of the fore brain. The amygdala is clearly associated with olfaction and brain stem function modulation. Rhythmic stimulation of the amygdala can produce grand mal seizures. The hippocampus may play a secondary role in seizure production. Initial depression followed by excitation leading to seizures is explained on the basis of the sensitivity of different groups of cells. Another possible explanation might be the spread of local anesthetic via the subarachnoid space to the cerebral cortex, producing seizures [8, 27].

Brainstem anesthesia/depression occurs upon entrance of the injected anesthetic agent into the subarachnoid space, either through direct entry or via spreading to the CNS. The clinical picture of brainstem anesthesia/depression varies from mild confusion, slurred speech, marked shivering, seizures, bilateral brainstem nerve palsies, amaurosis of the contralateral eye, to hemiplegia, paraplegia, or quadriplegia with or without loss of consciousness, alterations in blood pressure, and apnea or alteration in respiratory pattern. Respiratory depression and brainstem anesthesia/depression can develop as complications of peribulbar block, but the risk for developing serious complications is generally low [25].

In our case, the first observed manifestation was hypertension and tachycardia. Initially, features of parasympathetic blockade and sympathetic hyperactivity may be more evident; similar reports of hypertension and tachycardia have also been described in the literature. These are attributed to a combined vagal and carotid sinus reflex blockade [28].

Accidental intra-arterial injection can cause increased levels of local anesthetics in the brain, via retrograde flow in the internal carotid artery. Only this mode of spread of local anesthetics to the brain can account for the initial cardiovascular excitation with shooting of pulse and BP. This excitation is transient, which was also present in our case. As the anesthetics redistribute out of the brain quickly, the symptoms wear off.

The subsequent seizures that occurred directly following anesthesia could be attributed to the toxicity of local anesthetics, since no hypoxia, hypoglycemia, or incorrect anesthetic dosages were noted, and the following neurological examination and brain CT imaging were not indicative of stroke. The onset of CNS toxicity was almost instantaneous in our case. This led to the conclusion that probable direct intravascular injection had occurred even though there was a negative aspiration prior to injecting the anesthetic [25]. More specifically, the onset of grand mal seizure indicates that there must have been an inadvertent intra-arterial injection which triggered the seizures immediately following the block, as described previously [29].

The respiratory arrest that followed and sustained for about 40 minutes prior to intubation, was either due to the injection of the local anesthetic into the branches of the ophthalmic artery, with subsequent retrograde flow into the internal carotid artery, or by fast systemic absorption from local capillaries.

Another possible explanation could be the spread of local anesthetic in the subdural space along the optic nerve and optic chiasma, reaching the brainstem. This mechanism has well been described by reports of orbitography, where a contrast material is injected and its route is traced with the use of Doppler [8, 30, 31]. However, in our case this mechanism cannot account for the initial cardiovascular excitation and the direct CNS excitatory symptoms. A similar case has been described by [32].

Specific management, apart from intubation and mechanical ventilation for the respiratory arrest, includes intravenous fluid administration and benzodiazepine or barbiturates for seizures control [1]. For the management of the toxicity of the local anesthetic, the American Society of Regional Anesthesia has proposed the lipid emulsion therapy, i.e., 100 ml of lipid emulsion bolus (Intralipid™20%, Fresenius Kabi, Bad Homburg, Germany) over 1 min, followed by 600 ml over 30 minutes [33, 34].

Adequate knowledge of the anatomy of the orbit and globe are essential to minimize the risk of complications [35–38]. During the needle insertion and injection procedure, the patient's eyes should be in primary gaze position, as this place the optic nerve in a parallel fashion in relation to the needle. By having the patient look up, a mistake commonly made by Ophthalmologists, the optic nerve comes in closer proximity to the tip of the needle, which increases the chances of perforating it. The length of the needle is also important, with current guidelines stating that it should not exceed 31mm [17]. Another maneuver that should be practiced is the 'side to side test'. After injecting, the needle is slowly moved left and right and it is imperative to watch for any movement of the globe, indicating perforation. If that is the case, the anesthetic should not be injected and the needle should be withdrawn. Finally, the axial length of the globe should be taken into consideration prior to every peri- or retrobulbar block. In cases of high axial myopia, the authors recommend alternative types of anesthesia (e.g., sub-tenon's block), as these represent much safer options [7, 37]. A technique that can potentially prevent such complications is the ultrasound guided peribulbar block. However, it is not routinely used mainly due to its steep learning curve [1].

Conclusion

Serious complications following orbital regional anesthesia are rare, but can occur following both needle and blunt cannula (sub-Tenon's) techniques. This article reviews the etiology, management, and prevention of neurological complications of commonly used akinetic orbital blocks. Ophthalmologists, Anesthesiologists and Neurologists must be aware of and prepared to deal with these uncommon, but serious complications, of regional ophthalmic anesthesia. Peribulbar blocks should be performed by experienced surgeons, taking all necessary precautions, while the operating room should be equipped with basic resuscitation instruments. Patients receiving retrobulbar anesthesia should be carefully monitored for at least 20 minutes following the block. Life support equipment should be available prior to performing a retrobulbar block.

Consent for Publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Disclosure

AT performed the neurological assessment post ICU, participated in the literature review, and wrote part of the manuscript. INC, EC, PA treated the patient during his hospitalization, participated in the literature review, and wrote part of the case report. TP treated the patient during his hospitalization, reviewed and edited the text. TT reviewed and edited the manuscript. All authors have read and approved the manuscript.

Competing interests

The authors report no actual or potential conflict of interest.

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