

Extraocular structures inside the orbit of the eye



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INTRODUCTION

The Retrobulbar block injection is commonly practised around the world ⁽²⁾. In the beginning, regional anaesthesia of the eye consisted of retrobulbar anaesthesia (RBA), with the surgeon performing the block ⁽⁶⁾. This anaesthesia can be administered with an intraconal block ⁽¹⁾. It consists of an equal mixture of lidocaine (2%-4%) and bupivacaine (0.75%) with up to 15 units of hyaluronidase ⁽¹⁾. A sharp needle with 27 gauge 31mm is inserted in the interolateral border of the orbit ⁽³⁾. The needle passes through all the rectus and oblique muscles of the eye ⁽²⁾. The rectus muscles include superior rectus muscle, inferior rectus muscle, lateral rectus muscle and medial rectus muscle ⁽²⁾. The two oblique muscles are inferior and superior oblique muscles ⁽²⁾. The optic nerve and arteries should be avoided ⁽²⁾. This essay explains the extraocular structures inside the orbit of the eye.

Anatomy

Orbital openings

The lateral wall of the orbit consists of superior orbital fissure and the floor of the orbit involves the inferior orbital fissure ⁽²⁾. The superior orbital fissure brings the frontal, lacrimal, oculomotor, trochlear, nasociliary, abducent nerves and superior ophthalmic vein ⁽⁷⁾. The superior orbital fissure is divided by annulus of zinn ⁽⁷⁾. The area inside the annulus is called oculomotor foramen ⁽⁷⁾. The inferior orbital fissure comprises the foramen

rotundum which transmits the maxillary branch of the trigeminal nerve ⁽⁷⁾ . This nerve passes from middle cranial fossa to the pterygopalatine fossa ⁽⁷⁾ .

The Globe

Human eye vary in size ⁽⁴⁾ . The eyeball is located in the anterior part of orbital cavity, which is closer to the roof than the floor, also nearer the lateral than the medial wall ⁽⁷⁾ . The average anteroposterior diameter of the globe is 24. 15mm ⁽⁴⁾ . Normally it ranges from 21. 7mm to 28. 75mm ⁽⁴⁾ . When the anteroposterior diameter of the eye is longer that is, the axial length of the myopic eye is more ^(2, 4) . So the risk of globe perforation increases particularly with a retrobulbar block ⁽⁴⁾ . Staphyloma may occur when the eyes is highly myopic ⁽⁷⁾ . Thinning of the sclera and posterior globe enlargement can occur ⁽⁷⁾ . A bulge in This average globe diameter occupy approximately 7ml of the orbit where as the total structures are packed in 30ml space, so the remaining space is filled with fat, nerves, extraocular muscles, lacrimal gland, vascular structures and connective tissue ⁽⁵⁾ . The needle is inserted in the fat filled areas inside the orbit ⁽⁵⁾ . Needle trauma can occur with eyes with posterior staphyloma ⁽⁷⁾ .

The cavity of the orbit has a posterior apex with a pyramid shape ⁽⁶⁾ . The orbit is made up of mainly adipose tissue ⁽⁶⁾ . Anteriorly, the 4 rectus muscles of the eye insert near the equator of the globe ⁽⁶⁾ . Posteriorly, these four rectus muscles insert together at the apex on the tendinous annulus communis of Zinn, through which the optic nerve enters the orbit ⁽⁶⁾ . The

four rectus muscles define the retrobulbar cone of the orbit, that is not closed by any intermuscular membrane ⁽⁶⁾ . Sensory innervation is supplied by the ophthalmic nerve first branch of the fifth nerve that is trigeminal nerve, which passes through the retrobulbar cone ⁽⁶⁾ . The ophthalmic nerve and oculomotor nerve passes through the retrobulbar cone ⁽⁶⁾ . Injection of local anaesthesia solution inside the retrobulbar cone will provide anaesthesia ⁽⁶⁾ . It also provides akinesia of the globe and the extraocular muscles ⁽⁶⁾ . The superior branch of the facial nerve gives motor supply to the orbicularis muscle of the eyelids which has an extraorbital course ⁽⁶⁾ . Many major structures are situated in the retrobulbar cone which gives rise to major risk factors in needle and injection injury ⁽⁶⁾ . Many complications may occur when needle is inserted into the retrobulbar (intraconal) space, so doctors prefer to inject in the extraconal space ⁽⁸⁾ . The rectus muscles are in close contact with the orbital bone so the extraconal space is only a minute space compared with the retrobulbar space ⁽⁶⁾ .

The retrobulbar space is located inside the extraocular muscle cone which is behind the globe ⁽⁴⁾ . Comparatively avascular areas of the orbit are restricted to the anterior orbit in the inferotemporal (lower outer) and superotemporal (upper outer) quadrants ⁽⁴⁾ . The superonasal quadrant is rich in blood supply and has limited space ⁽⁴⁾ .

Extraocular muscles

The extraocular muscles of the eye includes four rectus and two oblique muscles which allow elevation, depression, adduction and abduction, medial

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and lateral rotation ⁽⁷⁾. The origin of the superior rectus muscle rises from the annulus of Zinn ⁽⁷⁾. It then passes forwards and laterally to be inserted into sclera which is about 7.7mm behind the corneoscleral junction ⁽⁷⁾. The superior rectus muscle is supplied by the superior division of the oculomotor nerve ⁽⁷⁾. This nerve crosses through the inferior surface of this muscle (intraconal) ⁽⁷⁾. The origin of the inferior rectus muscle arises from the annulus of Zinn below the optic foramen ⁽⁷⁾. It then passes forwards and laterally to be inserted into the sclera which is about 6.5mm from the corneoscleral junction ⁽⁷⁾. It is supplied by the inferior division of the oculomotor nerve ⁽⁷⁾. The origin of the lateral rectus muscle runs from the lateral part of tendinous ring ⁽⁷⁾. There is also a smaller head arising from sphenoid a little laterally ⁽⁷⁾. The lateral rectus muscle is inserted into the sclera about 6.9mm from the corneoscleral junction ⁽⁷⁾. It is supplied by the abducent nerve on its intraconal aspect ⁽⁷⁾. The origin of the medial rectus muscle is from the medial aspect of the annulus of Zinn. This muscle passes along the medial orbital wall. It is inserted into the sclera about 5.5mm from the limbus. It is supplied by the inferior division of the oculomotor nerve on its intraconal aspect. The superior oblique muscle is the longest and the most slender muscle compared to the other eye muscles. It originates from the body of the sphenoid bone superomedial to the optic canal. It passes forward and its long tendon passes through the trochlea which is attached to the trochlear fossa of the frontal bone. The tendon of the superior oblique muscle passes downwards, backwards and laterally. It then passes inferior to the superior rectus muscle. It is inserted posterior to the equator of the

eyeball. It is supplied by the trochlear nerve on its extraconal aspect. The origin of the inferior oblique muscle is very unique. It originates from the floor posterior to the orbital margin. It is just lateral to the nasolacrimal duct. It passes laterally, posteriorly and superiorly. It passes inferiorly to inferior rectus muscle. It is inserted into the sclera at the posterolateral aspect of the eyeball. This muscle is supplied by inferior division of the oculomotor nerve.

When you inject a local anaesthetic solution into the lateral adipose compartment from inferotemporal needle insertion. It normally blocks the nasociliary, lacrimal, frontal, supraorbital and supratrochlear branches of the ophthalmic division of the trigeminal nerve and the infraorbital branch of the maxillary division. But when you inject into the medial compartment through a needle placed between the caruncle and the medial canthal angle, it blocks the medial branches of the nasociliary nerve, the long ciliary nerves, the infratrochlear nerve and the medial components of the supraorbital and supratrochlear nerves. If an extra supplementary injection is required superiorly, it is important to be careful that the superomedial approach almost inevitably brings the needle into contact with a path filled and packed with nerves, blood vessels and muscles.

BLOOD SUPPLY

The main artery which supplies the globe and all the orbital contents is the ophthalmic artery which is a branch of the internal carotid artery. It passes into the orbit through the optic canal inferolateral to the optic nerve and within the meningeal sheath of that nerve. The artery tends to pierce the sheath to lie outside it as soon as it enters the orbit. The course of the

ophthalmic artery takes an early intraorbital course superior to the optic nerve and inferior to the superior rectus muscle. It then courses towards the medial wall of the orbit from where it runs anteriorly above the medial rectus muscle. So very careful measures are to be taken when injecting needles in elderly and hypertensive patients, it can be tortuous and vulnerable to needle trauma when it bleeds profusely. Venous drainage is through the superior and inferior ophthalmic veins. The superior vein starts deep to the medial part of the upper eyelid from the confluence of the supraorbital and facial veins. It passes posteriorly within the orbit. It receives branches corresponding to those of the ophthalmic artery. The superior ophthalmic vein leaves the orbit through the superior orbital fissure within the annulus fibrosus. The inferior ophthalmic vein arises from a venous plexus on the anterior part of the floor orbit. It passes posteriorly on the inferior rectus muscle passing through the inferior part of the superior orbital fissure draining into the cavernous sinus.

EYELIDS, LEVATOR PALPEBRA SUPERIORIS AND ORBICULARIS MUSCLES

The function of the eyelids is to protect the eye from injury and excess light. It also distributes tear fluid over the anterior surface of the eyeball.