Pediatric Anesthetic Considerations for Ophthalmic Surgery

Essay

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By

Noha Ahmed Osama Mohamed
M.B.B.Ch
Faculty of Medicine, Ain Shams University

Under Supervision of

Prof Dr. Bahira Mohamed Tawfik Helmy
Professor of Anesthesiology and Intensive Care
Faculty of Medicine – Ain Shams University

Prof Dr. Raouf Ramzy Gad Allah
Professor of Anesthesiology and Intensive Care
Faculty of Medicine – Ain Shams University

Dr. Ashraf Ahmed Abd El-Hamid Abou Slemah
Lecturer of Anesthesiology and Intensive Care
Faculty of Medicine Ain Shams University

Faculty of Medicine
Ain Shams University
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توطئة للحصول علي درجة الماجستير في التخدير والرعاية المركزة

مقدمة من

الطبيبة: نهى أحمد أسامة محمد

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الأستاذة الدكتورة بهيرة محمد توفيق حلمي

أستاذ التخدير والرعاية المركزة

كلية الطب- جامعة عين شمس

الأستاذ الدكتور/ رؤوف رمزي جاد الله

أستاذ التخدير والرعاية المركزة

كلية الطب- جامعة عين شمس

دكتور أشرف أحمد عبد الحميد أبو سليمه

مدرس التخدير والرعاية المركزة

كلية الطب- جامعة عين شمس

كلية الطب

جامعة عين شمس

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Introduction

Providing appropriate anesthesia care for pediatric patients during eye surgery requires basic understanding of intraocular pressure and its control, pharmacology of the drugs used by the ophthalmologist and the potentials of drug interactions with the anesthetics.

Also the anesthesiologist must be aware that several medical problems are associated with congenital and acquired eye anomalies and pathology and that many anesthetic drugs and procedures have profound effects on the ocular physiology.

Unlike adults most pediatric eye surgeries require general anesthesia, however peribulbar block appears to be a safe analgesic technique for pediatric ophthalmic surgeries with no complications related to it, also the combination of general anesthesia with peribulbar block proved to be very beneficial for aborting the oculocardiac reflex intraoperatively and for relief of postoperative pain.

Aim of Work

In this essay we will try to integrate and unfold the different techniques and considerations of how to anesthetize a pediatric patient undergoing an eye surgery.

The Globe

The eye ball is situated in the anterior part of the orbital cavity closer to the roof than to the floor and nearer the lateral than the medial wall. The position of the globe in relation to the orbital opening varies in normal individuals and with pathology e.g tumours or thyroid disease ***(Zonneveld, 1987)***.

The sclera is the fibrous layer of the eye ball and is present everywhere except in the cornea. the optic nerve penetrates the sclera posteriorly 1 or 2 mm medial to and above the posterior pole. The central retinal artery and vein accompany the optic nerve ***(Snell and Lemp, 1989)***.

The sclera is relatively tough but is pierced easily by sharp or blunt needles. The limbus forms the corneoscleral junction.

The uveal tract consists of the choroid, ciliary body and iris. the choroid is a thin coating deep to the sclera and has a rich vascular supply. Its function is largely as a vascular nutritional source for the retina. Its circulation is also important in the control of IOP. this layer offers no significant resistance to penetration by a needle ***(Koornneef, 1982)***.

The retina is a thin transparent membrane lining the eye ball from the optic nerve to the ciliary body. The visual part extends anterior to approximately the point of insertion of the medial and lateral rectus muscles.

The neural retina is attached firmly to the pigment epithelium at the optic disc and ora serrata but elsewhere attachment is weak. The layers normally remain attached because of negative pressure created by absorption of fluid between the two layers. Penetration of the globe by a needle is likely to result in such detachment ***(Zide and Jelks, 1985)***.

Anatomy of the Orbit:

Each orbit is an irregular pyramid in shape with its base forming the orbital opening, its apex is directed postero-medially forming the apex. The triangular roof is composed of the orbital plate of frontal bone with a small portion of the lesser wing of the sphenoid bone posteriorly. At the posterior end is the optic foramen which is the orbital opening of the optic canal ***(Johnson, 1995)***.

The lateral wall is formed from the zygomatic bone and the greater wing of sphenoid. The sphenoid portion of the lateral wall is separated from the roof by the superior orbital fissure and from the floor by the inferior orbital fissure ***(Szmyd et al., 2003)***.

The thin floor is composed mainly of the orbital plate of maxilla, the zygomatic bone anteriorly and the palatine bone posteriorly. The medial wall is quadrangular in shape and is composed of the ethmoid centrally, surrounded by the frontal bone superiorly and anteriorly, the lacrimal bone inferiorly, and the sphenoid bone posteriorly ***(Hustead et al., 1993)***.

Orbital openings and their contents:

The optic canal transmits the optic nerve and the ophthalmic artery from the middle cranial fossa to the orbit.

The superior orbital fissure carries the lacrimal, frontal, trochlear, oculomotor, nasociliary and abducent nerves, in addition to the superior ophthalmic vein. The trochlear, frontal and lacrimal nerves enter the orbit outside the muscle cone. The inferior orbital fissure contains the foramen rotundum connecting the middle cranial fossa to the pterygopalatine fossa ***(Grizzard al., 2001)***.

Relations:

Above the roof are the frontal air sinuses anteriorly and the meninges and frontal lobe of cerebral hemisphere. Inferior to the floor is the maxillary air sinus. The infraorbital nerve and blood vessels lie within the infraorbital canal. Laterally the orbit is related to the temporal fossa containing the temporal lobe of the cerebral hemisphere and its investing meninges posteriorly. Medially the orbital wall is related to the nasal cavity anteriorly, the ethmoid sinuses in the middle part and the sphenoid sinus posteriorly ***(Davis, 1996)***.

The Extraocular Muscles

The orbits are symmetrically arranged about the midline. The orbital axes diverge, and the medial walls are approximately parallel to each other. To be parallel to each other, the orbital axes must be adducted by 22.5 relative to the orbital axes. ***(Howe, 1907)***.

The six extraocular muscles; four recti and two obliques, attach to and rotate the eye. Anatomically and functionally the muscles are organized into 3 pairs: medial and lateral rectus, superior and inferior rectus, and superior and inferior oblique ***(Howe, 1907)***.

The rectus muscles (medial, lateral, superior and inferior) are flat stripes, having a width six times their thickness, that take origin at an oval, fibrous ring at the orbital apex; the annulus of Zinn, which overlies the optic foramen and the medial portion of the superior orbital fissure. Through the annulus of Zinn passes the abducent nerve, the upper and lower divisions of the occulomotor nerve, the optic nerve and ophthalmic artery, and the nasociliary branch of ophthalmic nerve ***(Wolff, 1961)***.

The rectus muscles course forward in a cone like configuration and insert in the sclera a few millimeters posterior to the corneal limbus, through tendons a few millimeters long. The distance of the insertions from the limbus increases in sequence from the medial to the inferior, to the lateral and to the superior rectus, a progression known as the spiral of Taillaux ***(Hesser, 1913)***.

The insertions vary somewhat in shape and locations. The exact muscle length depends on the eye position, but at rest as under anesthesia or deep sleep, the rectus muscles are approximately 40 mm in length, the superior oblique is 32mm, and the inferior oblique is 35mm ***(Taillaux, 1890)***.

The two oblique muscles approach the eye from the front. The superior oblique muscle is fusiform in shape and arises near the annulus of Zinn over the fronto-ethmoidal structure, superomedial to the origin of the medial rectus. It courses forward along the junction of the orbital roof and the medial wall. Its tendon passes through a pulley, or trochlea, and it is redirected posteriorly, passing inferiorly to the superior rectus muscle and inserting on the posterior, superior, and lateral octant of the globe. The trochlea is the functional origin of the superior oblique ***(Fink, 1947)***.

The inferior oblique arises behind the lacrimal fossa from the orbital plate of the maxilla and proceeds backwards laterally in a direct path to its insertion in the posterior, inferior, and lateral octant of the globe. It passes inferior to the inferior rectus ***(Fink, 1947)***.

In childhood the eye muscles grow along with the orbit and the eye. The muscle length increases by about 40%-50%, but, while the dimensions change, the angular relationships stay the same. This growth pattern ensures that the percent contraction of each muscle stays the same for a given size of eye movement. The central innervation patterns are thus independent of growth ***(Muhlendyck, 1978)***.

Blood supply

Two branches of the ophthalmic artery supply the extraocular muscles. One branch supply the lateral and superior recti and the superior oblique, and the other supplies the medial and inferior recti and the inferior oblique. The lacrimal artery may partially supply the lateral rectus and the infraorbital artery may partially supply the inferior rectus and oblique. The anterior ciliary arteries, which supply the blood to the anterior segment of the eye, arise from the rectus muscle and penetrate the sclera at the muscle insertions. The lateral rectus contains one anterior ciliary artery and the other recti two for each. The venous drainage of the extraocular muscles is into the superior and inferior orbital veins ***(Howard, 1996)***.