Perioperative Ocular and Visual Disturbances

Essay

Submitted for Partial Fulfillment of Master Degree

of ***Anaesthesia***

Presented by

Ibrahim Yousri Youssef

(M.B.B.CH.) Cairo university

Supervision by

Prof. Dr. Galal Abo El Seoud Saleh

Professor of Anaesthesiology and intensive care
and Pain Management
Faculty of Medicine, Ain-Shams University

Prof. Dr. Abeer Mohammed Abd El Aziz

Assistant Professor of Anaesthesiology and intensive care
and Pain Management
Faculty of Medicine, Ain-Shams University

Dr. Mohammed Mohammed Abd El Fattah

Lecturer of Anaesthesiology and intensive care
and Pain Management
Faculty of medicine, Ain-Shams University

Faculty of Medicine
Ain Shams University
2016

Acknowledgement

At first I thank **Allah** for blessing this work until it has reached its end as a part of his generous help throughout my life.

I would like to direct special thanks to **Prof. Dr. Galal Abo El Seoud Saleh** Professor of Anaesthesia and Intensive care, Faculty of Medicine, Ain-Shams University, for his great support and encouragement he gave through the whole work. It is a great honor to work under his guidance and supervision, and for being a source of inspiration.

I am deeply indebted to **Prof. Dr. Abeer Mohammed Abd El Aziz,** Assistant professor of Anaesthesia and intensive care, Faculty of Medicine, Ain-Shams University, for her close supervision, continuous help, precious time, sincere advice and the great effort she had done during the preparation and revision of the whole work.

I am also grateful to **Dr. Mohammed Mohammed Abd El Fattah,** Lecturer of Anaesthesia and intensive care Faculty of medicine, Ain-Shams University, for his generous help and support he gave me during this work.

Finally I would like to direct special thanks to my family who supported me throughout this work.

Ibrahim Yousri Youssef

Contents

List of Abbreviations

AION	:	Anterior ischemic optic neuropathy
BRAO	:	Branch retinal artery occlusion
CNS	:	Central nervous system
CRAO	:	Central retinal artery occlusion
CT	:	Computed tomography
D	:	Diopter
EOM	:	Extraocular muscles.
ERG	:	Electroretinography
IOP	:	Intraocular pressure
LA	:	Local anaesthetic
LGN	:	Lateral geniculate nucleus
MRI	:	Magnetic resonance imaging
NSAIDs	:	Non-steroidal anti inflammatory drugs
OA	:	Ophthalmic Artery
ON	:	Optic nerve
ONH	:	Optic Nerve Head
PCAs	:	Posterior Ciliary Arteries
PION	:	Posterior ischemic optic neuropathy
PONV	:	Post-operative nausea and vomiting
POVL	:	Postoperative visual loss

STB	**:**	Sub-Tenon’s block
TIVA	**:**	Total intravenous anesthesia
TURP	**:**	Trans-urethral resection of the prostate
VEPs	**:**	Visual evoked potentials

List of Figures

Introduction

The eye is one of the most complex organs of the human body. In the human eye, three layers can be distinguished. The outer region consists of the cornea and the sclera, while the middle layer of the eye is composed of the iris, the ciliary body and the choroid and the inner layer of the eye is the retina, a complex, layered structure of neurons that capture and process light. The three transparent structures surrounded by the ocular layers are called the aqueous, the vitreous and the lens ***(Colin et al., 2010).***

Patients assume a certain risk of vision loss when undergoing ophthalmic surgery, but awaking blind after elective non ocular surgery is a catastrophic event for the patient, the surgeon and the anaesthesiologist ***(Newman, 2008).***

Even from the earliest reports it was clear that postoperative visual loss (POVL) was not a single entity. In a few cases, the cause could be identified, as - for example - when foreign bodies entered the eyes causing corneal abrasions or pressure directly on the orbits had been long and excessive. Also, some cases resolved, and others did not ***(Grossman and Ward, 1993).***

The incidence of perioperative visual loss following ocular surgery appears to be much lower than that seen following nonocular surgery. Important ocular injuries include corneal abrasion (most common), conjunctival chemosis, periorbital edema, pressure injury to supplying nerves, proptosis, burn injuries, etc. Patient positioning, especially prone and lateral positions, surgical factors (massive blood loss, prolonged duration, spine or cardiac surgery), pressure by surgeon’s hand, coexisting diseases (e.g., anemia, diabetes mellitus, and arteriosclerosis), and preexisting ocular problems of the patient can cause them ***(Lee et al., 2006).***

Over time it is clear that there is no single factor responsible for postoperative visual loss. However, if all associated and/or implicated factors are considered and awarded an appropriate value, then techniques can be altered in an overall and sensible fashion to minimize the effects of these perturbations ***(Elizabeth, 2010).***

Aim of the work

The aim of this work is to present the specific mechanisms responsible for causes of perioperative ocular and visual complications, and how to manage and prevent.

Anatomy and physiology of the eye

The human eye is the basic organ of sight. The mechanism of sight and visual perception involves a set of structures (each of which has a definite function). The eye is housed in the orbit which is a protective framework of bones and connective tissue. The eyelids contain glands that produce the tear filmlayer over the anterior surface of the eye. The muscles that are attached to the eyeball controlling the movement of the eyes are called extraocular muscles. In addition, the muscles are coordinated between the two eyes, a necessary condition for binocular vision. A complex network of blood vessels and neurons provide nutrients as well as sensory and motor innervations to the eye. The crystalline lens of the eye plays a major role in focusing the light rays through a process called accommodation controlled via the ciliary muscles. The retina, the innermost of various layers, contains the light-absorbing rod and cone photoreceptors, as well as a neural network to process and transmit the electrical signals via the optic nerve to the visual cortex in the brain via the lateral geniculate body ***(Remington, 2005).***

Basic Dimensions of the Eye:

The eye is a spheroid structure that rests in the orbit on the frontal surface of the skull. The dimensions of the human eye are reasonably constant in adults, varying by only about a millimeter or so. The sagittal diameter (the vertical) is about 24 mm and is usually less than the transverse diameter which is about 24.5–25 mm. The adult human eye weighs approximately 7.5 gram ***(Hart, 1992).***

Eye Formation and Growth:

Eye formation begins during the end of the third week of development when outgrowths of brain neural tissue, called the optic vesicles, form at the sides of the forebrain region. The major structures of the eye are initially formed by the fifth month of fetal development. The eye structures enlarge, mature, and form increasingly complex neural networks prenatally. At birth, infant eyes are about two-third the size of an adult eye. Until the first month of life infants lack complete retinal development, with consequent effects on development of visual functions (i.e., visual acuity, contrast sensitivity, motion, etc.). From the second year until puberty, eye growth progressively slows. It should be noted that infants are born hyperopic (too much positive power), and a process of emmetropization occurs ***(Charman and Radhakrishnan, 2010).***

Layers of the eye:

In the human eye, three layers can be distinguished. The outer region consists of the cornea and the sclera. The cornea refracts and transmits the light to the lens and the retina and protects the eye against infection and structural damage to the deeper parts. The sclera forms a connective tissue coat that protects the eye from internal and external forces and maintains its shape. The cornea and the sclera are connected at the limbus. The visible part of the sclera is covered by a transparent mucous membrane, the conjunctiva. The middle layer of the eye is composed of the iris, the ciliary body and the choroid. The iris controls the size of the pupil, and thus the amount of light reaching the retina; the ciliary body controls the power and shape of the lens and is the site of aqueous production; and the choroid is a vascular layer that provides oxygen and nutrients to the outer retinal layers. The inner layer of the eye is the retina, a complex, layered structure of neurons that capture and process light. The three transparent structures surrounded by the ocular layers are called the aqueous, the vitreous and the lens ***(Colin et al., 2010).***

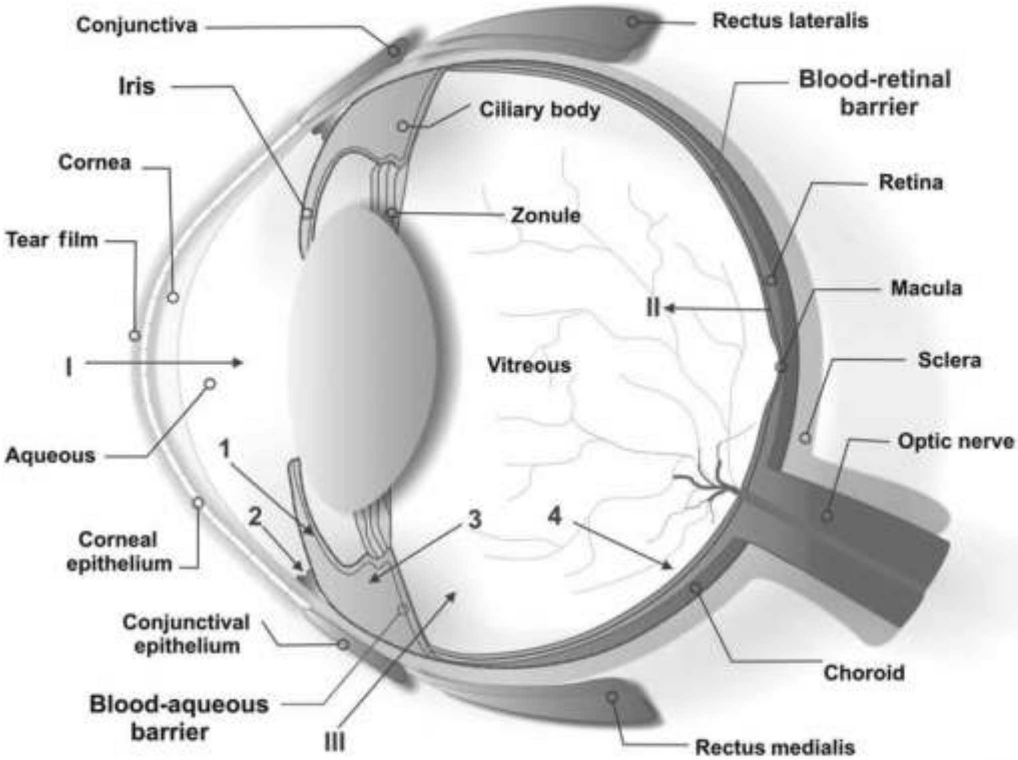

Fig.(1): Schematic illustration of the structure of the eye and the ocular barriers ***(Colin et al., 2010).***

The Cornea:

The cornea is the most anterior part of the eye, in front of the iris and pupil. It is the most densely innervated tissue of the body, and most corneal nerves are sensory nerves, derived from the ophthalmic branch of the trigeminal nerve. The cornea of an adult human eye has an average horizontal diameter of about 11.5 mm and a vertical diameter of 10.5 mm, and a curvature that remains rather constant throughout life. The optic zone (pre-pupillary cornea), which provides most of the cornea's refractive function, has a diameter of 4 mm and is located in the centre of the cornea, anterior to the pupil, in photopic conditions. The cornea is avascular and the branches of the anterior ciliary arteries stop at the limbus where they form arcades that supply the peripheral cornea. Therefore, the peripheral and central cornea are very distinct in terms of physiology and pathology. Five layers can be distinguished in the human cornea: the epithelium, Bowman's membrane, the lamellar stroma, Desçemet's membrane and the endothelium. The surface of the corneal epithelium is covered by the tear film, which protects the corneal surface from chemical, toxic or foreign body damage and from microbial invasion and smoothes out micro-irregularities of the surface of the epithelium. It consists of an outer lipid layer and an inner water-mucous layer. The mucous layer interacts with the epithelial cells, allowing the tear film to spread with each eyelid blink. The corneal epithelium is composed of two to three layers of superficial cells, two to three layers of wing cells and one layer of basal cells. The surface of the superficial epithelial cells is irregular due to the presence of microplicae (ridge-like folds of the plasmalemma) that interact with the overlying tear film. The cells of the corneal epithelium are renewed every 7–10