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Effects of general anesthesia on ocular Refraction: An observational study

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ABSTRACT

Background: Refractive error is an ocular condition whereby light rays do not focus onto the macula for visual processing when they enter the eye. The most prevalent type, myopia, often known as short sightedness, is brought on when light rays entering the eye are focused anterior to the macula, blurring distance vision. Though rare, there are few situations that can call for the introduction of performing objective ocular refraction under GA. Refractive testing under general anesthesia (GA) is more safely suited for patients with conditions like subjective difficulty with charts, poor testing cooperation, nonorganic visual impairment refractions, physically or developmentally disabled patients, and those with co-existing ophthalmic pathology.

Materials and Methods: A 2-week prospective observational study was conducted in our hospital to look at the anesthetic methods used for ocular surgery at two sizable ophthalmic units. The anesthetist filled out a questionnaire for each case. The types of anesthetics used, the choice of ventilation or spontaneous respiration, the anesthetic agents used, the use and type of muscle relaxants, the presence of any significant ocular deviation, and any corrective actions taken, such as deepening anesthesia or giving a muscle relaxant, were among the information gathered.

Result: 90 procedures in all were surveyed within the 2-week period. 52.2% (47) of them anesthesia was provided by consultant anesthetist, 25.6% (23) provided by Anesthesia Post Graduate Trainee(PGT) and 22.2% (20) provided by specialist registrar anesthesia. 74% (23) of the patients with NDMR out of the total 59% (31) ventilated patients had NDMR. 42% (22) of the patients had surgery done while they were spontaneously breathing, and 14% (3) of them had muscle relaxants to help with intubation. Total intravenous anesthesia was administered to one patient. In the poll, 29% (15) of the patients chose atracurium as their preferred NDMR, whereas 21% (11) chose vecuronium. In total, 50% of the patients in the survey had no planned NDMR. In 8% (4) of patients, there was a significant ocular deviation. One of these four patients had total intravenous anesthesia (TIVA), while the other three were ventilated. None of them had taken NDMRs, or non-depolarizing muscle relaxants. In one case, the anaesthesia was deepened, and in two other cases, NDMR was administered as a remedy for the deviation. The prevalence of this condition was 18% in patients not receiving NDMR.

Conclusion: The objective refraction values showed that myopia manifested as a result of general anesthesia. Under the same circumstances, corneal refractive values flatten, indicating that the primary cause of myopia was ciliary muscle contraction. We hypothesize that this alteration resulted from ciliary muscle contraction and parasympathetic dominance during general anesthesia.

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1. Introduction

Refractive error is an ocular condition whereby light rays do not focus onto the macula for visual processing when they enter the eye. According to estimates from the World Health Organization (WHO), 123.7 million people worldwide suffer from untreated refractive error.[1] The most prevalent type, myopia, sometimes referred to as short sightedness, develops when light rays entering the eye are focused anteriorly to the macula, obstructing distance vision. By 2050, the WHO predicts that about half of the world's population would be myopic.[2] Myopia can be categorized as mild, moderate, or severe, or according to the pathophysiology that causes it: 0 to -1.5D, -1.5D to -6.0D, and >-6.0D. Curvature myopia, or increased corneal or lens curvature Myopia (accommodative) is characterized by elevated lens refractive index, accommodative spasms, or excessive accommodation.[3]

Progress increases the chance of developing eye pathology with either type. One of the main causes of blindness, myopic macular degeneration has the potential to result in an irreversible loss of central vision.[4] According to the literature, people with high myopia even have a 50% greater risk of acquiring glaucoma. The incidence of cataracts requiring surgery is also 17% higher in high myopes. A ratio of 5 to 6 higher risk of retinal tears and detachments is associated with high myopia.[5]

Despite the fact that the measurement of axial length can approximate the type and magnitude of refractive error, a cycloplegic refraction is still regarded as the gold standard, particularly in the paediatric population.[6] A muscarinic antagonist is used in a cycloplegic examination to paralyze the ciliary muscles and stop accommodation. The fact that topical cyclopentolate 1% has fewer adverse effects and a shorter duration of action than other cycloplegics makes it popular among eye care professionals.[7] If accommodation is not controlled, myopia may be overcorrected and hyperopia may be undercorrected during refractive testing.[8]

Though rare, there are few situations that can call for the introduction of performing objective ocular refraction under GA. Refractive testing under general anesthesia (GA) is more safely suited for patients with conditions like subjective difficulty with charts, poor testing cooperation, Refractions of nonorganic visual impairment, patients who are physically or cognitively challenged, and people who also have an ophthalmic disease co-exist. The ophthalmologist would be able to perform auxiliary management and simultaneously examine both eyes under the operating microscope.

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2. Materials and Methods

An investigation into the anesthetic methods used for ocular surgery at two sizable ophthalmic units in our hospital was conducted over the course of two weeks. The anesthetist filled out a questionnaire for each case. The types of anesthetics used, the decision between spontaneous breathing and ventilation, the anesthetics employed, the type and amount of muscle relaxants used, the presence of any major ocular deviation, and any corrective measures taken, such as deepening anesthesia or administering a muscle relaxant, were among the information gathered.

The two refraction systems used for testing were the standard automated distant subjective refraction with the CV-5000 s digital phoropter (the "standard") or the standard automated distant subjective refraction with the standard automated binocular refraction with the Chronos (the "novel"). For this investigation, an automated phoropter was created using the Chronos device. Participants were moved to the next system sequentially with an optional pause after completing refraction on the previous system. The break was provided so that attendees may use the restroom or take a water break, but none of them chose to do so.

The autorefraction values served as the starting point for the two subjective refraction procedures. In the (1) conventional station, we started with objective measurements from the KR-1 autorefractor (Topcon Corporation), whereas in the (2) innovative Chronos station, we employed internal autorefractors from the same instrument. The light source used by the KR-1 and Chronos autorefractors is different. Chronos employs a super luminous diode, whilst the KR-1 uses a light-emitting diode. Both devices include a 2-mm projection ring. The projected rings and rotatable prism are same amongst devices, though. The Chronos checks both eyes concurrently, but the KR-1 only evaluates one eye at a time. Both subjective refraction methods used the same standardized approach for subjective refraction. Neither refraction technique resulted in cycloplege among the participants.

3. Results

Over the course of the two weeks, 90 procedures in total were surveyed. Of these, a consultant administered anesthesia to 47% (26) patients, PGT to 33% (18), and a specialist registrar to 20% (11) (Table 1).

Table 1: Techniques employed by grade of anaesthetist

Grade	Ventilated (n=55) %	NDMR (n=35) %
Consultant	47 (26%)	60 (21%)
PGT	33 (18%)	15 (5%)
Specialist registrar	20 (11%)	25 (9%)

Table 2: The choice of muscle relaxant and the associated development of significant eye deviation

Parameters	n=90 (%)
Vecuronium	47 (43%)
Atracurium	32 (29%)
None +Eye Deviation	20 (18%)

In all, 61% (55), of which 39% (35) had NDMR, were ventilated patients. 42% (22) of the patients had surgery done while they were spontaneously breathing, and 14% (3) of them had muscle relaxants to help with intubation. Total intravenous anesthesia was administered to one patient. The preferred NDMR was atracurium in 32 (29%) and vecuronium in 47 (43%) of the patients surveyed. In total, 50% of the patients in the survey had no planned NDMR.

In 8% (4) of patients, there was a significant ocular deviation. One of these four patients had total intravenous anesthesia (TIVA), while the other three were ventilated. None of them had taken NDMRs, or non-depolarizing muscle relaxants. In one case, the anaesthesia was deepened, and in two other cases, NDMR was administered as a remedy for the deviation. The prevalence of this condition was 18% in patients not receiving NDMR.

4. Discussion

Myopia is a refractive anomaly in which the retina receives light from a distance focused in front of the eye.[9] This paper specifically addresses a case of pediatric axial myopia. Uncorrected refractive error is still generally regarded to be the second most prevalent cause of blindness and the most common cause of visual impairment globally. The global prevalence and anticipated temporal changes over the ensuing few decades are not precisely estimated. Additionally, there are variations between ethnic groups and geographical areas, although overall is rising everywhere.[10]

Throughout infancy and the early years of adulthood, more time spent doing close tasks (such as reading) seems to be linked to physiological myopia, which is often 2D. However, pathological myopia, which is less frequent, is characterized by enlargement of the globe and lengthening of the posterior segment and is connected to myopia that is more severe (>-6D).[11] The fundamental idea behind controlling myopia is to identify childhood myopia early and try to stop it from progressing into a pathological state. This highlights the significance of primary O-O shared care within the neighborhood.[12]

A juvenile patient's ability to obtain a consistently precise refraction is crucial. This not only increases asthenopia reduction and patient comfort but also enables more precise tracking of myopic advancement in relation to age and axial length change. It is strongly advised to use objective cycloplegic refraction since it is more sensitive than subjective refraction error across the board, but particularly in children and young adults.[13] Cycloplegia's primary goal is to minimize the eye's accommodating efforts. Additionally, employing this objective method has the added advantage of avoiding subjective chart difficulty, poor test taker compliance, and non-organic vision impairment refractions.[14]

Objective retinoscopy can still be challenging in children who are physically challenged, have developmental disabilities, have co-existing ocular pathology, or are healthy youngsters without pathology, even with these simplifying techniques. This is the rationale behind having an ophthalmologist assist the refractionist in doing objective retinoscopy when GA is present.[15] Additionally, it offers uncomplicated evaluation of the anterior and posterior segments under the operating microscope as well as binocular indirect ophthalmoscopy with scleral indentation. Myopic fundus characteristics, such as peripheral retinal degenerations (more usually of the lattice type), tears, fractures, and rhegmatogenous retinal detachments, must be identified the latter is essential.[16]

Clinically identifying these traits in some pediatric patients, particularly when it comes to the ora serrata, can occasionally be extremely difficult, painful, and time-consuming. Treatment (such as laser photocoagulation, cryotherapy, etc.) can be administered concurrently with intra-theatre diagnosis in some cases.[17] Additionally, clinical tests requiring close contact, such as the measurement of intraocular pressure (IOP), central corneal thickness (CCT), and pachymetry, biometry, and interpupillary distance (IPD), can be carried out. The latter benefit reduces the likelihood of high IOPs during IOP measurements with crying and squinting eyes.[18]

5. Conclusion

The objective refraction values showed that myopia manifested as a result of general anesthesia. Under the same conditions, corneal refractive values flatten, demonstrating that the primary cause of myopia was ciliary muscle contraction. We hypothesize that this alteration resulted from ciliary muscle contraction and parasympathetic dominance during general anesthesia.

6. Source of Funding

None.

7. Conflict of Interest

None.

References

1. Pasmanter N, Occelli LM, Komáromy AM, Petersen-Jones SM. Use of extended protocols with nonstandard stimuli to characterize rod and cone contributions to the canine electroretinogram. *Doc Ophthalmol.* 2022;144(2):81–97.

2. Odom JV, Bach M, Brigell M, Holder GE, Mcculloch DL, Mizota A, et al. ISCEV standard for clinical visual evoked potentials: (2016 update). *Doc Ophthalmol*. 2016;133(1):1–9.
3. Ito Y, Maehara S, Itoh Y, Hayashi M, Kubo A, Itami T. Effect of sevoflurane concentration on visual evoked potentials with pattern stimulation in dogs. *J Vet Med Sci*. 2015;77(2):155–60.
4. Strain GM, Jackson RM, Tedford BL. Visual evoked potentials in the clinically normal dog. *J Vet Intern Med*. 1990;4(4):222–5.
5. Itoh Y, Maehara S, Okada K, Izumisawa Y. Pattern-stimulated visual evoked potential in dog: changes in elicited response with pattern size and calculation of visual acuity. *J Vet Med Sci*. 2010;72(11):1449–53.
6. Jha MK, Thakur D, Limbu N, Badhu BP, Paudel BH. Visual Evoked Potentials in Primary Open Angle Glaucoma. *J Neurodegener Dis*. 2017;2017:9540609. doi:10.1155/2017/9540609.
7. Yuksel B, Dogan B, Koctekin B, Atis N, Erdal A, Kurtulus F, et al. Color vision testing versus pattern visual evoked potentials and optical coherence tomography parameters in subclinical optic nerve involvement in multiple sclerosis. *J Clin Neurosci*. 2019;61:48–53. doi:10.1016/j.jocn.2018.11.011.
8. Tartaglione A, Spadavecchia L, Maculotti M, Bandini F. Resting state in Alzheimer's disease: a concurrent analysis of flash-visual evoked potentials and quantitative EEG. *BMC Neurol*. 2012;12:145.
9. Wang J, Li Y, Musch DC, Wei N, Qi X, Ding G, et al. Progression of myopia in school-aged children after covid-19 home confinement. *JAMA Ophthalmol*. 2021;139(3):293–300.
10. Fredrick DR, Paul N, Biard, Seang MS. Myopia. *Nat Rev Dis Primers*. 2020;6(1):99.
11. Wong YL, Sabanayagam C, Ding Y, Wong CW, Yeo ACH, Cheung YB, et al. Prevalence, risk factors, and impact of myopic macular degeneration on visual impairment and functioning among adults in Singapore. *Invest Ophthalmol Vis Sci*. 2018;15(11):4603–13.
12. Williams K, Hammond C. High myopia and its risks. *Community Eye Health*. 2019;32(105):5–6.
13. Bach A, Villegas VM, Gold AS, Shi W, Murray TG. Axial length development in children. *Int J Ophthalmol*. 2019;12(5):815–9.
14. Herrera L, Perez-Navarro I, Sanchez-Cano A, Perez-Garcia D, Remon L, Almenara C, et al. Choroidal thickness and volume in a healthy pediatric population and its relationship with age, axial length, ametropia, and sex. *Retina*. 2015;35(12):2574–83.
15. Doherty SE, Doyle LA, McCullough SJ, Saunders K. Comparison of retinoscopy results with and without 1% cyclopentolate in school-aged children. *Ophthalmic Physiol Opt*. 2019;39(4):272–81.
16. Gimbel HV, Neuhann T. Development, advantages, and methods of the continuous circular capsulorhexis technique. *J Cataract Refract Surg*. 1990;16(1):31–7.
17. Power C, Crowe C, Higgins P, Moriarty DC. Anaesthetic depth at induction. An evaluation using clinical eye signs and EEG polysomnography. *Anaesthesia*. 1998;53(8):736–43.
18. Rose DK, Cohen MM, Wigglesworth DF, Deboer DP, Math M. Critical respiratory events in the postanesthesia care unit. *Anesthesiology*. 1994;81(2):410–8.

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