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Case Report

Oculocardiac Reflex in Ophthalmic Surgery: Mechanisms, Management, and Clinical Implications

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Abstract

The Oculocardiac Reflex (OCR) is a well-documented physiological phenomenon in ophthalmic surgery, characterized by a sudden decrease in heart rate in response to ocular manipulation. This reflex, first described by Aschner in 1908, involves complex neural pathways and has significant implications for patient safety and surgical outcomes. This paper provides an overview of the mechanisms underlying OCR, explores its management strategies, discusses its clinical relevance in ophthalmic surgery, and reports its incidence and prevalence.

Keywords: Oculocardiac Reflex; Ophthalmic Surgery; Pulseless V Tach; Anesthesia; Vagus Nerve

Introduction

The Oculocardiac Reflex (OCR) is a vagally mediated reflex that can be triggered during ophthalmic procedures, particularly those involving intraocular manipulation [1]. First described over a century ago by Aschner, the OCR represents a critical aspect of ocular surgery due to its potential cardiovascular consequences [2]. Understanding the mechanisms, management, and clinical implications of OCR is essential for ophthalmic surgeons and anesthesiologists to optimize patient care and surgical outcomes.

Case Presentation

A 63-year-old African American male without any significant past medical history presented to the hospital with a diagnosis of right eye vitreous hemorrhage, cataract formation, chronic inflammation, and total retinal detachment with proliferative vitreoretinopathy. He underwent elective vitrectomy with phacoemulsification of the right eye. The procedure started with the patient under general anesthesia and intubated. The face was prepped and draped in the usual manner. 25-gauge sclerotomies were placed around the limbus and the procedure was started by enlarging the superior temporal incision and phacoemulsification to the cataract. The posterior synechia had to be severed by an MVR blade and the vitrectomy machine. Total retinal detachment with large proliferation inferiorly was noted. Retinotomy had to be done to allow the retina to flatten. Perfluoron was used to dry up the retina then 5000 viscosity silicone oil was used to follow-up with the eye. Towards the end of the procedure, the patient became bradycardic and suddenly went to asystole and pulmonary arrest. Immediately resuscitation was started he was given epinephrine and shocked twice for pulseless V Tach and then SVT. He achieved ROSC after 2 rounds of CPR. He remained intubated and was transferred to the SICU for further care. Echo post-arrest showed preserved LV function and no wall motion abnormalities. The patient was tachycardic after the code with heart rate in the 160s. The patient had narrow complex tachycardia for which he received adenosine and IV fluid and ultimately converted to sinus rhythm. His initial EKG was concerning for ST elevation MI. A coronary angiogram

was done and it showed no obstructive coronary disease. Also, a complete echocardiogram was performed which revealed left ventricular ejection fraction in the normal range at 65% with no segmental wall motion or valvular abnormalities. Eventually, he was extubated and vitally stable. The patient was ultimately discharged home.

Mechanisms of OCR

The OCR involves a complex interplay of neural pathways, primarily mediated by the ophthalmic branch of the trigeminal nerve (V1) and the vagus nerve (cranial nerve X). The following key mechanisms are associated with the OCR:

Vagal Stimulation: Ocular manipulation, such as traction on extraocular muscles or pressure on the globe, triggers sensory signals via the ophthalmic branch of the trigeminal nerve (V1). These signals converge on the trigeminal ganglion, leading to efferent impulses transmitted to the medulla oblongata [3].

Vagal Efferent Pathway: The medulla oblongata serves as the central processing unit for OCR. It sends efferent impulses through the vagus nerve to the heart's atrioventricular (AV) node. This parasympathetic stimulation of the AV node results in a sudden decrease in heart rate, often accompanied by bradycardia or even asystole [4].

Management of OCR

Effectively managing OCR during ophthalmic surgery is crucial to prevent adverse cardiovascular events. Several strategies have been employed:

Anesthetic Techniques: Tailoring anesthesia depth and type is a fundamental approach. Maintaining adequate depth of anesthesia with intravenous agents and inhalational agents, along with neuromuscular blockade, can attenuate OCR responses [5].

Topical Anesthesia: The use of topical anesthetics, such as tetracaine eye drops, has been explored to reduce OCR intensity during ocular procedures [6]. These agents can provide local analgesia, diminishing the reflex's occurrence.

Monitoring: Continuous electrocardiographic monitoring is essential during surgeries with a potential OCR trigger. Prompt recognition of bradycardia allows for timely intervention, such as atropine administration, to reverse the reflex [7].

Incidence and Prevalence: OCR incidence varies depending on the type of ophthalmic surgery and patient population. Studies have reported incidence rates ranging from 10% to 90% [8]. Pediatric patients undergoing strabismus surgery are particularly susceptible, with reported incidence rates as high as 90% [6]. The prevalence of OCR in orbital floor fractures and trauma cases has also been documented [9, 10].

Clinical Relevance of OCR

OCR's relevance extends beyond ophthalmic surgery. It has been observed in various clinical settings, including orbital floor fractures and pediatric trauma cases, emphasizing the need for healthcare providers across disciplines to recognize and manage this reflex appropriately [11,12].

Future Research Directions

Future research directions offer exciting prospects for enhancing our understanding of OCR. Investigating heart rate variability analysis as a predictive tool and exploring genetic factors predisposing individuals to OCR may yield valuable insights into individualized risk assessment and management [8, 9]. Additionally, innovative pharmacological interventions may further refine OCR management, reducing the reflex's incidence and severity [10].

Conclusion

The Oculocardiac Reflex (OCR) is a complex and clinically relevant phenomenon in ophthalmic surgery. Its intricate neural pathways and potential cardiovascular consequences underscore the importance of understanding, recognizing, and effectively managing OCR. Ophthalmic surgeons, anesthesiologists, and perioperative teams must remain vigilant to ensure patient safety and optimize surgical outcomes.

The extensive body of research into OCR mechanisms, management strategies, and clinical implications has significantly contributed to our knowledge of this reflex. While OCR remains a concern in ophthalmic surgery, advances in anesthesia techniques and topical agents have improved our ability to mitigate its impact [10,13]. Continuous electrocardiographic monitoring plays a pivotal role in early detection and intervention, reducing the likelihood of adverse cardiac events [14].

Moreover, OCR's relevance extends beyond ophthalmic surgery. It has been observed in various clinical settings, including orbital floor fractures and pediatric trauma cases, emphasizing the need for healthcare providers across disciplines to recognize and manage this reflex appropriately [11-12].

In conclusion, the Oculocardiac Reflex, a century-old enigma, continues to challenge and intrigue medical professionals. With an ever-expanding knowledge base and ongoing research efforts, we are better equipped to navigate the complexities of OCR, ensuring safer ophthalmic surgeries and improved patient outcomes [15-19].

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