"EFFICACY AND SAFETY OF TOPICAL, SUBTENON'S AND PERIBULBAR ANAESTHESIA IN MANUAL SMALL INCISION CATARACT SURGERY"

By

DR. RASHMI.N.R

Dissertation Submitted to the

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH KOLAR

In partial fulfillment
Of the requirements for the degree of

MASTER OF SURGERY

IN

OPHTHALMOLOGY

Under the Guidance of

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APRIL 2015

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LIST OF ABBREVIATIONS USED

SL. NO.	ABBREVIATION	FULL FORM
1.	ICCE	INTRA CAPSULAR CATARACT EXTRACTION
2.	ECCE	EXTRA CAPSULAR CATARACT EXTRACTION
3.	SICS	SMALL INCISION CATARACT SURGERY
4.	MSICS	MANUAL SMALL INCISION CATARACT SURGERY
5.	RBA	RETROBULBAR ANAESTHESIA
6.	PBA	PERIBULBAR ANAESTHESIA
7.	STA	SUBTENON'S ANAESTHESIA
8.	TA	TOPICAL ANAESTHESIA
9.	GA	GENERAL ANAESTHESIA
10.	IOP	INTRAOCULAR PRESSURE
11.	G	GAUGE
12.	mm	MILLI METRE
13.	IOL	INTRAOCULAR LENS
14.	min	MINUTES
15.	SCH	SUB-CONJUNCTIVAL HAEMORRHAGE

ABSTRACT

BACKGROUND

Manual Small Incision Cataract Surgery (MSICS) is the only feasible technique to tackle the enormous problem of cataract blindness in India. Cataract surgery is being performed under various types of anaesthesia. Most of the surgeons prefer good analgesia and akinesia. Retrobulbar anaesthesia, due to its serious complications was replaced with peribulbar anaesthesia. But that also did not eliminate serious complications totally. Recently other methods like subtenon's anaesthesia is expected to have less complications while topical anaesthesia is expected to have least complications.

OBJECTIVES

1. To study the effect of anaesthesia, patient's and surgeon's comfort in topical, subtenon's and peribulbar anaesthesia in manual small incision cataract surgery.

2. To study the intra and post operative complications of manual small incision cataract surgery done under topical, subtenon's and peribulbar anaesthesia.

METHODS

A hospital based prospective study of 300 patients who underwent Manual Small Incision Cataract Surgery (MSICS) at R.L.JALAPPA HOSPITAL AND RESEARCH CENTRE, TAMAKA, KOLAR attached to SRI DEVARAJ URS MEDICAL COLLEGE between January 2013 and June 2014 was done, of which 100 patients each were operated under topical, subtenon's and peribulbar anaesthesia. The efficacy and safety of the three methods of anaesthesia in MSICS with respect to onset and duration of anaesthesia, pain (during

administration, intraoperatively and 6 hours postoperatively), akinesia, lid movements and complications were compared.

RESULTS

Onset of anaesthesia was fastest in the topical group and faster in subtenon's compared to peribulbar. Pain during administration of anaesthesia and 6 hours post-operatively was significantly lower in topical and subtenon's groups while intra-operative pain levels were comparable among the three groups. Topical group patients had full range of movements throughout the surgery whereas akinesia was comparable among the subtenon's and the peribulbar groups. But peribulbar proved better for control of intraoperative lid movements. Complications like chemosis and subconjunctival haemorrhage were significantly more in the subtenon's group. Other complications like ecchymosis and ptosis were significantly more in the peribulbar group.

CONCLUSION

Subtenon's anaesthesia is safer than the sharp needle peribulbar technique giving good analgesia during surgery and more efficient than topical with regards to intraoperative eyeball movements and lid movements.

KEYWORDS

Manual Small Incision Cataract Surgery, Topical anaesthesia, Subtenon's anaesthesia, Peribulbar anaesthesia

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INTRODUCTION

Senile cataract is the leading cause of preventable blindness in India and worldwide. Annual incidence of 3.8 million cataracts and over 9 million cataract blind people have been reported in India.[1] The only treatment option for cataract is the surgical removal of the cataractous lens and the implantation of an intraocular lens. Cataract surgery has undergone a commendable revolution from 17th century practise of couching to intracapsular cataract extraction (ICCE), extracapsular cataract extraction (ECCE), small incision cataract surgery (SICS) and current trend phacoemulsification.

The cost considerations and the steep learning curve associated with the phacoemulsification procedure makes it a less feasible procedure for high-volume surgery needed in developing countries. However, the Manual Small Incision Cataract Surgery (MSICS) is the surgery of choice in such circumstances.[2]

Unless medically contraindicated, cataract surgery is usually performed under local (regional) anaesthesia. Local anaesthesia involves the blockage of a nerve subserving a given part of the body by infiltration of the area around the nerve with local anaesthetic.[3] The following local anesthesia techniques are currently used in ophthalmic surgery: facial blocks, retrobulbar anesthesia (RBA), Peribulbar anesthesia (PBA), Subtenon's anesthesia (STA) and subconjunctival anesthesia as injective method, topical applications as drip, gel or sponge anesthesia and intracameral anesthesia in addition.[4]

The retrobulbar anaesthesia is largely discarded because of the few major complications associated with the technique like retrobulbar hemorrhage and optic nerve injury. The MSICS

has been conventionally performed under peribulbar anaesthesia over the last few decades which is associated with a fewer minor complications.

However during the recent years, there has been a move towards other methods like subtenon's anaesthesia (STA) and topical anaesthesia (TA). Subtenon's anaesthesia will have much lesser complications as it is performed using a blunt cannula. Topical anaesthesia being non invasive, will have the least complications.

We are conducting this prospective study to evaluate the efficacy and safety of topical, subtenon's and peribulbar anaesthesia in manual small incision cataract surgery in our set up.

OBJECTIVES OF THE STUDY

1. To study the effect (onset and duration) of anaesthesia, patient's comfort (in terms of pain) and surgeon's comfort (in terms of lid squeezing and akinesia) in topical, subtenon's and peribulbar anaesthesia in manual small incision cataract surgery.

2. To study the intra and post operative complications of manual small incision cataract surgery done under topical, subtenon's and peribulbar anaesthesia.

REVIEW OF LITERATURE

Among all the techniques of cataract extraction, Manual small incision cataract surgery (MSICS) has become popular in developing countries like India as it gives better uncorrected vision as compared to ECCE,[5] and at an affordable cost.[6] Manual small incision cataract surgery can be done under general or local anaesthesia.

General anaesthesia for cataract surgery is not followed routinely because of its own risks. It was avoided because it used to cause raised intra-operative intraocular pressure, pulmonary complications, post-operative retching, nausea, vomiting, delayed ambulation and oral feeding. In infants, young children, mentally handicapped patients, patients objecting to local anaesthesia, it is still the anaesthesia of choice.

Local anaesthesia is the anaesthetic technique of choice for surgery on the eye in many instances. The expansion of day-care facilities has encouraged its use, and the development of less invasive surgical techniques has rendered general anaesthesia largely unnecessary.[7]

The goal of ideal local anesthesia is to obtain complete akinesia of the eyeball and low intraocular pressure (IOP) in order to provide optimal surgical conditions.[8]

Joint guidelines published by the Royal College of Ophthalmologists (RCOphth) and the Royal College of Anaesthetists (RCoA)[9] state that the goals of ocular anaesthesia are to:

- Provide pain-free surgery
- Facilitate the surgical procedure
- Minimise the risk of systemic complications

● Reduce the risk of surgical complications.

Relevant considerations include surgical outcomes, anaesthetic complications and the need for anaesthetic monitoring, patient comfort, and cost. The anaesthetic technique must produce optimal surgical conditions, providing good anaesthesia for the patient in a safe manner.

Manual Small Incision Cataract Surgery(MSICS), which is the procedure of choice for cataract extraction in developing countries and can be performed under retrobulbar, peribulbar, subtenon's and topical anesthesia.[10]

Knapp described the first retrobulbar block in 1884 using cocaine.[11] Retrobulbar anaesthesia, which was used for almost a century, was associated with a number of potentially sight-threatening complications.[12]. Retrobulbar anesthesia in which needle was directed towards a space just behind the globe was the most popular technique used in ophthalmology during earlier days.

In the 1970s and 1980s, peribulbar blocks, in which the needles were directed away from the eye toward the other structures in the orbit, were used. In addition, retrobulbar and peribulbar blocks provided some degree of amaurosis, preventing the patient from seeing the bright operating microscope light and reducing visual images. Bloomberg championed the cause of a shorter needle peribulbar regional and called his technique periocular block.[13]

Sharp needle techniques are associated with risks such as inadvertent globe perforation, retrobulbar haemorrhage or direct injection into the optic nerve. A further possible consequence of sharp needle techniques is injection into the dural sheath leading to unconsciousness and cardiovascular compromise from local anaesthetic effect on the brainstem. These are rare but

serious complications. They also shared a risk of intraocular infections, retinal detachments, double vision after surgery.

Advances in cataract surgery including the use of a smaller, self-sealing incision have shortened the duration of surgery[6] resulting in the use of shorter acting anaesthetic agents with less invasive methods of administration.

In the 1980s, three surgeons in the U.S. Air Force, Elizabeth Hansen, Calvin Mein and Robert Mazzoli attempted vitreoretinal and then cataract surgery employing a needle technique even more anteriorly, away from the muscles and the retrobulbar space, in a way that was described as subtenons anesthesia, a method that was first employed by C.S. Turnbull, in 1884 and later by Ivor John Kirby, in the 1950s, but which was otherwise forgotten. It was revisited in the 1990s by several workers including Hansen[14] and Stevens,[15] and has continued to become increasingly popular worldwide.

The globe perforation and life threatening complications like brainstem depression have a 2.5-fold greater risk in sharp needle techniques (peribulbar, retrobulbar) as compared with subtenon block[16] while subtenon block has 2.3-time greater risk of minor complications like subconjunctival hemorrhage and conjunctival chemosis.[16] Intraocular pressure increases significantly in many eyes after peribulbar anesthesia[17] while there is minimal rise in IOP after subtenon anesthesia.[18] Both of these blocks provide excellent and equal analgesia.[19]

Subtenon's anesthesia was less painful than peribulbar anesthesia at the time of administration of anesthesia, although, during surgery and till 90 minutes after administration, there is no difference in pain between the two groups. Subtenon's anesthesia provides better akinesia than peribulbar anesthesia. Subtenon's anesthesia leads to smaller rise in IOP than peribulbar

anesthesia 1 minute after the injection. However, 10 minutes after injection IOP declines to its base level in both groups.[20] Subtenon's anaesthesia is recommended as a safe and effective alternative to peribulbar anaesthesia for MSICS.[21]

The most important development in anesthesia for cataract surgery in the past decade was the introduction of topical anesthesia[22] by Fichman. Topical anesthesia affects only the nerve endings of the trigeminal nerve in the cornea and conjunctiva. So, akinesia of the globe will not be achieved, therefore, good patient cooperation is required for safe use of topical anesthesia.[23] The lack of amaurosis is ideal for day-care surgery, which itself is increasingly popular. The greatest attraction of topical anaesthesia is its complete absence of the complications described for injectional local anaesthetic techniques.[24]

An unicentre, prospective, randomized, clinical interventional trial which included 140 consecutive patients undergoing routine cataract surgery, concluded that patient comfort and surgery-related complications did not differ between topical anaesthesia and peribulbar anaesthesia; and in view of the minimally invasive character of topical anaesthesia compared to peribulbar anaesthesia, suggested the use of topical anaesthesia for routine cataract surgery.[25]

Patient's satisfaction for anaesthesia is comparable for topical versus other techniques.[26] MSICS performed under topical anaesthesia is a patient-friendly procedure without compromising the outcome.[27]

A randomized controlled trial done at Govt medical college, Thrissur concluded that at the time of anaesthetic administration, topical anaesthesia scored much higher than peribulbar anaesthesia. The risk of globe perforation, optic nerve injury, pain and fear perceived because of peribulbar anaesthesia are all eliminated with topical anaesthesia. Further benefits included non-

interference with the visual function (including the risk of retrobulbar haemorrhage), unlimited ocular movements and absence of increased intraorbital volume.[28]

HISTORY OF CATARACT SURGERY

Written history of cataract spans over 20 centuries. An African and an Arabic oculist translated into Latin cataracta meaning; something poured underneath, something being the WATERFALL.[29][30]

The first mention of cataract surgery was in the code of Hammurabi around about 1750 BC. Early surgeons, performing couching had no idea of pushing something behind the pupil was the human lens. In 16th century Atoine Jan and Michel Pierre identified from autopsy specimen that the cataract was truly the crystalline lens itself.[29][31] The written proof of couching came from Sushruta an Indian surgeon.[29][32]

The procedure of couching, which involved simply banging of the eye to try to dislodge the cataractous lens, was popular for many thousands of years until about 1700 when the concept of trying to surgically remove the lens was conceived. During these early days, anaesthesia had not been developed, and it was not until the young Sigmund Freud identified the anaesthetic properties of the leaves of the coca plant and through much experimentation deduced their anaesthetic effects. An European surgeon called Kola worked out that it could be used for topical ocular anaesthetic and from that date cataract surgery did not have to be performed without the use of anaesthetic.

Daviel performed extracapsular extraction from inferior limbus in sitting position.[29][33] Pierre Francos shifted incision to the upper limbus while sitting on head side of patient. The pharmacological mydriasis and planned iridectomy was introduced by Carl Himly.[29][34]

The next breakthrough came in intracapsular surgery with the development of chemical zonulysis using an enzyme α chymotrysin.[29][35] Aphakic correction with contact lens was started and got established from 1940. Harold Ridley implanted first synthetic lens on November 29, 1949.[29][36]

First feeling of intact supports for IOL was urged by Cornelius Binkhorst.[29] Then came the modification in the conventional ECCE with the introduction of self-sealing corneoscleral tunnel and a smaller incision, the procedure of Manual Small Incision Cataract Surgery.

The most significant change marked by the modern era was the introduction of phacoemulsification surgery in 1967 by Dr. Charles Kelman.[37] In this technique, ultrasound waves are used to break the lens into minute fragments that can be aspirated. A combined ultrasonographic, irrigation, and aspiration hand piece allows the removal of any lens through a small incision.

The technique of phacoemulsification was developed to enable ophthalmologists to extract cataracts through the smallest possible incision using an ultrasound or laser probe, to break the lenses without damaging the lens capsule. Today it has become the preferred technique for cataract removal. No sutures are required as incision is self-healing.[38][39]

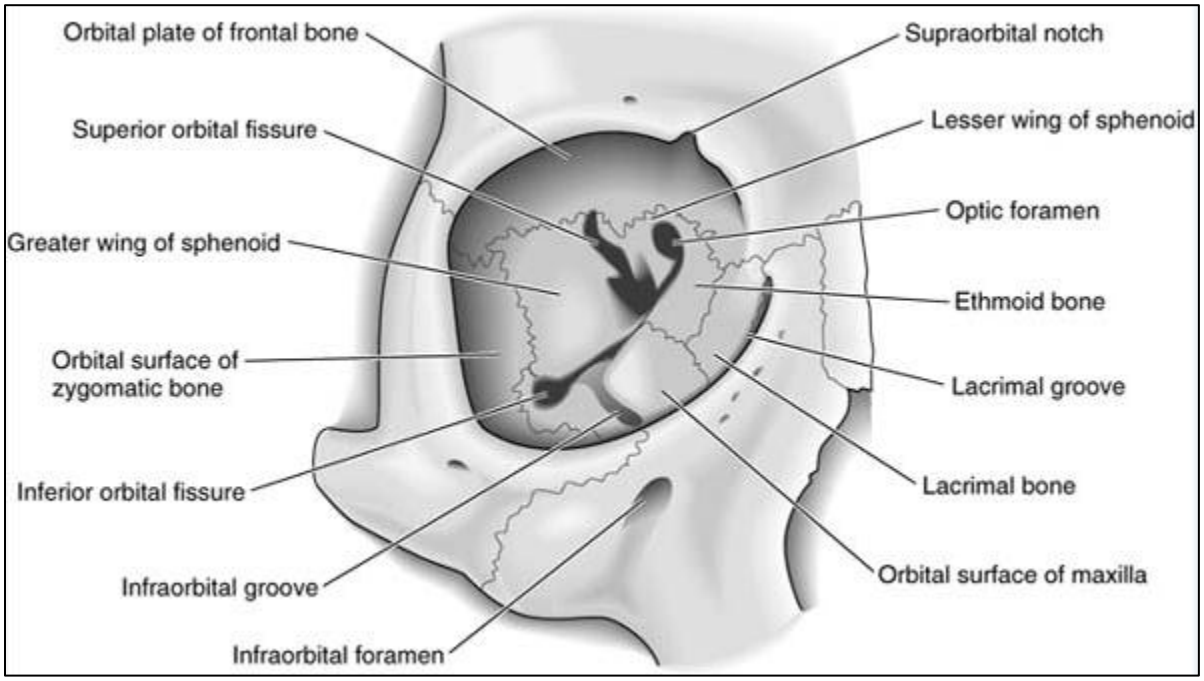
The cost considerations and the steep learning curve associated with the phacoemulsification procedure make it an unsuitable procedure for high-volume surgery needed in a developing country like ours. However, the manual small incision cataract surgery (MSICS) is the surgery of choice in such circumstances.

APPLIED ANATOMY OF THE ORBIT

The human orbital cavities, following the bilateral symmetry of the other vertebrates, flank the sagittal plane of the skull between its cranial and facial parts encroaching about equally on both. Above them is the anterior cranial fossa, between them the nasal cavitiy and the ethmoidal air sinuses, below each a maxillary sinus, and laterally from behind forwards are the middle cranial and temporal fossae.[40]

The orbit resembles a quadrilateral pyramid whose base is directed forwards, laterally and slightly downwards. Seven bones form the orbit – maxillary, palatine, frontal, sphenoid, zygomatic, ethmoid and lacrimal bones.[40]

FIGURE 1: BONES OF THE ORBIT



ROOF

It is formed by the triangular orbital plate of the frontal bone and a small extent by the lesser wing of the sphenoid posteriorly. Anterolaterally there is a slight depression, the lacrimal fossa for the orbital part of the lacrimal gland. It separates the orbital cavity from the anterior cranial fossa and the frontal lobe of the cerebral hemisphere.[40]

FLOOR

It is formed by three bones – orbital plate of the maxilla, orbital surface of the zygomatic bone and the small orbital process of the palatine bone.[40]

LATERAL WALL

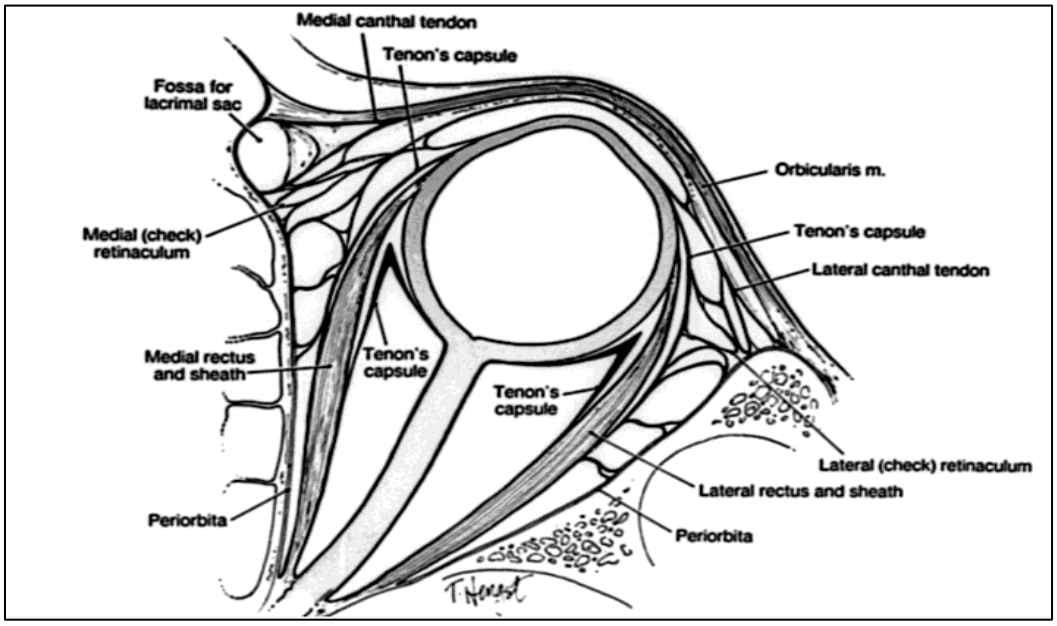
It is the thickest wall, formed by two bones. The anterior one-third is formed by the zygomatic bone and the posterior two-thirds is formed by the greater wing of the sphenoid bone. The lateral wall and roof are continuous anteriorly but are separated posteriorly by the superior orbital fissure.[40]

MEDIAL WALL

The thin medial wall is formed by four bones – the frontal process of the maxilla, the lacrimal bone, the orbital plate of the ethmoid and the small part of the sphenoid. On the anterior part of the medial wall is the lacrimal groove for the lacrimal sac. The medial wall separates the orbital cavity from before backwards, the nasal cavity, ethmoidal sinuses and the sphenoid sinus.[40]

The globe is normally spherical situated in the anterior part of the orbit 22-24 mm in diameter. In myopic eyes, it can be elongated to more than 30mm.[41]

FIGURE 2: TENON'S CAPSULE



Tenon's capsule forms a dense layer of connective tissue that surrounds the extraocular muscles in the anterior orbit. It extends from limbus to optic nerve head and continues as a fibrous sheath that surrounds the extraocular muscles.[41] The anterior portion of tenon's capsule is adherent to episclera upto a point which is 10mm posterior to the limbus.[41]

Through the tenons capsule pass the following:

The optic nerve

The ciliary nerves

The ciliary arteries

The vortex veins

The tendons of extra ocular muscles

SURGICAL SPACES OF ORBIT [42]

The orbit is divided into a number of spaces. From the surgical point of view, four spaces can be described in the orbit.

1) Subperiosteal space

This is a potential space between orbital bones and the periorbita, limited anteriorly by the strong adhesions of periorbita to orbital rim.

2) **Peripheral orbital space (Anterior space or extraconal space)**

This space is bounded peripherally by periorbita, internally by the four extra ocular muscles with their inter-muscular septa and anteriorly by the septum orbitale (including tarsal plates and tarsal ligaments). Posteriorly, it merges with the central space.

Contents of this space are peripheral orbital fat, superior oblique, inferior oblique and levator palpebrae superioris muscles, lacrimal, frontal, trochlear, anterior ethmoidal and posterior ethmoidal nerves, superior and inferior ophthalmic veins, lacrimal gland and half of the lacrimal sac.

3) **Central space (intraconal space)**

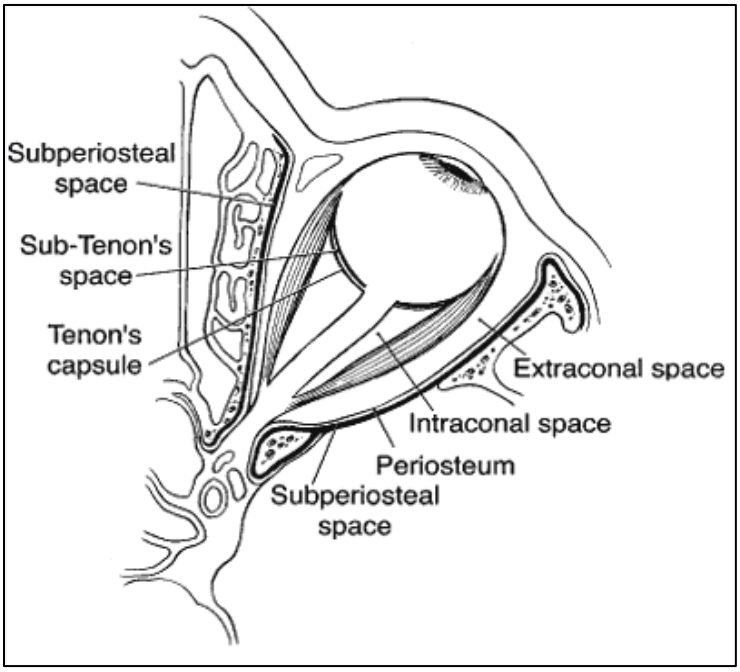
It is also called muscular cone or posterior or retrobulbar space. This space is bounded anteriorly by Tenon's capsule lining the back of the eye and peripherally by the extra ocular rectus muscles and their intermuscular septa (in the anterior part). In the posterior part, where intermuscular septa are imperceptible, this space becomes continuous with the peripheral orbital space. Contents of the central space include optic nerve and its meninges, superior and inferior

divisions of oculomotor nerve, abducent nerve, nasociliary nerve, ciliary ganglion, ophthalmic artery, superior ophthalmic vein and the central orbital fat.

4) **Subtenon's space**

It is a potential space around the eye ball between the sclera and tenon's capsule.

FIGURE 3: SURGICAL SPACES OF THE ORBIT



NERVE SUPPLY

MOTOR – The orbicularis oculi is served by the supraorbital nerve, a branch of facial nerve.

The extraocular muscles are supplied by cranial nerves III, IV and VI. To achieve akinesia, motor fibres within these nerves have to be inhibited at some level in their path. Superior rectus is supplied by the superior division of the oculomotor nerve entering the inner surface of the muscle at the junction of its middle and posterior thirds. Inferior rectus, medial rectus and

inferior oblique are supplied by the inferior division of the oculomotor nerve entering the inner surface of the muscles at the junction of middle and posterior thirds. Inferior oblique receives its nerve supply at middle of its posterior border.[40] Motor nerve to the inferior oblique runs a long intraconal course and is therefore relatively easily blocked.

Trochlear nerve enters orbital surface of half of posterior third of superior oblique. Motor nerve to the superior oblique runs a short intraorbital but extraconal course before entering the muscle. Retained activity of this muscle is frequently seen after intraconal local anaesthetic injection because of this anatomical difference.

SENSORY – The upper lid is served mainly by the supraorbital nerve, the lower lid innervated by the infraorbital nerve. Innervations to the globe and its internal structures is derived from the ophthalmic branch of the trigeminal nerve via the long nasociliary nerve and short ciliary nerve. The ciliary ganglion lies near the apex of the retrobulbar cone and is associated with the optic nerve and ophthalmic artery. It is composed of sympathetic fibres, sensory fibres and parasympathetic fibres; the sympathetic fibres and sensory fibres transit through the ganglion whereas the parasympathetic fibres synapse within it. The efferent nerve, the short ciliary nerve progresses anteriorly to provide sensation to the globe and anatomic motor function to the iris.[43]

Nasociliary nerve supplies sensory innervations of ciliary body, iris, central and perilimbal conjunctiva. Lacrimal, frontal and infraorbital nerves innervate peripheral part of conjunctiva.[43]

ANAESTHETIC DRUGS

Any agent which, when applied to nervous tissue, which prevents conduction of the nerve impulse in any part of the neuron, can be classified as local anesthetic. In fact all true anaesthetics only produce a reversible depression of conduction. Further they are commonly used to produce loss of pain with or without loss of touch and other local sensation or nervous control and therefore the term local analgesic is better than local anaesthetic.

The acceptability of an anaesthetic technique depends on its clinical success rate and its safety. In the field of regional anaesthesia, these two factors are occasionally diametrically opposed, but so is the danger of toxic side effects. Thus within the context of the desirable criteria of rapid onset and appropriate duration, preference must be given to the substances with lowest toxicity.

The ideal anaesthetic drug for ophthalmic blocks would be the one that has a high therapeutic index, is painless on injection, rapid in onset, and produces consistent motor and sensory block. Further they are used commonly to produce analgesia with or without akinesia and other local sensations or nervous control.[44]

CLASSIFICATION

ESTERS	AMINO ACIDS
Cocaine	Lignocaine
Procaine	Bupivacaine
Nesocaine	Etidocaine

Amethocaine

Cinchocaine

Bilocaine

Mepivacaine

LIGNOCAINE

Chemical name – 2 diethyl amino aceto-2', 6'-xylidine hydrochloride.

Used in 1%, 1.5% and 2% concentrations for local injection and 4% as topical anaesthesia. It is often regarded as a standard local anaesthetic because of its fast onset and better tissue penetration properties.[44]

When administered locally, it has a tendency to cause vasodilatation and this is normally counteracted by the addition of a vasoconstrictor. It has a potent analgesic action on mucous surfaces when applied topically. It produces general analgesia when given intravenously, which lasts longer than that of procaine; less than 10 % excreted in the urine and less than 7% excreted into the bile.

Dose:

a) Nerve blocks: 2 % solution.

Max. dose is 100 ml (500 mg) with adrenaline.

Max. dose is 40 ml (200 mg) without adrenaline.

b) Surface analgesia:

2 % solution max. 8 ml

4 % solution max. 4 ml

Precautions:

They are stable in the presence of acids and alkalis and can be autoclaved repeatedly.

BUPIVACAINE (Sensoricaine)

Chemical name – 1-butyl-1-piperidyl 2',6' xylidine hydrochloride.[45]

It has high lipid solubility and protein binding properties. It therefore has increased potency and much greater duration of action. Both its potency and toxicity are approximately 4 times than those of lignocaine, so that its therapeutic ratio is similar. It does however, has a longer duration of action up to 6 hours. General systemic effects are similar to those of other local analgesics.

Its disadvantages are decreased tissue penetration with resultant delayed onset of anaesthetic action. It is more cardiotoxic than lignocaine.[44] No local toxic effects on nerves or surrounding tissues have been reported.

Plain solutions of 0.25%, 0.5% and 0.75% are available.

Max Dose: Not more than 50 mg (2 mg/kg body wt) in a 70 kg healthy adult (30 ml of 0.5 %) should be given at one time or in any 4 hour period.

Max. recommended dose / day is 400 mg.

Side effects and precautions: Serious side effects are rare but may occur in connection with relative or absolute over dosage.

Most local anaesthetic agents consist of a lipophilic group connected by an intermediate chain. pKa of most local anaesthetics is in the range of 8-9. So, at physiological pH, the cationic form is available which is thought to be most active form at receptor site.[44]

Nowadays, a combination of 2% lignocaine with 0.5% bupivacaine is used and is very beneficial.

PHARMACOKINETICS

Absorption – Systemic absorption of injected local anaesthetic from the site of administration is modified by several factors including dosage, site of injection, drug tissue binding and presence of vasoconstrictive substances.[44]

Metabolism – The local anaesthetics are converted in the liver or in plasma to more water soluble metabolites and excreted in urine.[44]

Mechanism of action – Primary mechanism of action of local anaesthetic is peripheral nerve blockade of voltage gated sodium channels. Local anaesthetics bind to receptors near the intracellular end of sodium channels and block them.

ACTION ON NERVES – On application of a local anaesthetic over a nerve root, pain fibres are blocked first, other sensations disappear next and motor function blocked last.[44]

ADRENALINE

It is commonly used in a concentration of 5 micro g/ml (1 part in 2,00,000) in local anaesthetic solutions. It prolongs the effect of local anaesthetics by decreasing the rate of absorption and

localizing the anaesthetic. Adrenaline causes a decrease in retinal perfusion because of vasoconstriction and decrease in intraorbital pressure.[44]

HYALURONIDASE

It breaks down acid in the connective tissue and facilitates spread of injected drugs. It enhances the onset of block and reduces intraocular pressure by attenuating spread of local anaesthetic. The activity of hyaluronidase depends on the pH of the solution and the most beneficial range is 6.4-7.4.

Hyluronidase is not only beneficial for the success of the block but also for avoiding increased IOP and for lessening risk of muscle toxicity by local anaesthetic.[43]

ANAESTHESIA AND NSAIDS

Modern day cataract surgery can be performed despite patient being on antiplatelet or anticoagulant therapy.[46]

In a prospective study of 1383 patients, retrobulbar and peribulbar block was found to be safe, without any increased incidence of retrobulbar hemorrhage despite ongoing acetylsalicylic acid or other NSAID therapy.[47]

In cataract patients, continuation of warfarin therapy at therapeutic levels has been recommended because such patients have a 1% risk of having intraoperative stroke if the medication is discontinued preoperatively.[48]

If warfarin therapy is continued, maintaining International Normalized Ratio at the therapeutic level, topical or sub-tenon's anaesthesia might be more recommendable than retrobulbar / peribulbar block, to prevent risk of retrobulbar hemorrhage.[43]

PREANAESTHETIC MEDICATION

Sedation – the patient should be free from pain; relaxed, alert and capable to communicate with surgeon during the operation. Sedation in ophthalmic procedure is used to treat anxiety, to overcome minor tremor, unintentional cough, hypertension or tachycardia.[43]

Anticoagulants – patients who are receiving anticoagulant medication should undergo clotting studies to ensure that they lie within an acceptable therapeutic range (INR <3).[41]

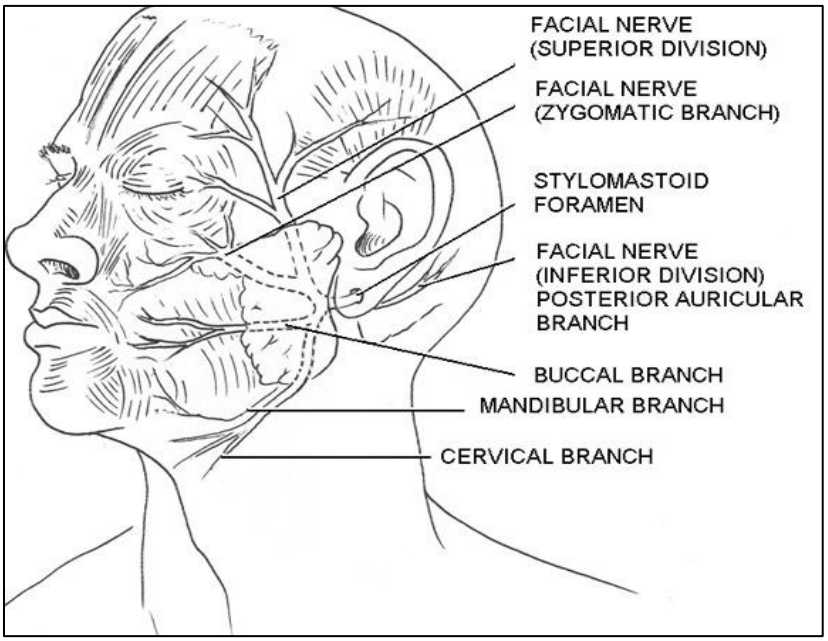
Other medications – routine medications should be continued upto the time of surgery. Antihypertensive medication in particular should not be discontinued as uncontrolled intraoperative hypertension leads to an increased risk of retrobulbar hemorrhage.[41]

Antidiabetic medications, either insulin or oral hypoglycemic drugs also should not be discontinued.

DIFFERENT TYPES OF BLOCKS AVAILABLE FOR CATARACT SURGERY

FACIAL BLOCKS

FIGURE 4: BRANCHES OF FACIAL NERVE



TYPES OF FACIAL BLOCKS

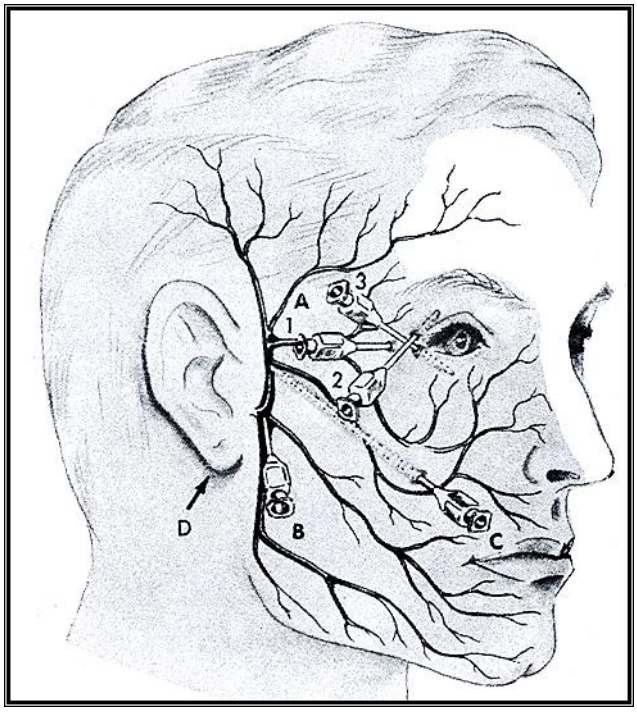
A. Van Lint[49] in 1914 introduced his classical facial nerve block technique; here akinesia is obtained by infiltrating anaesthetic agent in the region of the terminal branches of the facial nerve.

B. O'Brien akinesia obtains a paresis of the orbicularis muscle by blocking the facial nerve at the proximal trunk.

C. Atkinson published many articles on regional anaesthesia for ophthalmic surgery from 1934 to 1964. Injection is made along the inferior edge of the zygomatic bone and then upwards across the zygomatic arch towards the top of the ear.

D. Nadbath-Ellis block involves an injection in the area of the facial nerve as it emerges from the stylomastoid foramen and enters the parotid gland.

FIGURE 5: FACIAL NERVE BLOCKS



A - Van Lint, B - O'Brien, C - Atkinson, D - Nadbath Ellis

RETROBULBAR ANAESTHESIA

Retrobulbar anaesthesia was first described in 1884 by Knapp,[50] who injected 4 % cocaine for ocular anaesthesia prior to enucleation surgery. The modern technique was described in 1934 by Atkinson.[51] Retrobulbar injection was performed using a 22 or 23 G needles which were about 3.5 to 3.7 cm long, having a blunt tip. The patient is directed to look upward and nasally so as to move the inferior oblique and the fascia between the lateral and inferior rectus muscles forward and upward out of the way of the needle. The needle was directed straight back, well away from the eye ball, towards the apex of orbit and inserted to a depth of 2.5 to 3.5 cm and injection made in the muscle cone, the point of inserting the needle tip being just above the inferior margin at the junction of the outer one third and medial two third.

A safer method of retrobulbar injection is to ask the patient to look slightly downwards and outwards, based on the CT findings of Unsold[52] et al. In this position, the tip of needle is less likely to damage the optic nerve and posterior ciliary arteries.

Havener WH,[53] as suggested by Swan KC, advocated that the anaesthetic should be injected in the anterior retrobulbar space. The region just behind the globe is relatively avascular. The vessels of the apex of the orbit are larger and more fixed in position and cannot be readily displaced by a needle. They are much more readily pierced than the more anterior vessels. This is the reason retrobulbar haemorrhage is more frequent after deep injections.

The retrobulbar injection can also be performed through inferior cul-de-sac. James P. Gills described a procedure for performing a retrobulbar block and akinesia with one injection. With this technique, paralysis of the orbicularis oculi muscle occurs with the retrobulbar block.

Jeffrey G.Straus in 1988, developed a new retrobulbar needle and injection technique to decrease the risk of most complications associated with conventional needles and techniques. The needle is curved as it extends from its hub, but it has a straight terminal position. This is a 25 G, 38 mm needle with an Atkinson tip.

Advantages of retrobulbar injection[54]

1) Quick action.
2) Less volume of anaesthetic required.
3) Widely used in eye camp surgeries.

Complications and drawbacks of retrobulbar injection[55]

1) Bruising (ecchymosis)
2) Retrobulbar haemmorhage
3) Globe penetration or perforation.
4) Amaurosis.
5) Perforation of optic nerve.
6) Needle perforation of optic nerve sheath.
7) Myotoxicity.
8) Brain stem anaesthesia.

9) Occulocardiac reflex

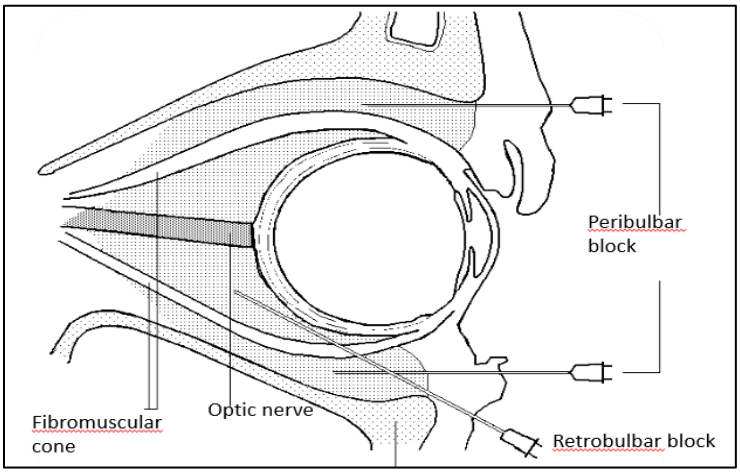
10) Central retinal artery occlusion

11) Suprachoroidal haemorrhage.

12) Adjuvant facial block necessary

13) The action is not uniform and sustained for long time.

FIGURE 6: POSITION OF NEEDLE IN RETROBULBAR AND PERIBULBAR BLOCKS



PERIBULBAR ANAESTHESIA

Peribulbar anaesthesia has been used since the late 1960's; however it was not formally described until March of 1986 by Davis and Mandel.[56] Various modifications have

subsequently been described by Bloomberg[57] and others. Their studies have reported excellent anaesthesia without complications in large number of patients undergoing cataract surgery when peribulbar techniques were used.

In January 1989, Weiss and Diechman[58] reported a study of a comparison between retrobulbar and peribulbar anaesthesia for cataract surgery. They found that the efficacy of peribulbar anaesthesia appears to be comparable to that of retrobulbar anaesthesia. However, a significant increase in chemosis was found with peribulbar anaesthesia.

The commonly used technique was that of Weis, here the technique was quite similar to retrobulbar, except that a 25 G 1.6 cm needle was used and the needle was introduced at the junction of the medial two third and lateral one third and directed exactly as that of retrobulbar. The hub of the needle indented the skin, aspiration was done to check if the needle was in any vessel, if not, the local anaesthetic was injected approximately 5-7 ml in volume. Pressure was applied with a Honan balloon for 10 minutes at 30 mm Hg. Lid and globe akinesia were checked for. If this was not satisfactory a supplementary injection was given at the supratrochlear notch.

Advantages of peribulbar injection[59]

1) Gives uniform action and sustains for longer duration
2) It is safer than retrobulbar injection
3) Less incidence of retrobulbar haemmorhage

Complications and drawbacks of peribulbar anaesthesia

1) The necessity of multiple intraorbital injections

2) The requirement of two to four times volume of anaesthetic used with retrobulbar anaesthesia.

3) Delayed onset of anaesthesia and akinesia

4) Requires hyaluronidase for diffusion of the anaesthetic solution in the orbit.

5) Requires application of pinky ball or similar pressure applying mechanism and constant monitoring of the same for 20 minutes

6) Ill monitored pressure over eye ball may lead to central artery occlusion

7) Globe perforation

8) Long term ptosis

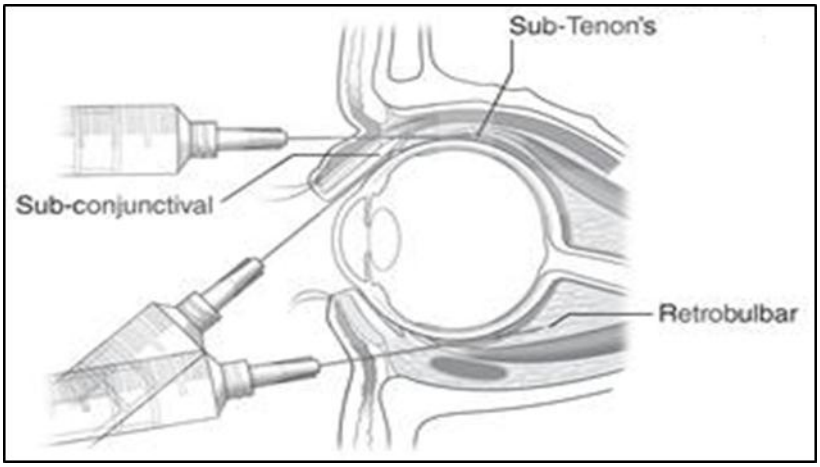
9) Cannot be given in ruptured globe, dislocated or subluxated lens

10) Acquired Browns syndrome

SUBCONJUNCTIVAL INJECTION

Subconjunctival (perilimbal) injection of local anaesthesia: Articles published in 1990 and 1991 advocated (with careful selection of patients) subconjunctival injection of local anaesthetics in small volume near the superior limbus, mainly for anterior segment surgery. The subconjunctival method allows exposure to the greater risks associated with performing intraocular surgery in the presence of extra ocular muscle activity. Globe perforation associated with the technique has been reported.

FIGURE 7: POSITION OF NEEDLES IN SUBCONJUNCTIVAL AND SUB-TENON'S ANAESTHESIA



SUB-TENON'S ANAESTHESIA

Anaesthesia for cataract surgery produced by injecting small volumes of local anaesthetic beneath Tenon's capsule was first described by Swan in 1956. He indicated that the sub-tenon's method produced better iris and anterior segment anaesthesia than did sub conjunctival injection.

The injection technique involved insertion of blunt cannula into subtenon space after surgical dissection of Tenon's capsule. The degree of abolition of extra ocular muscle involvement is proportional to the volume of injectant.

Procedure:

The patient should be assessed for anaesthesia in the standard manner. Inability to comply with the anaesthetist's instructions, as for example, as a result of deafness or mental incapacity, inability to lie flat, allergy to local anaesthetics, lack of intravenous access or excessive

uncontrollable anxiety are absolute contra indications to sub-tenon's anaesthesia. The procedure should be explained to the patient to allay anxiety and assist the anaesthetist in carrying out the block.

The injection is made on a supine patient. The conjunctiva is anaesthetized with topical anaesthetic solution. An eye lid speculum is inserted at this point to improve access. Throughout the procedure, patient is asked to look up and outwards to expose the inferonasal quadrant. A small tent of conjunctiva is raised with a pair of non toothed forceps approximately midway between the limbus of the eye and the visible angle of the inferonasal portion of the conjunctiva. A small incision is made in the tented conjunctiva with a pair of ophthalmic scissors. The closed scissors are introduced through the aperture created and a tunnel is fashioned over the bare sclera by blunt dissection through tenon's capsule. A curved blunt irrigating cannula is then inserted with the syringe of anaesthetic solution attached. Stevens described a metal cannula designed for this purpose.[60] The cannula is introduced along the contour of the globe and gentle contact of its tip is maintained with the sclera. Occasionally resistance to the needle is felt around the equator where a fibrous band can form as the ocular muscles broach the capsule. This is usually easily overcome by gentle pressure.

To reduce the risk of trauma to soft tissues, flexible cannula have been used.[61][62][63] They have two potential problems: the precise site of injection may be unpredictable, and with an anterior injection the volume administered could be limited by the swelling of the conjunctiva. For anterior segment procedures, where absolute akinesia may not be required, these factors are unlikely to be significant.

Normally little resistance is found to injection. If resistance is felt, withdrawal and re-insertion of the needle using gentle pressure of the tip against the globe to ensure entry into correct tissue plane will help. Slight proptosis of the eye ball is normal after a correctly sited injection. There may be slight leakage of solution from the tunneled point of entry of cannula into the conjunctiva. If ballooning of the conjunctiva occurs, solution may be in the incorrect tissue plane. After removal of the cannula, pressure is applied by massaging the globe.

Common pitfalls are related to positioning of the conjunctival incision and the confirmation of dissection down to sclera. The incision must be made at a sufficient distance from the limbus to avoid the oblique insertion of tenon's capsule into sclera. A distance of 7- 10 mm from the limbus is acceptable. Detecting the end point of dissection comes with experience. The sclera has a different, more fibrous and whiter appearance than either the Tenon's capsule, or continuation of the fascial layer of the extra ocular muscles. Good illumination is very important for this difference to be apparent. While some ophthalmologists may prefer to use magnification, the procedure is normally performed satisfactorily with the naked eye.

Extra care should be taken in myopic patients. They have longer and thinner globes, and there is an increased risk of scleral perforation. The technique is relatively contraindicated where there is a history of scleral disease with possible scarring and friability of the sclera. Previous retinal detachment surgery can be associated with scleral buckles and adhesions, which may hinder dissection and spread of anaesthetic solution, and increase the risk of globe perforation in the quadrant dissected.

Recent reports suggest that the use of subtenon's block is becoming more wide spread among anaesthetists and ophthalmological surgeons.[64] It has been suggested that it has more acceptable risk profile than traditional ophthalmic anaesthesia.[65]

Advantages of Sub-Tenon's anaesthesia

1) As this method requires blunt cannula there is no prick pain at the time of giving anaesthesia.
2) Patient is unware of receiving any injection.
3) Small amount or volume of anaesthetic solution is required.
4) No need of pinky ball, only digital massage is sufficient.
5) Quick action within five minutes.
6) No risk of retrobulbar haemorrhage, globe perforation, optic nerve damage, and other complications associated with retrobulbar and peribulbar injection.
7) Intraocular pressure is not much raised even immediately after giving the anaesthesia and good hypotony is achieved thereafter.
8) The degree of abolition of extraocular muscle movement is proportional to the volume of injectant.
9) Also good for retinal surgeries, and squint surgeries.

Complications or drawbacks of subtenon anaesthesia

1) Increased incidence of conjunctival chemosis and subconjunctival haemorrhage.

2) Theoretically, there is a potential for damaging one of the vortex veins.

3) Should be avoided in patients receiving anticoagulant medication.

4) Abolition of orbicularis action is proportional to the volume of injectant (with hyaluronidase).

An incision into the conjunctiva and underlying fascia is made and a theoretical risk of providing a route of infection is possible, though any ocular surgery would normally have antibiotic cover by topical treatment which would also provide cover for this small incision.

Theoretically, rigid metal cannula can perforate a staphylomatous myopic eyes but disastrous if occurred.

TOPICAL ANAESTHESIA

The most recent step in the evolution of regional anaesthesia for catraract extraction has been the introduction of solely topical corneoconjunctival anaesthesia. The method is best for lens removal by phacoemulsification with foldable PCIOL implantation through a clear corneal incision of 4 mm width or less. However studies have also been conducted for its use in manual small incision cataract surgery. Anaesthesia was achieved with amethocaine 1% (four drops) instilled over a 30 minute interval pre-operatively and prilocaine 2% injected subconjunctivally at the incision site immediately before surgery.[66] Topical anaesthesia for cataract surgery has

several advantages compared with regional anaesthesia. Firstly, it eliminates the risk of damage to the globe or orbital contents associated with retrobulbar and, less commonly, peribulbar injections.[67-70] Secondly, it allows rapid visual rehabilitation following surgery with the potential for good vision in the immediate post operative period.[71][72] Thirdly there is no post operative ptosis or diplopia.[72] Retention of full ocular motility may also be advantageous during surgery by improving surgical access.[73][74][26] Finally topical anaesthesia can increase the time and cost efficiency of surgery because of reduced anaesthetic requirements Sedative drugs are avoided or used minimally to allow retention of patient cooperation. The most appropriate topical agents are lidocaine 4 % and bupivacaine 0.75 %.

TOPICAL ANAESTHESIA WITH 4% INTRA CAMERAL LIGNOCAINE

MSICS can be performed under topical anaesthesia with or without intracameral lignocaine, which makes the surgery patient friendly, without compromising the outcome. Lignocaine 4 % drops were instilled in the conjunctival sac 5 minutes before the surgery. Once fully draped, the eye speculum was inserted and then, 4% lignocaine was generously poured on the exposed ocular surface. After waiting for about one minute, the surgery was started. The entry into the anterior chamber was followed by intracameral injection of diluted 2% lignocaine solution, either commercially available preservative free or regular 2 % lignocaine injection diluted to 0.5 % with Ringers Lactate solution.[75] This concentration is safe for corneal endothelium and provides adequate anaesthesia to uveal tissue for pain free surgery.[76][77] Lignocaine gel has been shown to be an effective[78][79] and possibly, a superior[80][81] substitute to lignocaine drops. This method also shares the same advantages of only topical anaesthesia.

GENERAL ANAESTHESIA

If GA is selected, the chief requirements are akinesia of globe and eyelids and ocular hypotony to protect against extrusion of intraocular contents. Following a smooth induction, in which stimulation from laryngoscopy and tracheal intubation is avoided, a deep level of anaesthesia is maintained until the wound has been closed. A non depolarising muscle relaxant is administered with neuromuscular monitoring to ensure 90 % twitch suppression while the eye is open. For effective reduction of IOP during general anaesthesia, controlled ventilation with end tidal carbon-di-oxide monitoring is used to produce moderate hypocapnea. Intra-operative use of antiemetics reduces the incidence of post-operative nausea and vomiting. When the surgery is completed, spontaneous ventilation is established with the patient still deeply anaesthetized. Coughing initiated by tracheal intubation can be prevented by prior administration of intravenous lidocaine.

Most eye diseases in children are of congenital nature, with a high association of other congenital malformations. A paediatric consultation is recommended as part of the preoperative assessment.

MATERIALS AND METHODS

SOURCE OF DATA

Minimum of 300 patients, attending Out Patient Department, (Department Of Ophthalmology, R.L.JALAPPA HOSPITAL AND RESEARCH CENTRE, TAMAKA, KOLAR) with senile cataract fulfilling the criteria framed will be selected for manual small incision cataract surgery to be done under topical, subtenon's and peribulbar anaesthesia at R.L.JALAPPA HOSPITAL AND RESEARCH CENTRE, TAMAKA, KOLAR attached to SRI DEVARAJ URS MEDICAL COLLEGE between January 2013 and June 2014.

INCLUSION CRITERIA

1. Immature cortical cataract.
2. Posterior subcapsular cataract.
3. Nuclear sclerosis grade I, II, III and IV.

EXCLUSION CRITERIA

Patients with:

1. Age >90 years.
2. Sensitivity to xylocaine.
3. Preference to phacoemulsification.

4. Inability to understand and comply with verbal commands (deafness, dementia, mental retardation and aphasia).

5. Pseudoexfoliation.

6. Previous intraocular injury, inflammation or surgery.

7. Nystagmus.

8. Orthopnea.

9. Extreme anxiety.

10. Irreversible blindness in the contralateral eye.

METHOD OF COLLECTION OF DATA

Minimum of three hundred patients, fulfilling the criteria framed, attending OPD, Department Of Ophthalmology at R.L.JALAPPA HOSPITAL AND RESEARCH CENTRE, TAMAKA, KOLAR were included in the study.

PRE-OPERATIVE EVALUATION

All the patients were admitted one day prior to the surgery. All these patients underwent complete eye examination including a detailed history of any previous ocular disease or surgery, visual acuity recording by Snellen's chart, direct and indirect ophthalmoscopy, detailed slit lamp examination, lacrimal syringing and intraocular tension recording. General physical and systemic examination including blood pressure recording and blood sugar evaluation was done. As

longevity of life is increasing, proper history of cardiovascular diseases, intake of any systemic medications forms an important aspect of pre-operative evaluation.

PRE-OPERATIVE PREPARATION

All patients were put on oral Tab Cotrimoxazole twice daily and Ciprofloxacin 0.3% eye drops hourly one day before the surgery. Preoperatively pupils were dilated using Tropicamide with Phenylephrine 0.5% or 1% drops along with Flurbiprofen 0.03% drops.

Written informed consent was taken from all the patients.

Sensitivity to local anaesthetics was tested with lignocaine and bupivacaine test dose.

The patients were randomly divided into three groups by lottery method as follows:

Group A: Manual small incision cataract surgery done under Topical Anaesthesia (100 cases).

Group B: Manual small incision cataract surgery done under Subtenon's Anaesthesia (100 cases).

Group C: Manual small incision cataract surgery done under Peribulbar Anaesthesia (100 cases).

PROCEDURES

PROCEDURE FOR TOPICAL ANAESTHESIA

The topical group (Group A - 100) had lignocaine 2% jelly instilled in the conjunctival sac 5 minutes prior to surgery.

PROCEDURE FOR SUB TENON'S ANAESTHESIA

The injection was made on a supine patient. The conjunctiva was anaesthetized with topical anaesthetic solution (4% xylocaine). An eye lid speculum was inserted at this point to improve access. Throughout the procedure, patient was asked to look up and outwards to expose the inferonasal quadrant. A small tent of conjunctiva was raised with a pair of non-toothed forceps approximately midway between the limbus of the eye and the visible angle of the inferonasal portion of the conjunctiva. A small incision was made in the tented conjunctiva about 5-7 mm from the limbus with a pair of ophthalmic scissors. The closed scissors were introduced through the aperture created and a tunnel was fashioned through the bare sclera by blunt dissection through tenon's capsule. A curved blunt irrigating cannula (19 G, 25 mm) was then inserted with the syringe of anaesthetic solution (2ml of 2% xylocaine with adrenaline mixed with 1 ml of 0.5% bupivacaine) attached. The cannula was introduced along the contour of the globe and gentle contact of its tip was maintained with the sclera. Occasionally resistance to the needle was felt around the equator where a fibrous band can form as the ocular muscles broach the capsule. This was usually easily overcome by gentle pressure. The cannula was then reintroduced and guided along a path following the contour of the globe until the tip was past the posterior of the equator of the globe. Slow delivery of 2 ml of local anaesthetic was then performed.

FIGURE 8: FORMATION OF TENT AND INCISION OF CONJUNCTIVA

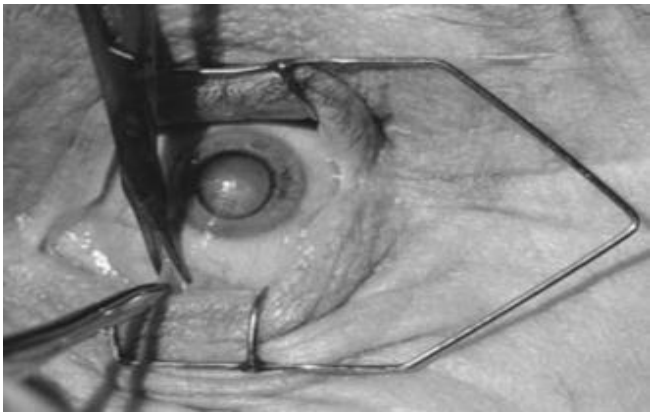


FIGURE 9: INSERTION OF BLUNT CANNULA ATTACHED TO A SYRINGE LOADED WITH LOCAL ANAESTHETIC FOLLOWING DISSECTION OF TENON'S CAPSULE

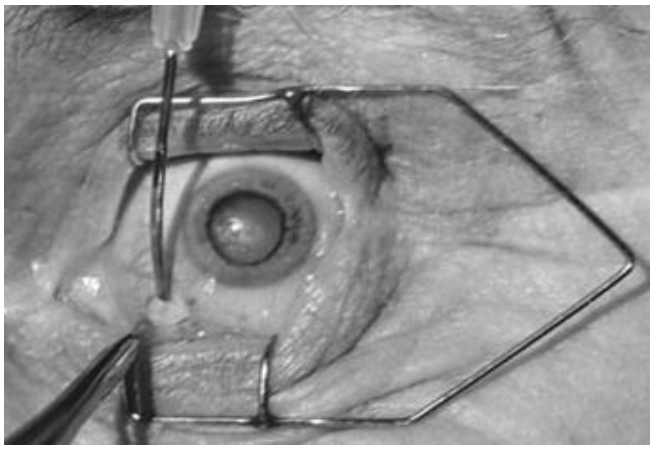
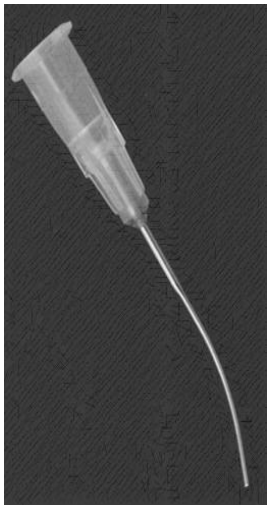


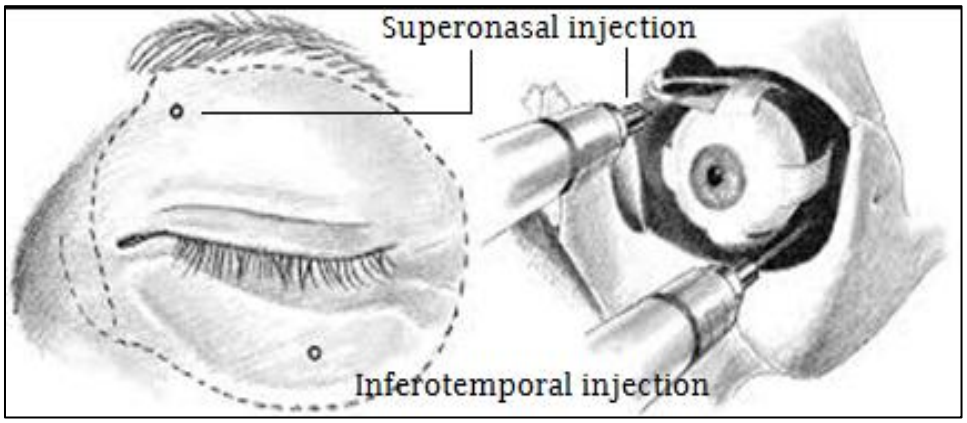
FIGURE 10: VISITEC CURVED SUB-TENON'S CANNULA



PROCEDURE FOR PERIBULBAR ANAESTHESIA

Peribulbar anaesthesia was given by the following method.

FIGURE 11: NEEDLE POSITIONS IN PERIBULBAR ANAESTHESIA



1) Inferotemporal injection

The injection was made on a supine patient. With the globe in primary gaze, initial injection was given at the junction of lateral one-third and medial two-thirds of the inferior orbital margin. The

25 G, 25 mm needle attached to a syringe containing anaesthetic mixture (4ml of 2% xylocaine with adrenaline and 3 ml of 0.5% bupivacaine) was then advanced parallel to the orbital floor and 3ml injected at a depth of about 2.5 cm from the inferior orbital rim. This area contains the neurovascular bundle to the inferior oblique and the belly of the inferior rectus which are potentially at risk for needle perforation.

FIGURE 12: POSITION OF NEEDLE FOR INFEROTEMPORAL INJECTION IN PERIBULBAR ANAESTHESIA

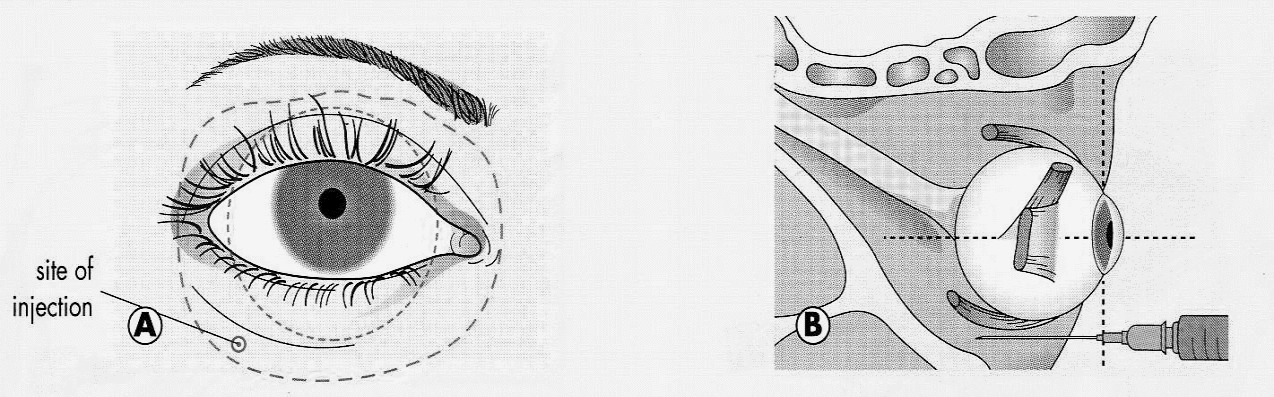


FIGURE 13: INFEROTEMPORAL INJECTION IN PERIBULBAR ANAESTHESIA

2) Superonasal injection

The superior nasal quadrant is less safe to pass the needle (25 G, 25 mm). Its use should be discouraged. The needle can be introduced through the upper eyelid at about 2 mm below and medial to the supraorbital notch or lateral and inferior to the supraorbital notch. It is advanced in a sagittal plane under the roof of the orbit and 3ml of anesthetic solution is injected. The needle hub should just touch the skin; if the skin is indented this can increase the incidence of injury of the important structures located deeply in this orbital quadrant (optic nerve). The use of a 25 G, 15mm needle is also recommended. This should be used only as a supplementary block in order to achieve full akinesia if it is required by the surgeon.

FIGURE 14: SUPERONASAL INJECTION IN PERIBULBAR ANAESTHESIA

OCULAR COMPRESSION

After local anesthetic injection, Honan's ball (an ocular compression device) was applied for 10-20 min. In addition to softening the globe, compression also helps to spread the anesthetic solution posteriorly, decrease conjunctival oedema and promote akinesia. In conditions where impairment of blood flow to the retina and optic nerve can take place such as in glaucoma and

retinal surgery, it has been recommended to maintain ocular perfusion and refrain from using continuous compression. If it is necessary, intermittent digital pressure is applied.

SURGERY TECHNIQUE

All patients underwent Manual Small Incision Cataract Surgery after administration of anaesthesia, which consisted of following steps:

1. Lids retracted with speculum
2. Superior rectus bridle suture taken
3. Fornix based conjunctival flap taken
4. Episcleral tissue separated
5. Light cautery applied
6. Sclero-corneal tunnel made
7. Entry made with keratome
8. Capsulorrhexis performed with 26 G needle
9. Extension of sclero-corneal tunnel done
10. Hydrodissection and hydrodilineation procedure carried out
11. Prolapse of nucleus into anterior chamber

12. Nucleus delivery by sandwich technique

13. Cortical aspiration done by manual simcoe irrigation aspiration cannula

14. Reformation of anterior chamber with viscoelastic substance

15. Placement of posterior chamber intraocular lens

16. Anterior chamber reformed with saline

17. Hemostasis maintained throughout the procedure

18. Subconjunctival injection of antibiotic and steroid given

19. Pad and bandage applied

All cases were operated by two surgeons with good experience and the average time taken for each surgery was 10-15 minnutes.

Effect of anaesthetic drugs (onset and duration), patient's comfort (in terms of pain during anaesthesia, intraoperatively and 6 hours postoperatively) and surgeon's comfort (in terms of lid squeezing and akinesia) were noted and graded. Also intra-operative and post-operative complications were noted.

GRADING OF PAIN

TABLE 1: GRADING OF PAIN (during anaesthesia, intra-operatively and 6 hours post-operatively)

Grade 0	No pain.
Grade 1	No pain, slight sensation
Grade 2	Slight pain
Grade 3	Moderate pain
Grade 4	Intense pain

GRADING OF AKINESIA DURING SURGERY

Akinesia was scored on a scale designed to measure ocular movements in each quadrant.

TABLE 2: GRADING OF EYE MOVEMENTS

Grade 0	No movement
Grade 1	Mild movements
Grade 2	Moderate movements
Grade 3	Severe movements

GRADING OF LID MOVEMENTS DURING SURGERY

TABLE 3: GRADING OF LID MOVEMENTS

Grade 0	Little or no lid squeezing.
Grade 1	Moderate or ill sustained squeezing throughout
Grade 2	Instantaneous and sustained squeezing

Post operatively, 1st day, 1st week and 6th week, the patients were followed up and anaesthetic related post-operative complications were noted in all three groups.

ANALYSIS OF RESULTS

In this study, we compare the efficacy and safety of topical, subtenon's and peribulbar anaesthesia with respect to pain, akinesia, and lid movements; complications like chemosis, subconjunctival haemorrhage, ecchymosis and ptosis in manual small incision cataract surgery.

Descriptive statistical analysis has been carried out in the present study. Significance was assessed at 5% level of significance. Chi-square test has been used to find the significance of study parameters on categorical scale between two or more groups. Statistical analysis was done using SPSS software 17.

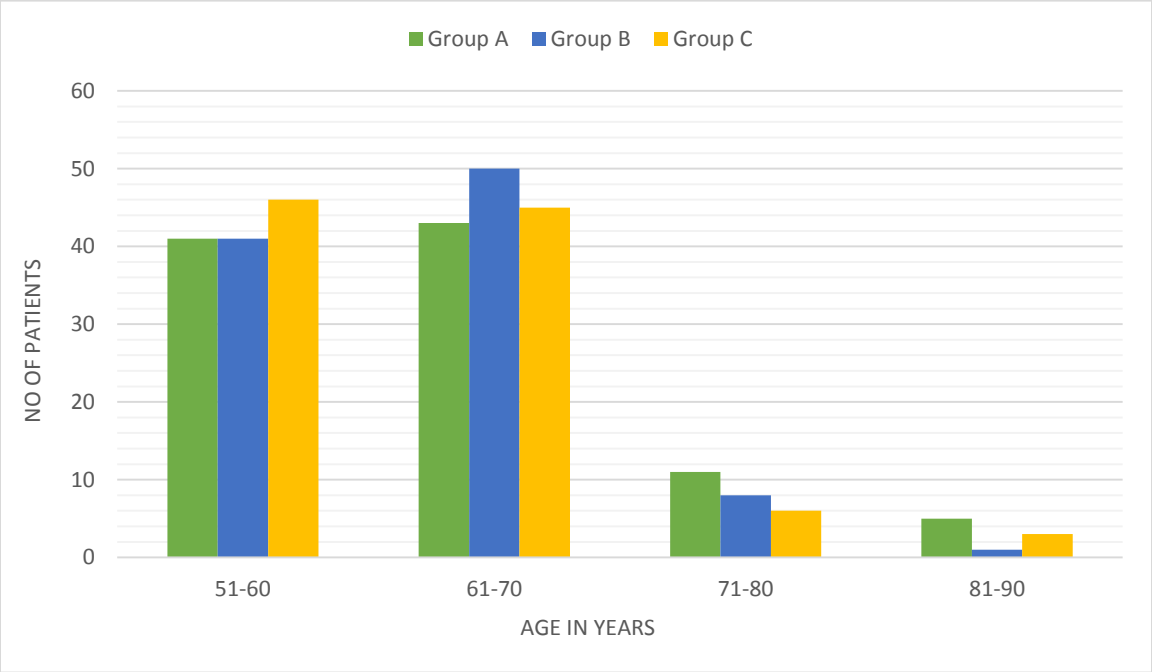
OBSERVATION AND RESULTS

TABLE 4: AGE DISTRIBUTION OF PATIENTS STUDIED

Age in years	Group A		Group B		Group C	
	No	**%**	**No**	**%**	**No**	**%**
51-60	41	41.0	41	41.0	46	46.0
61-70	43	43.0	50	50.0	45	45.0
71-80	11	11.0	8	8.0	6	6.0
81-90	5	5.0	1	1.0	3	3.0
Total	100	100.0	100	100.0	100	100.0
Mean ±SD	64.36±7.68		63.57±6.85		63.88±7.01	

Samples are age matched with **p = 0.526**

CHART 1: BAR CHART SHOWING AGE DISTRIBUTION



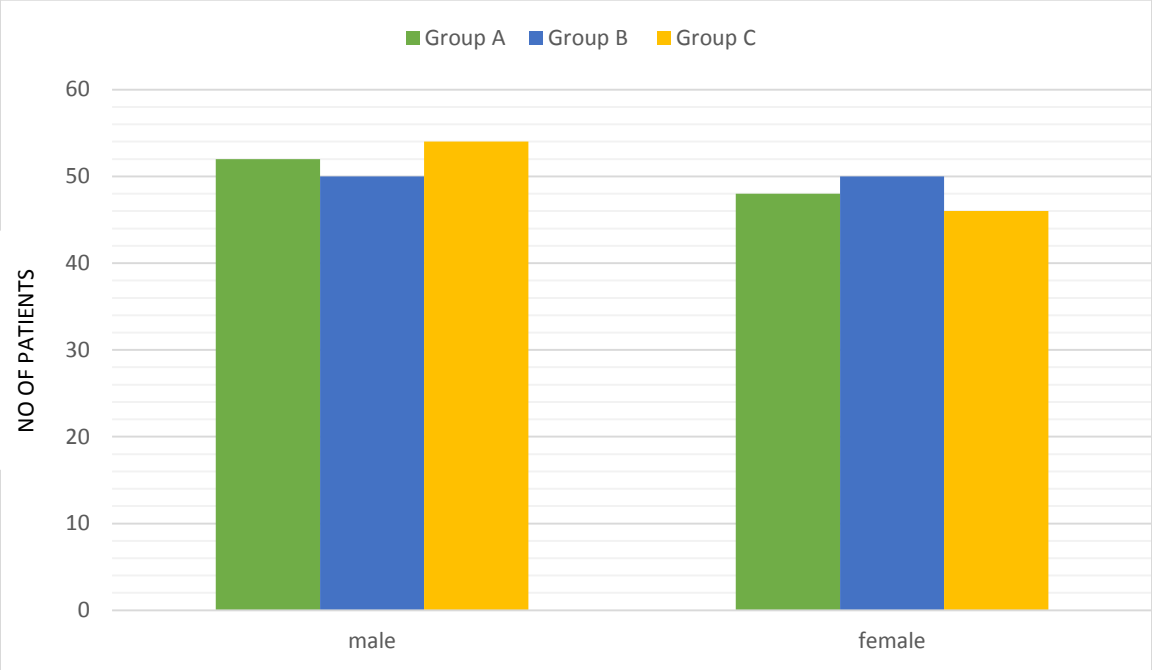
In our study, in topical group (group A), there were a total of 100 patients. Out of these 100 patients, 41 (41%) were aged between 51-60 years, 43 (43%) were aged between 61-70 years, 11(11%) were aged between 71-80 years, and 5 (5%) were aged between 81-90 years. In the subtenon's group (group B), out of total 100 patients, 41 (41%) were aged between 51-60 years, 50 (50%) were aged between 61-70 years, 8 (8%) were aged between 71-80 years and 1 (1%) was aged between 81-90 years. Out of the 100 patients in peribulbar group (group C), 46 (46%) were aged between 51-60 years, 45 (45%) were aged between 61-70 years, 6 (6%) were aged between 71-80 years and 3 (3%) were aged between 81-90 years.

TABLE 5: GENDER DISTRIBUTION OF PATIENTS STUDIED

Gender	Group A		Group B		Group C	
	No	%	No	%	No	%
Male	52	52.0	50	50.0	54	54.0
Female	48	48.0	50	50.0	46	46.0
Total	100	100.0	100	100.0	100	100.0

Samples are gender matched with **p** = **0.852**

CHART 2: BAR CHART SHOWING GENDER DISTRIBUTION



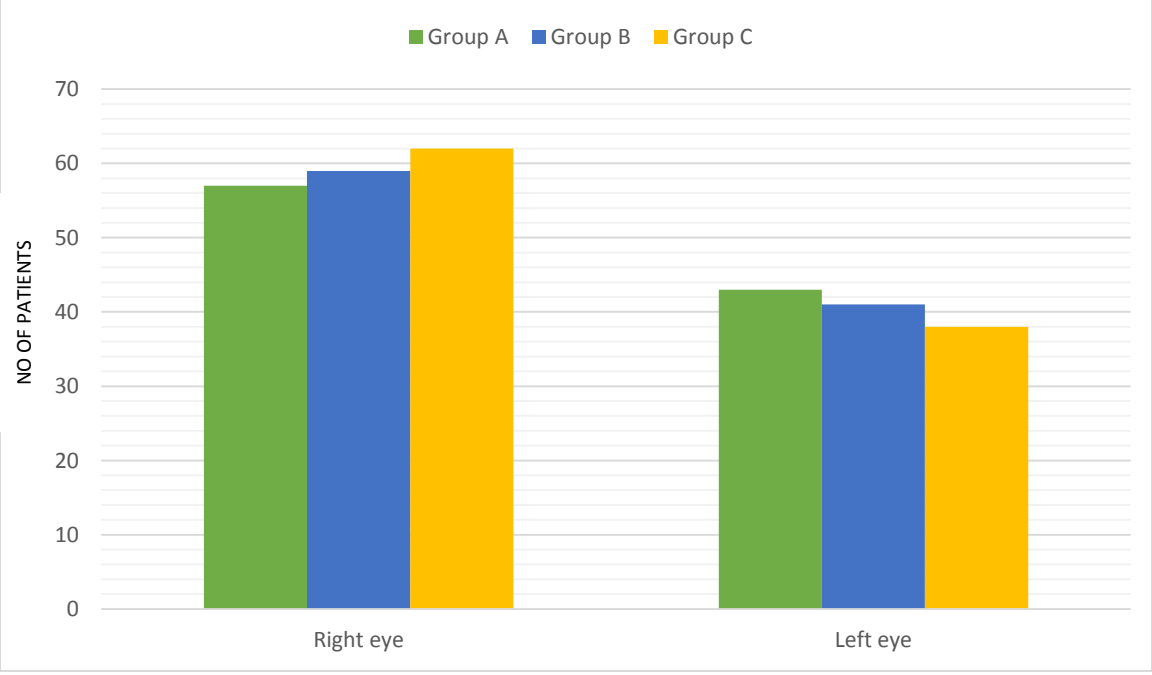
In our study, in group A (topical group), out of total 100 patients, 52 patients (52%) were male and 48 patients (48%) were female. Out of total 100 patients in group B (subtenon's group), 50

patients (50%) were male and 50 patients (50%) were female. In group C (peribulbar group), out of total 100 patients, 54 patients (54%) were male and 46 patients (46%) were female.

TABLE 6: EYE TO BE OPERATED

Eye to be operated	Group A		Group B		Group C	
	No	%	No	%	No	%
Right eye	57	57.0	59	59.0	62	62.0
Left eye	43	43.0	41	41.0	38	38.0
Total	100	100.0	100	100.0	100	100.0

CHART 3: BAR CHART SHOWING LATERALITY OF THE EYE TO BE OPERATED



In Group A (topical) 57 right eyes (57%) were operated and 43 left eyes (43%) were operated. In Group B (subtenon's), 59 right eyes (59%) were operated and 41 left eyes (41%) were operated.

In Group C (peribulbar), 62 right eyes (62%) were operated and 38 leftt eyes (38%) were operated.

TABLE 7: ONSET AND DURATION OF ANAESTHETIC DRUGS

Group A		Group B		Group C	
Onset of action	Duration of action	Onset of action	Duration of action	Onset of action	Duration of action
Instanteneous	10-20 min	3-8 min	20-40 min	10-15 min	45-60 min

In Group A (topical), onset of action of drugs was instantaneous for all the 100 patients and the effect persisted for 10-20 minutes for all the 100 patients. In Group B (subtenon's), onset of action of drugs was 3-8 minutes for all the 100 patients while the effect of the drugs lasted for 20-40 minutes for all the 100 patients. In Group C (peribulbar), onset of action of drugs was 10-15 minutes from the time of administration for all the 100 patients and effect of the anaesthesia lasted for 45-60 minutes for all the 100 patients.

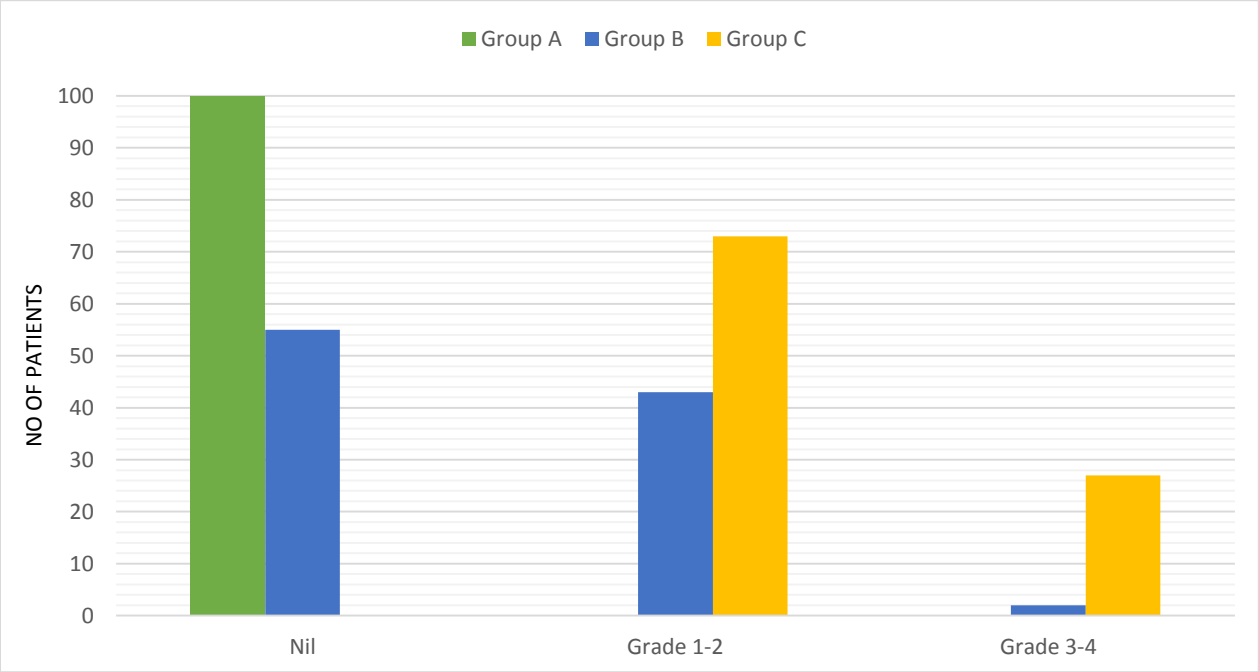
TABLE 8: COMPARISON OF PAIN DURING ANESTHESIA (GRADE) IN THREE GROUPS OF PATIENTS STUDIED

The status of pain (as per grading system) in the 100 subjects during the administration of anaesthesia is given below

Pain during anesthesia (Grade)	**Group A**		**Group B**		**Group C**	
	No	**%**	**No**	**%**	**No**	**%**
Nil	100	100.0	55	55.0	0	0.0
1-2	0	0.0	43	43.0	73	73.0
3-4	0	0.0	2	2.0	27	27.0
Total	100	100.0	100	100.0	100	100.0
Mean ±SD	0.00±0.00		0.57±0.728		2.10±0.89	

Pain during anesthesia is significantly more in Group C (mean = 2.10) compared to Group B (mean = 0.57); is significantly low in Group A (mean = 0.0) with **p = <0.01****

CHART 4: BAR CHART SHOWING COMPARISON OF PAIN DURING ADMINISTRATION OF ANAESTHESIA (GRADE)



In group A (topical), no patients felt any pain during administration of anaesthesia. In group B (subtenon's), 55 patients (55%) did not feel any pain during administration of anaesthesia, 43 patients (43%) felt pain of grade 1-2 and 2 patients (2%) felt pain of grade 3-4. In group C (peribulbar), 73 patients (73%) felt pain of grade 1-2 and 27 patients (27%) felt pain of grade 3-4 during administration of anaesthesia. Pain scores during administration of anaesthesia were found to be significantly high in peribulbar group and significantly low in topical group compared to subtenon's group (**p = <0.01****) with the mean pain scores being 0.0, 0.57 and 2.10 in topical, subtenon's and peribulbar groups respectively.

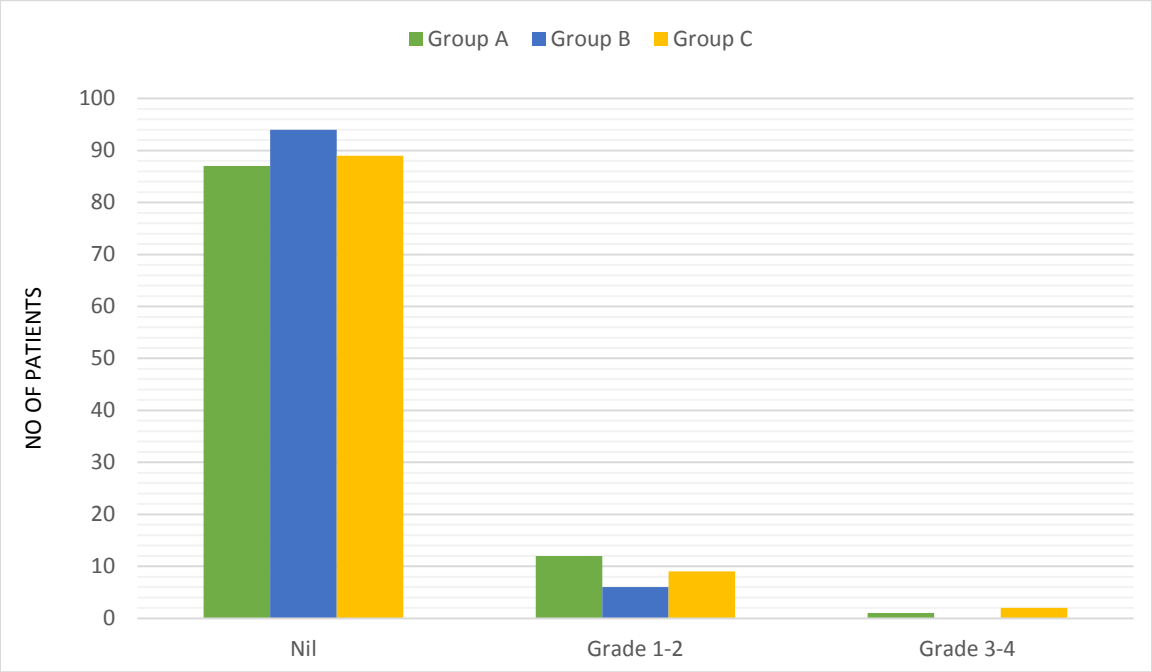
TABLE 9: COMPARISON OF PAIN DURING SURGERY IN THREE GROUPS OF PATIENTS (GRADE)

The status of pain (as per grading system) in the 100 subjects during the surgery is given below

Pain during Surgery	Group A		Group B		Group C	
	No	%	No	%	No	%
Nil	87	87.0	94	94.0	89	89.0
1-2	12	12.0	6	6.0	9	9.0
3-4	1	1.0	0	0.0	2	2.0
Total	100	100.0	100	100.0	100	100.0
Mean ±SD	0.18±0.52		0.08±0.34		0.19±0.59	

Distribution of pain during surgery was comparable in three groups of patients with **p = 0.368**

CHART 5: COMPARISON OF PAIN DURING SURGERY IN THREE GROUPS OF PATIENTS (GRADE)



In group A (topical), 87 patients (87%) did not experience any pain during surgery, while 12 patients (12%) complained of pain of grade 1-2 and 1 patient (1%) experienced pain of grade 3-4. In group B (subtenon's), 94 patients (94%) did not experience any pain during the surgery, 6 patients (6%) experienced pain of grade 1-2 while nobody experienced pain of grade 3-4. In group C (peribulbar), 89 patients (89%) did not feel any pain during surgery, 9 patient (9%) experienced pain of grade 1-2 and 2 patients (2%) experienced pain of grade 3-4. The overall pain scores during surgery were comparable in all the three groups; the mean scores being 0.18, 0.08 and 0.19 in topical, subtenon's and peribulbar groups respectively. There was no statistically significant difference between any of the three groups (**p = 0.368**).

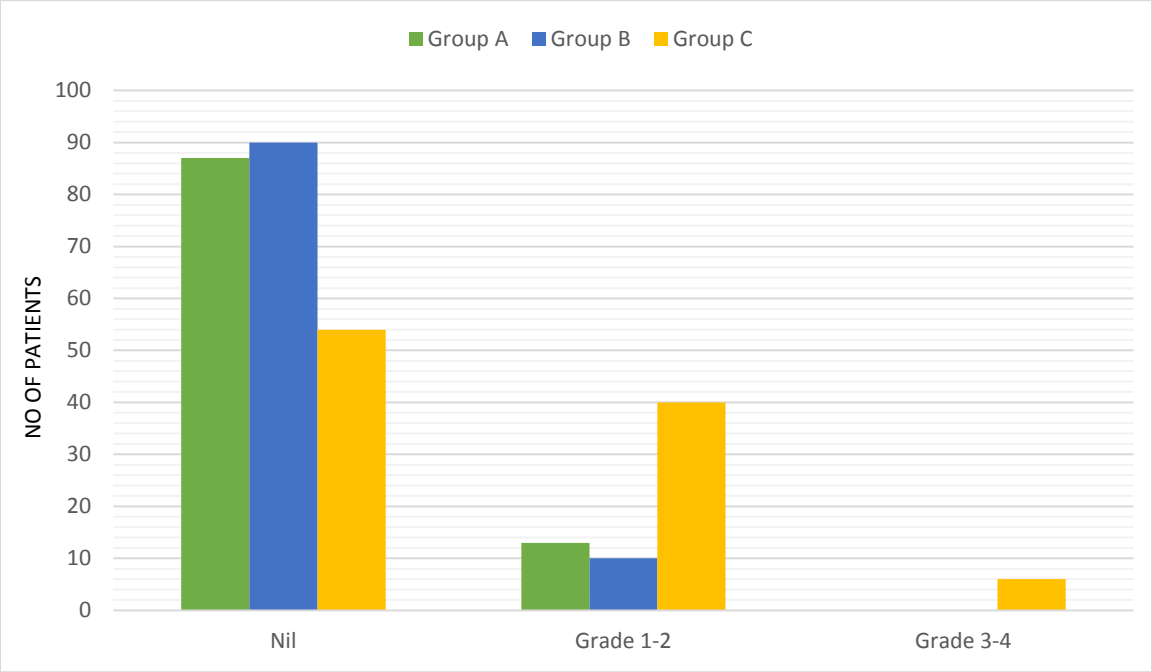
TABLE 10: COMPARISON OF PAIN 6 HOURS AFTER SURGERY (GRADE) IN THREE GROUPS OF PATIENTS

The status of pain (as per grading system) in the 100 subjects 6 hours after surgery is given below

Pain 6 hours after surgery	**Group A**		**Group B**		**Group C**	
	No	**%**	**No**	**%**	**No**	**%**
Nil	87	87.0	90	90.0	54	54.0
1-2	13	13.0	10	10.0	40	40.0
3-4	0	0.0	0	0.0	6	6.0
Total	100	100.0	100	100.0	100	100.0
Mean ±SD	0.17±0.47		0.13±0.42		0.85±1.04	

Pain felt 6 hours after surgery was significantly more in Group C with **p = <0.01****

CHART 6: COMPARISON OF PAIN 6 HOURS AFTER SURGERY (GRADE) IN THREE GROUPS OF PATIENTS



In group A (topical), 87 patients (87%) did not experience any pain 6 hours after surgery, 13 patients (13%) experienced pain of grades 1-2, while no patient experienced pain of grade 3-4. In group B (subtenon's), 90 patients (90%) did not experience any pain 6 hours after surgery, 10 patients (10%) experienced pain of grade 1-2 and no patient experienced pain of grade 3-4. In group C (peribulbar), 54 patients (54%) did not experience any pain 6 hours after surgery, 40 patients (40%) complained of pain of grade 1-2 while 6 patients (6%) complained of pain of grade 3-4. The pain scores 6 hours after surgery were found to be significantly high in peribulbar group **(P<0.01**)** compared to topical and subtenon's group; the mean pain scores being 0.17, 0.13 and 0.85 in topical, subtenon's and peribulbar groups respectively.

TABLE 11: COMPARISON OF AKINESIA (SCORE) IN THREE GROUPS OF PATIENTS

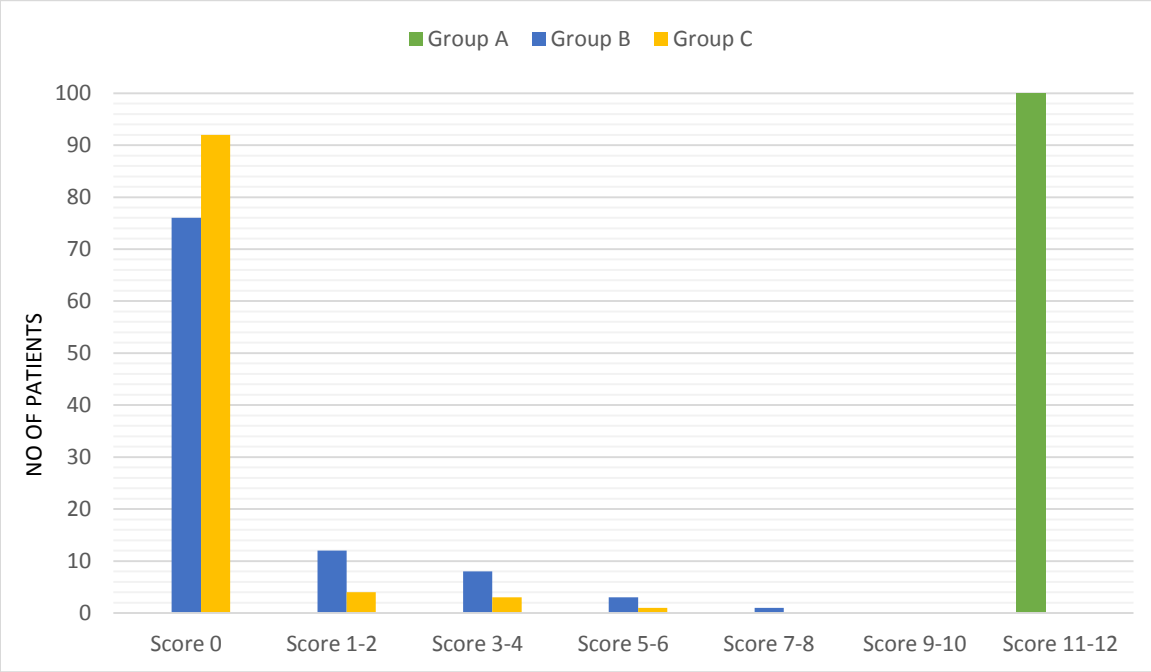
The status of akinesia (as per grading system in each quadrant) in the 100 subjects during the intra-operative period is given below

Eye Movements / Score	Group A		Group B		Group C	
	No	**%**	**No**	**%**	**No**	**%**
0	0	0.0	76	76.0	92	92.0
1-2	0	0.0	12	12.0	4	4.0
3-4	0	0.0	8	8.0	3	3.0
5-6	0	0.0	3	3.0	1	1.0
7-8	0	0.0	1	1.0	0	0.0
9-10	0	0.0	0	0.0	0	0.0
11-12	100	100.0	0	0.0	0	0.0
Total	100	100.0	100	100.0	100	100.0

Presence of eye movements is statistically more in Group A compared to Group B and Group C

(**p = <0.01****)

CHART 7: COMPARISON OF EYE MOVEMENTS IN THREE GROUPS OF PATIENTS (SCORE)



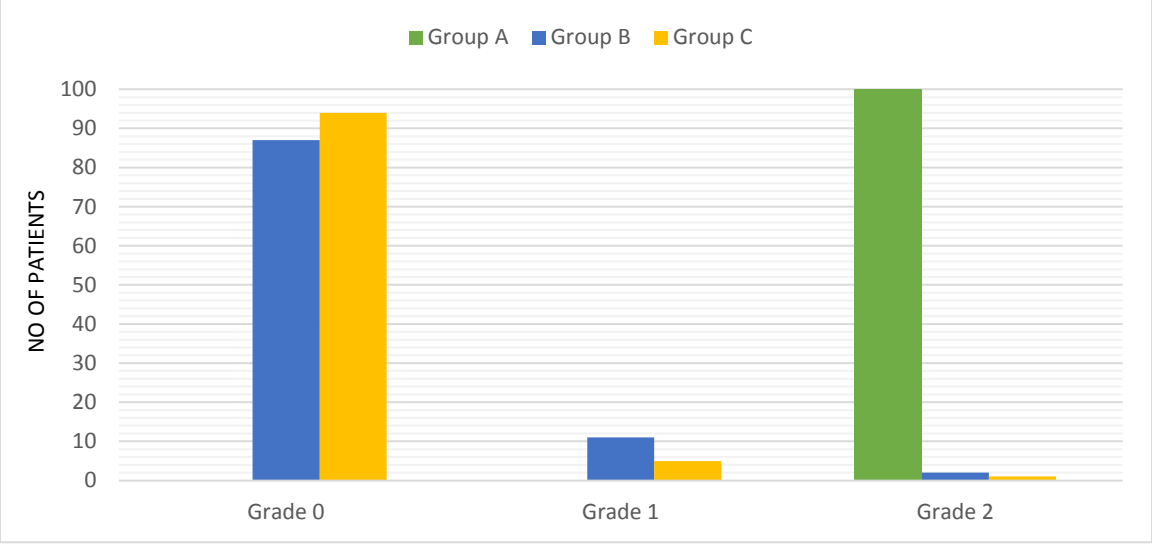
In group A (topical), all the 100 patients had grade 3 eye movements in all 4 quadrants during the surgery. In group B (subtenon's), 77 patients (77%) did not have any eye movements during surgery, 23 patients (23%) had eye movements, of which, 11 patients (11%) had eye movements of score 1-2, 8 patients (8%) had eye movements of score 3-4, 3 patients (3%) had eye movements of score 5-6 and 1 patient (1%) had eye movements of score 7-8. In group C (peribulbar), 92 patients (92%) did not have any eye movements during the surgery, 8 patients (8%) had eye movements, of which, 4 patients (4%) had eye movements of score 1-2, 3 patients (3%) had eye movements of score 3-4 and 1 patient (1%) had eye movements of score 5-6. Presence of eye movements being more in Group A compared to Group B and Group C was statistically significant (**p = <0.01****)

TABLE 12: COMPARISON OF LID MOVEMENTS OF PATIENTS STUDIED

Lid Movements		Group A		Group B		Group C	
		No	%	No	%	No	%
No	Grade 0	0	0.0	87	87.0	94	94.0
Yes	Grade 1	0	0.0	11	11.0	5	5.0
	Grade 2	100	100.0	2	2.0	1	1.0
Total		100	100.0	100	100.0	100	100.0

Presence of lid movement was statistically more in group A compared to Group B and Group C with **p = <0.01****

CHART 8: COMPARISON OF LID MOVEMENTS OF PATIENTS STUDIED



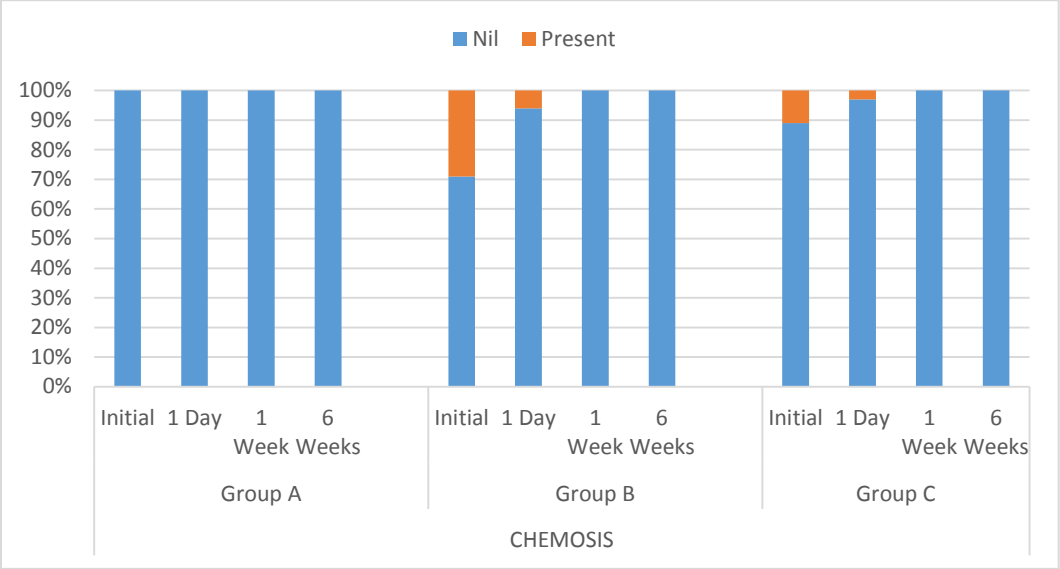
In group A (topical), all the 100 patients (100%) had lid movements of grade 2 during the surgery. In group B (subtenon's), 87 patients (87%) did not have any lid movements during

surgery, 11 patients (11%) had lid movements of grade 1, while 2 patients (2%) had lid movements of grade 2. In group C (peribulbar), 94 patients (94%) did not have lid movements during the surgery, 5 patients (5%) had lid movements of grade 1, while 1 patient (1%) had lid movements of grade 2. Comparing the three groups, squeezing of the lids (**p = <0.01****) was significantly more commonly noted in the topical group.

TABLE 13: AN EVALUATION OF CHEMOSIS IN THREE GROUPS OF PATIENTS STUDIED

Chemosis	Initial	1 day	1 week	6 weeks
Group A				
• Nil	100	100	100	100
• Present	0	0	0	0
Group B				
• Nil	71	94	100	100
• Present	29	6	0	0
Group C				
• Nil	89	97	100	100
• Present	11	3	0	0
P value	**0.00**	**0.01**	-	-

CHART 9: EVALUATION OF CHEMOSIS IN THREE GROUPS OF PATIENTS STUDIED

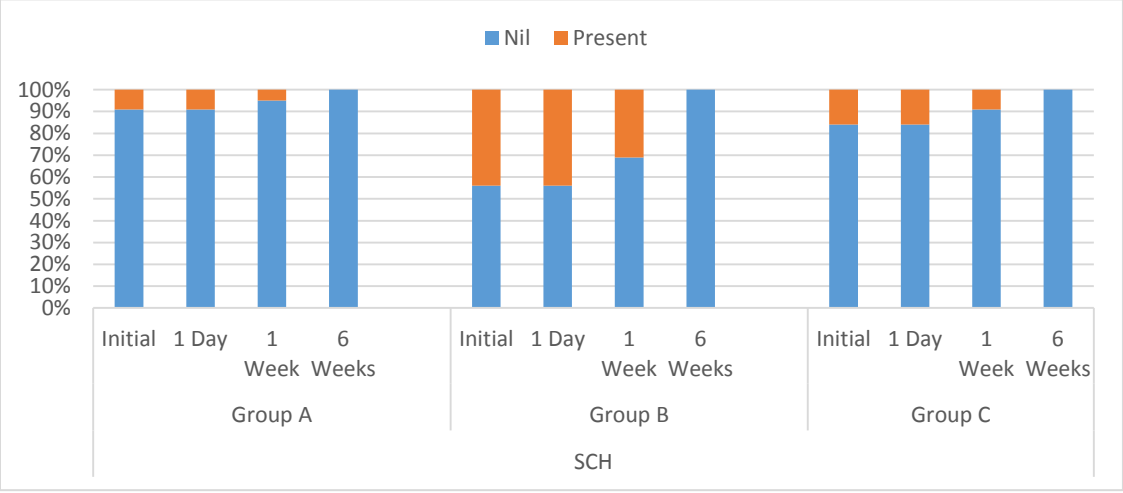


In group A (topical), no patient had chemosis. In group B (subtenon's), 29 patients (29%) developed chemosis following anaesthesia and 71 patients (71%) did not have chemosis. On 1st post operative day, 6 patients (6%) had chemosis and 94 patients (94%) did not have chemosis. By 1 week follow up, no patients had chemosis. In group C (peribulbar), 11patients (11%) developed chemosis following anaesthesia and 89 patients (89%) did not have chemosis. On 1st post operative day, 3 patients (3%) had chemosis and 97 patients (97%) did not have chemosis. By 1 week follow up, no patient had chemosis. Chemosis (**p = <0.01****) was significantly more in subtenon's and peribulbar group compared to topical group.

TABLE 14: AN EVALUATION OF SCH IN THREE GROUPS OF PATIENTS STUDIED

SCH	Initial	1 day	1 week	6 weeks
Group A				
• Nil	91	91	95	100
• Present	9	9	5	0
Group B				
• Nil	56	56	69	100
• Present	44	44	31	0
Group C				
• Nil	84	84	91	100
• Present	16	16	9	0
P value	**0.00**	**0.00**	**0.00**	-

CHART 10: EVALUATION OF SCH IN THREE GROUPS OF PATIENTS STUDIED



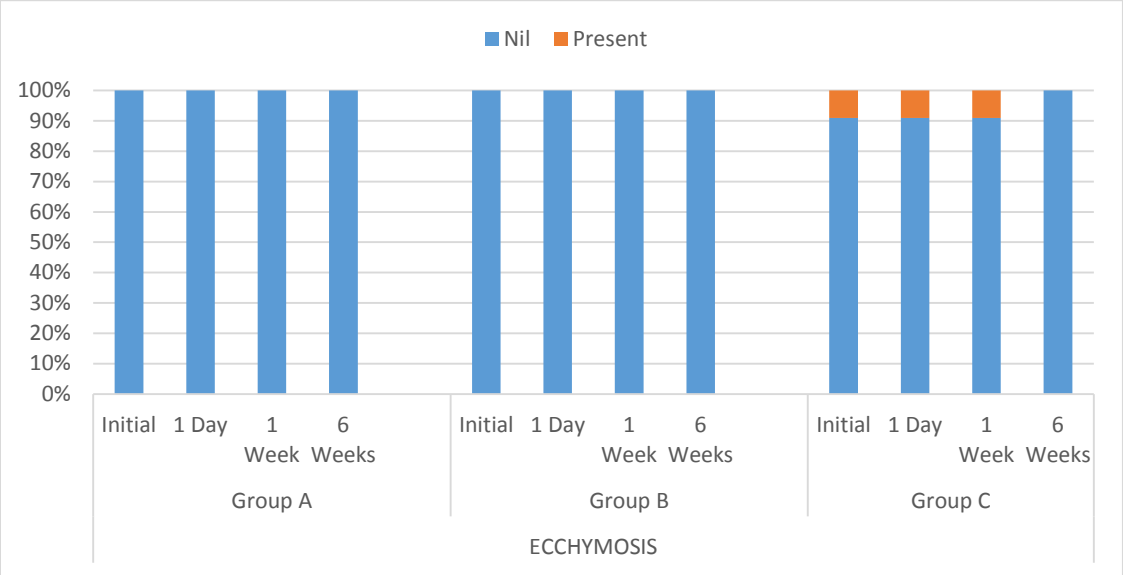
In group A (topical), no patient had SCH following anaesthesia but 9 patients (9%) developed SCH intra-operatively. On 1st post operative day, 9 patients (9%) had SCH while 91 patients (91%) did not have any SCH. On 1st week post operative follow up, 5 patients (5%) had SCH

while 95 patients (95%) did not have SCH. On 6th week post operative follow up, no patients had any SCH. In group B (subtenon's), 44 patients (44%) developed SCH following anaesthesia while 56 patients (56%) did not have any SCH. On 1st post operative day, 44 patients (44%) had SCH and 56 patients (56%) did not have SCH. On 1st week post operative follow up, 31 patients (31%) had SCH while 69 patients (69%) did not have SCH. On 6th week post operative follow up, no patients had any SCH. In group C (peribulbar), 16 patients (16%) developed SCH following anaesthesia while 84 patients (84%) did not have SCH. On 1st post operative day, 16 patients (16%) had SCH and 84 patients (84%) did not have SCH. On 1st week post operative follow up, 9 patients (9%) had SCH and 91 patients (91%) did not have SCH. On 6th week post operative follow up, no patients had any SCH. SCH (**p = <0.01****) was significantly more in subtenon's and peribulbar group compared to topical group.

TABLE 15: AN EVALUATION OF ECCHYMOSIS IN THREE GROUPS OF PATIENTS STUDIED

Ecchymosis	Initial	1 day	1 week	6 weeks
Group A				
• Nil	100	100	100	100
• Present	0	0	0	0
Group B				
• Nil	100	100	100	100
• Present	0	0	0	0
Group C				
• Nil	91	91	91	100
• Present	9	9	9	0
P value	**0.00**	**0.00**	**0.00**	-

CHART 11: EVALUATION OF ECCHYMOSIS IN THREE GROUPS OF PATIENTS STUDIED

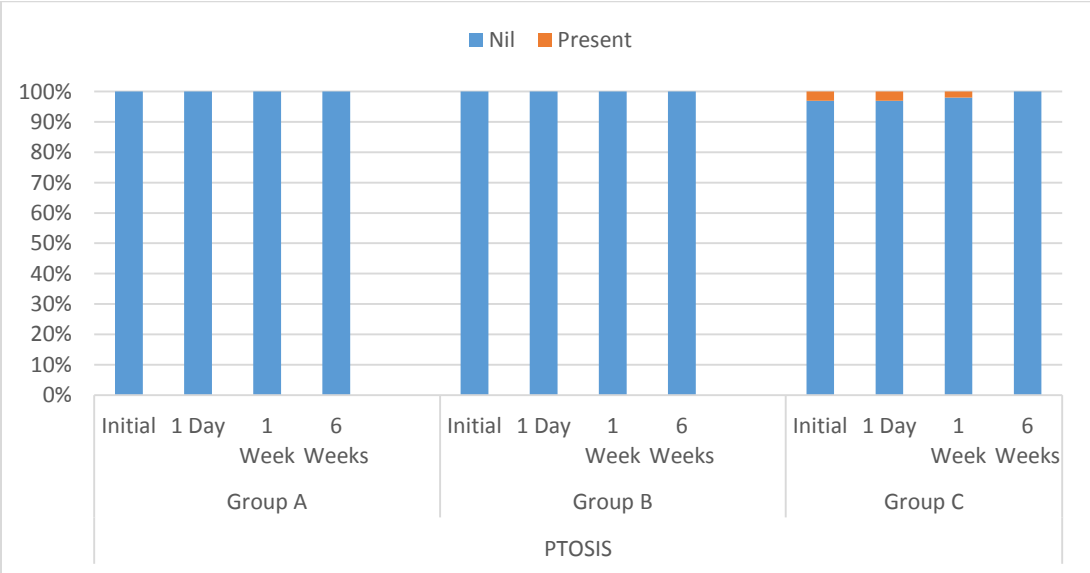


In group A (topical) and group B (subtenon's), no patient had ecchymosis. In group C (peribulbar), 9 patients (9%) developed ecchymosis following anaesthesia while 91 patients (91%) had no ecchymosis. On 1st post operative day, 9 patients (9%) had ecchymosis and 91 patients (91%) did not have ecchymosis. On 1st week post operative follow up, 9 patients (9%) had ecchymosis and 91 patients (91%) had no ecchymosis. On 6th week post operative follow up, no patient had ecchymosis. Ecchymosis (**p = <0.01****) was found to be significantly more in peribulbar group compared to topical and subtenon's group.

TABLE 16: AN EVALUATION OF PTOSIS IN THREE GROUPS OF PATIENTS STUDIED

Ptosis	Initial	1 day	1 week	6 weeks
Group A				
• Nil	100	100	100	100
• Present	0	0	0	0
Group B				
• Nil	100	100	100	100
• Present	0	0	0	0
Group C				
• Nil	97	97	98	100
• Present	3	3	2	0
P value	**0.048**	**0.048**	**0.134**	-

CHART 12: EVALUATION OF PTOSIS IN THREE GROUPS OF PATIENTS STUDIED



In group A (topical) and group B (subtenon's), no patient had ptosis. In group C (peribulbar), 3 patients (3%) developed ptosis following anaesthesia while 97 patients (97%) had no ptosis. On 1st post operative day, 3 patients (3%) had ptosis and 97 patients (97%) did not have ptosis. On 1st week post operative follow up, 2 patients (2%) had ptosis and 98 patients (98%) had no ptosis. On 6th week post operative follow up, no patient had ptosis. Ptosis (**p = <0.05****) was found to be significantly more in peribulbar group compared to topical and subtenon's group.

DISCUSSION

In our study of the 300 patients included, 100 cases were randomly allocated to each of the three groups.

Group A: Manual small incision cataract surgery done under Topical Anaesthesia.

Group B: Manual small incision cataract surgery done under Subtenon's Anaesthesia .

Group C: Manual small incision cataract surgery done under Peribulbar Anaesthesia.

The effectiveness of the block was estimated by evaluating the time of onset, duration of action and the completeness of akinesia and anaesthesia. The complications during the block were recorded to assess the safety of each anaesthetic procedure.

As shown in **Table 4,** in our study, in topical group (group A), there were a total of 100 patients. Out of these 100 patients, 41 (41%) were aged between 51-60 years, 43 (43%) were aged between 61-70 years, 11 (11%) were aged between 71-80 years, and 5 (5%) were aged between 81-90 years. In the subtenon's group (group B), out of total 100 patients, 41 (41%) were aged between 51-60 years, 50 (50%) were aged between 61-70 years, 8 (8%) were aged between 71-80 years and 1 (1%) was aged between 81-90 years. Out of the 100 patients in peribulbar group (group C), 46 (46%) were aged between 51-60 years, 45 (45%) were aged between 61-70 years, 6 (6%) were aged between 71-80 years and 3 (3%) were aged between 81-90 years. Samples were age matched (**p = 0.526**).

As shown in **Table 5,** in our study, in group A (topical group), out of total 100 patients, 52 patients (52%) were male and 48 patients (48%) were female. Out of total 100 patients in group

B (subtenon's group), 50 patients (50%) were male and 50 patients (50%) were female. In group C (peribulbar group), out of total 100 patients, 54 patients (54%) were male and 46 patients (46%) were female. Samples were gender matched (**p = 0.852**).

As shown in **Table 6,** in our study, in Group A (topical group) 57 right eyes (57%) were operated and 43 left eyes (43%) were operated. In Group B (subtenon's group), 59 right eyes (59%) were operated and 41 left eyes (41%) were operated. In Group C (peribulbar group), 62 right eyes (62%) were operated and 38 leftt eyes (38%) were operated.

All patients were assessed for the effect of anaesthetic drugs (onset and duration), patient's comfort (in terms of pain during anaesthesia, intraoperatively and 6 hours postoperatively) and surgeon's comfort (in terms of akinesia and lid movements) and intra operative and post operative complications (in terms of chemosis, SCH, ecchymosis and ptosis).

As shown in **Table 7,** in our study, in Group A, onset of action of drugs was instantaneous for all the 100 patients and the effect persisted for 10-20 minutes for all the 100 patients. In Group B, onset of action of drugs was 3-8 minutes for all the 100 patients while the effect of the drugs lasted for 20-40 minutes for all the 100 patients. In Group C, onset of action of drugs was 10-15 minutes from the time of administration for all 100 patients and effect of the anaesthesia lasted for 45-60 minutes for all the 100 patients.

As topical anaesthesia is a surface anaesthetic procedure which acts by anaesthetizing the nerve endings in the cornea and conjunctiva, its onset is almost instantaneous. Sub-tenon's group had faster onset of action because the anaesthetic solution placed in the sub-tenon's space posteriorly has no barrier other than the thin Tenon's capsule and reaches the muscle cone immediately following the injection. In peribulbar anaesthesia, the solution has to travel from extraconal

space to intraconal space through the orbital fascia and the extraocular muscles, therefore the onset of action is delayed.

As shown in **Table 8,** in our study, in group A (topical), no patients felt any pain during administration of anaesthesia. In group B (subtenon's), 55 patients (55%) did not feel any pain during administration of anaesthesia, 43 patients (43%) felt pain of grade 1-2 and 2 patients (2%) felt pain of grade 3-4. In group C (peribulbar), 73 patients (73%) felt pain of grade 1-2 and 27 patients (27%) felt pain of grade 3-4 during administration of anaesthesia. Pain scores during administration of anaesthesia were found to be significantly high in peribulbar group and significantly low in topical group compared to subtenon's group (**p = <0.01****) with the mean pain scores being 0.0, 0.57 and 2.10 in topical, subtenon's and peribulbar groups respectively.

In a study by **Zafirakis P et al**, 81% of patients who received topical anesthesia and 8% of patients who received sub-Tenon anesthesia reported no pain during delivery of the anesthetic agent. The mean pain score was 0.19 ± 0.39 (SD) in the topical group and 1.35 ± 0.63 in the sub-Tenon group. The difference between groups was statistically significant (P < 0.01**).[82]

Stan J Roman et al in their study reported that administration of subtenon's anaesthesia was painless in 99% of patients of which 55% had no pain and 44% had only sensation.[83]

Stevens J D in his study of 50 cases of sub-tenon's block, reported that 36% of the patients had no pain and 46% of patients felt slight sensation while administering the block.[15]

In the Auckland Hospital study done by **Philip Guise** on 6000 sub-Tenon's blocks, it was noted that 68% of patients found the administration of the block to be painless and 7% reported more than mild discomfort.[84] STB is also more comfortable to perform than peribulbar block.[21]

In a study done by **Tasneem Parkar et al**, among the 88 patients in the peribulbar group, 35.2% of patients had no pain, 53.4% had slight pain and 7.1% had moderate pain during administration of the block whereas among the 80 patients in the sub-tenon's group, 77.5% of patients experienced no pain, 20% had slight pain during administration of anaesthesia.[21]

Friedman et al in his study comparing the pain scores at injection during sub-tenon's and peribulbar anaesthesia observed that sub-tenon's block is less painful.[85]

Briggs M C et al in their study reported that subtenon's anaesthesia administration was slightly less painful than peribulbar anaesthesia administration.[86]

Our results are comparable with other studies. In topical anaesthesia group, as only eye gel was instilled prior to surgery, no patient experienced any pain during administration of anaesthesia. Sub-tenon's anaesthesia is more comfortable to the patient at the time of administration of block as the procedure involves the instillation of topical anaesthetic solution to anaesthetize the conjunctiva before making a nick into it at the pre-injection site and blunt cannula is used to deliver the anaesthetic agent. In peribulbar anaesthesia, a sharp needle is used to prick the skin that is not anaesthetized to deliver the anaesthetic solution which is painful to the patient.

As shown in **Table 9,** in our study, in group A (topical), 87 patients (87%) did not experience any pain during surgery, while 12 patients (12%) complained of pain of grade 1-2 and 1 patient (1%) experienced pain of grade 3-4. In group B (subtenon's), 94 patients (94%) did not experience any pain during the surgery, 6 patients (6%) experienced pain of grade 1-2 while nobody experienced pain of grade 3-4. In group C (peribulbar), 89 patients (89%) did not feel any pain during surgery, 9 patient (9%) experienced pain of grade 1-2 and 2 patients (2%) experienced pain of grade 3-4. The overall pain scores during surgery were comparable in all the

three groups; the mean scores being 0.18, 0.08 and 0.19 in topical, subtenon's and peribulbar groups respectively. There was no statistically significant difference between any of the three groups (**p = 0.368**).

In a study done by **Mithal C and group** employing 2% lignocaine jelly for topical anaesthesia, the mean pain score was 0.82 (SD +/- 0.97). Seventy-one patients (55.4 %) had a pain score of zero, that is, no pain. One hundred and twenty one patients (94.5 %) had a score of 3 or less, that is, mild to none pain.[27]

Zafirakis et al in his study found that 86% of STA patients had no pain or only slight discomfort during surgery compared to only 72% patients in TA group.[82]

Chittenden and his colleagues reported a significantly higher median pain score in the topical group. They concluded that subtenon's anaesthesia produced less pain in patients undergoing cataract surgery.[87]

A study done by **Fukasaku and team** found that 99% of sub-Tenon's patients had complete intraoperative analgesia compared to 83% of retrobulbar and 69% of topical patients.[88]

Roman SJ et al reported that the subtenon's block was very efficient; 97.3% of patients reported no pain during surgery with 87.2% reporting no pain nor sensation and 10.1% only sensation.[83]

Guise PA in his study found that 93% of patients receiving sub-tenon's block had no pain during surgery, but 7% experienced some discomfort from subconjunctival antibiotic at the end of the procedure.[84]

Kollaritis et al found that sub-tenon's block provides a similar degree of intra operative analgesia to retrobulbar and peribulbar blocks.[89]

A study done by **Tasneem Parkar et al.**, found no statistically significant difference in the intra-operative analgesia in peribulbar and sub-tenon's group. Among the total of 168 patients, 88.6% of peribulbar block and 91.3% of sub-tenon's block experienced no pain during surgery and the remaining patients having mild pain in both the groups. Only 2.3% of patients in peribulbar group experiencing severe pain.[21]

Azmon and his colleagues in their study observed that there was no statistically significant difference between peribulbar and subtenon's groups in intraoperative analgesia. There was no need for a supplemental block during surgery in any patient. 43% of patients in the subtenon's group reported no pain and 31% reported mild discomfort during surgery. In the peribulbar group, the results were similar; 47% reported no pain and 28% reported mild discomfort during surgery.[90]

As shown in **Table 10,** in our study, in group A (topical), 87 patients (87%) did not experience any pain 6 hours after surgery, 13 patients (13%) experienced pain of grades 1-2, while no patient experienced pain of grade 3-4. In group B (subtenon's), 90 patients (90%) did not experience any pain 6 hours after surgery, 10 patients (10%) experienced pain of grade 1-2 and no patient experienced pain of grade 3-4. In group C (peribulbar), 54 patients (54%) did not experience any pain 6 hours after surgery, 40 patients (40%) complained of pain of grade 1-2 while 6 patients (6%) complained of pain of grade 3-4. The pain scores 6 hours after surgery were found to be significantly high in peribulbar group **(P<0.01**)** compared to topical and

subtenon's group; the mean pain scores being 0.17, 0.13 and 0.85 in topical, subtenon's and peribulbar groups respectively.

In the study conducted by **Srinivasan S et al**, post operative pain was significantly high (P= 0.0009**) in topical group compared to subtenon's group.[91]

A study done by **Smita Narayan** reported that, 75 patients among the 78 patients in the peribulbar group and 70 patients among the 72 patients in topical group experienced either no pain or only mild sensation 4 hours after surgery. Only 3 patients in the peribulbar group and 2 patients in the subtenon's group experienced pain.[28]

A study done by **Tasneem Parkar et al**, found no significant difference in pain between peribulbar block and sub-tenon's block 4 hours after surgery.[21]

As shown in **Table 11,** in our study, in group A (topical), all the 100 patients had grade 3 eye movements in all 4 quadrants during the surgery. In group B (subtenon's), 77 patients (77%) did not have any eye movements during surgery, 23 patients (23%) had eye movements of which, 11 patients (11%) had eye movements of score 1-2, 8 patients (8%) had eye movements of score 3-4, 3 patients (3%) had eye movements of score 5-6 and 1 patients (1%) had eye movements of score 7-8. In group C (peribulbar), 92 patients (92%) did not have any eye movements during the surgery, 8 patients (8%) had eye movements of which, 4 patients (4%) had eye movements of score 1-2, 3 patients (3%) had eye movements of score 3-4 and 1 patient (1%) had eye movements of score 5-6. Presence of eye movements being more in Group A compared to Group B and Group C was statistically significant (**p = <0.01****).

A study done by **Mithal C and group** found that the surgeon's evaluation of the topical technique in terms of surgical ease and complications was favorable as demonstrated by the fact that patients' cooperation was good in majority of cases (91.6 %). In most of the patients, there were no unwanted eye movements (74 %).[27]

Roman SJ et al in their study found that akinesia was always limited with subtenon's block and no patient reached complete akinesia at the end of surgical procedure and 37.6% had no akinesia at all.[83]

In a study done by **Tasneem Parkar et al**, 64.8% of 88 patients in the peribulbar group had absolute akinesia during surgery as compared to none (0%) out of 80 patients in the sub-tenon's group. In peribulbar group, 64.7% patients had score 0 akinesia, 14.8% had score 2, 17% had score 4, 2.3% had score 6 and 1.2% patients experienced score 8 akinesia. None of the patients had grade 10 and grade 12 akinesia. In the sub-tenon's group, no patient had score 2 akinesia, 10 % had score 4, 8.7% had score 6, 37.5% had score 8, 41.3% had score 10 and 2.5% patients experienced score 12 akinesia.[21]

In the study conducted by **Azmon et al**, subtenon's injection achieved akinesia comparable to that of the peribulbar injection.[90]

Variation in the anatomical barriers, site of injection, its time relative to the surgery and difference in the composition and volume of the anaesthetic solution administered can explain the various reports of akinesia depending on publications.[83]

As shown in **Table 12,** in our study, in group A (topical), all the 100 patients (100%) had lid movements of grade 2 during the surgery. In group B (subtenon's), 87 patients (87%) did not

have any lid movements during surgery, 11 patients (11%) had lid movements of grade 1, while 2 patients (2%) had lid movements of grade 2. In group C (peribulbar), 94 patients (94%) did not have lid movements during the surgery, 5 patients (5%) had lid movements of grade 1, while 1 patient (1%) had lid movements of grade 2. Comparing the three groups, squeezing of the lids (**p = <0.01****) was significantly more commonly noted in the topical group.

Kumar C M reported the mean score of lid akinesia as 1.92 at the end of 25 minutes in the subtenon's group and a mean score of 2 in the peribulbar group. Superior oblique muscle and lid movements may also remain active in a significant number of patients.[92]

The main disadvantage of topical anaesthesia is lack of akinesia and presence of lid movements which can make surgery technically difficult. But with good patient selection, proper counseling and patient cooperation this problem can be avoided. During capsulorrhexis, the patient should be asked to particularly keep the eyes still. The surgeon should avoid touching iris, especially during cortical aspiration and IOL implantation. This can be achieved by having widely dilated pupil. The key to successful cataract surgery with topical anaesthesia is surgeon-patient communication. Patients with hearing or language problems or dementia are poor candidates.[93]

Although ocular movements and squeezing of lids in topical group was significantly high compared to subtenon's and peribulbar group in our study, it was not a problem for experienced surgeons and especially when patient was also co-operative.

COMPLICATIONS OF BLOCK

No serious sight threatening complications were noted in our study in any patient among the three groups.

As shown in **Table 13,** in our study, in group A (topical), no patients had chemosis. In group B (subtenon's), 29 patients (29%) developed chemosis following anaesthesia and 71 patients (71%) did not have chemosis. On 1st post operative day, 6 patients (6%) had chemosis and 94 patients (94%) did not have chemosis. By 1 week follow up, no patients had chemosis. In group C (peribulbar), 11patients (11%) developed chemosis following anaesthesia and 89 patients (89%) did not have chemosis. On 1st post operative day, 3 patients (3%) had chemosis and 97 patients (97%) did not have chemosis. By 1 week follow up, no patient had chemosis. Chemosis (**p = <0.01****) was significantly more in subtenon's and peribulbar group compared to topical group.

A study done by **Stan J Roman et al** reported that, out of 110 patients in subtenon group, 39% had chemosis involving more than 1 quadrant. It takes a little practice to limit chemosis by ensuring that the local anaesthetic solution is truly delivered to posterior subtenon's space and not to anterior subconjunctival space. Chemosis did not interfere in any surgical steps in our study.[83]

Guise P A in his study noted that conjunctival chemosis was found in 5.6% of patients receiving subtenon's block but only in 0.06% of patients, it was considered to interfere significantly with surgery.[84]

In **Tasneem Parkar** et al study, out of 80 patients in subtenon group, 36.25% had chemosis compared to 34% of 88 patients in the peribulbar group. They found no difference in chemosis between both techniques of anaesthesia.[21]

Verghese I and others reported the incidence of chemosis varying from 25 to 60% with a posterior cannula and the incidence increases to 100% with shorter cannulae. This usually resolves after the application of digital pressure, and no intraoperative problems have been reported.[94]

In sub-tenon's block, chemosis occurred due to diffusion of anaesthetic solution anteriorly and improper dissection of the Tenon's capsule.[95] In peribulbar block, chemosis occurred due to anterior spread of the local anaesthetic agent and use of large volume of anaesthetic agent.[96][7]

As shown in **Table 14,** in our study, in group A (topical), no patients had SCH following anaesthesia but 9 patients (9%) developed SCH intra-operatively. On 1st post operative day, 9 patients (9%) had SCH while 91 patients (91%) did not have any SCH. On 1st week post operative follow up, 5 patients (5%) had SCH while 95 patients (95%) did not have SCH. On 6th week post operative follow up, no patients had any SCH. In group B (subtenon's), 44 patients (44%) developed SCH following anaesthesia while 56 patients (56%) did not have any SCH. On 1st post operative day, 44 patients (44%) had SCH and 56 patients (56%) did not have SCH. On 1st week post operative follow up, 31 patients (31%) had SCH while 69 patients (69%) did not have SCH. On 6th week post operative follow up, no patients had any SCH. In group C (peribulbar), 16 patients (16%) developed SCH following anaesthesia while 84 patients (84%) did not have SCH. On 1st post operative day, 16 patients (16%) had SCH and 84 patients (84%) did not have SCH. On 1st week post operative follow up, 9 patients (9%) had SCH and 91

patients (91%) did not have SCH. On 6th week post operative follow up, no patients had any SCH. SCH (**p = <0.01****) was significantly more in subtenon's and peribulbar group compared to topical group.

In the study conducted by **Zafirakis P et al**, complications like chemosis, and conjunctival haemorrhage occurred significantly more frequently in the sub-Tenon than in the topical group ($p < 0.001$**).[82]

In **Stan J Roman et al** group, out of 110 patients, 56% of patients receiving subtenon's block had subconjunctival hemorrhage and the rest 44% had no SCH.[83]

Stevens JD reported an incidence of 32% of SCH extending to more than one quadrant.[15]

In **Tasneem Parkar et al** study, out of 80 subtenon patients, 58.75% had SCH while the remaining 41.25% had no SCH. Out of 88 patients in peribulbar group, 38.64% patients were found to have SCH while the rest 61.36% of patients did not have SCH.[21]

Verghese I and others reported an incidence of sub-conjunctival hemorrhage varying from 20 to 100% and depends on the cannula used. This can be minimized by careful dissection avoiding damage to fine vessels plus the application of cautery and the use of topical phenylephrine.[94]

SCH in topical group occurred due to handling of tissue in an attempt to stabilize the eyeball in patients with excessive unwanted eye movements. SCH in sub-tenon's block is caused by inevitable severing of fine vessels during the conjunctival dissection.[15] SCH occurred in peribulbar group because of injury to fine blood vessels.

As shown in **Table 15,** in our study, In group A (topical) and group B (subtenon's), no patients had ecchymosis. In group C (peribulbar), 9 patients (9%) developed ecchymosis following anaesthesia while 91 patients (91%) had no ecchymosis. On 1st post operative day, 9 patients (9%) had ecchymosis and 91 patients (91%) did not have ecchymosis. On 1st week post operative follow up, 9 patients (9%) had ecchymosis and 91 patients (91%) had no ecchymosis. On 6th week post operative follow up, no patient had ecchymosis. Ecchymosis (**p = <0.01****) was found to be significantly more in peribulbar group compared to topical and subtenon's group.

Kallio and his colleagues conducted a prospective study of 1383 patients undergoing retrobulbar and peribulbar block and found ecchymosis to occur in 4% of patients.[47]

As shown in **Table 16,** in our study, In group A (topical) and group B (subtenon's), no patient had ptosis. In group C (peribulbar), 3 patients (3%) developed ptosis following anaesthesia while 97 patients (97%) had no ptosis. On 1st post operative day, 3 patients (3%) had ptosis and 97 patients (97%) did not have ptosis. On 1st week post operative follow up, 2 patients (2%) had ptosis and 98 patients (98%) had no ptosis. On 6th week post operative follow up, no patient had ptosis. Ptosis (**p = <0.05****) was found to be significantly more in peribulbar group compared to topical and subtenon's group.

CONCLUSION

In our study we found that, onset of anaesthesia was fastest for the topical group and faster in subtenon's compared to peribulbar. Pain during administration of anaesthesia was significantly lower in topical and subtenon's groups while intra operative pain levels were comparable among the three groups. Post-operative pain was significantly low in both topical and subtenon's groups. Topical group patients had full range of movements throughout the surgery whereas akinesia was comparable among the subtenon's and the peribulbar groups. But peribulbar proved better for control of intraoperative lid movements. Complications like chemosis and SCH were significantly more in the subtenon's group. Other complications like ecchymosis and ptosis were significantly more in the peribulbar group. All the three groups were free of sight or life threatening complications.

MSICS is an attractive low cost high volume surgery considered feasible in a country like ours having many people of low socioeconomic status. Both topical and subtenon's anaesthesia are safe and effective compared to the sharp needle technique of peribulbar block. As scleral incision is needed in Manual Small Incision Cataract Surgery and akinesia is a problem with topical anaesthesia, Sub-Tenon's block is preferred over topical anaesthesia.

As onset was faster in the subtenon's group, surgery was started immediately after administration of anaesthesia. Patient comfort was better during administration of the block and post-operative analgesia was excellent, although the intraoperative pain and akinesia was same as that of the peribulbar group. Also the amount of anaesthetic agents used in subtenon anaesthesia is also less, thus proving to be more economical and less time consuming. Chemosis and SCH, markedly noted in this group did not hamper any steps of cataract surgery.

SUMMARY

This was a hospital based prospective study conducted at R.L.Jalappa Hospital and Research Centre, Kolar from January 2013 to June 2014 to evaluate the effect of anaesthetic drugs (onset and duration), pain during administration of anaesthesia, intra operative pain, pain 6 hours after surgery, intra operative akinesia, intra operative lid movements and complications like chemosis, subconjunctival haemorrhage, ecchymosis and ptosis in patients undergoing topical, subtenon's and peribulbar anaesthesia for manual small incision cataract surgery. This study included 300 cases, 100 of whom were randomly picked for topical anaesthesia, 100 for subtenon's anaesthesia and 100 for peribulbar anaesthesia adhering strictly to the inclusion and exclusion criterias framed.

Onset of anaesthesia was fastest for the topical group and faster in subtenon's compared to peribulbar. Pain during administration of anaesthesia and 6 hours post-operatively was significantly lower in topical and subtenon's groups while intra-operative pain levels were comparable among the three groups. Topical group patients had full range of movements throughout the surgery whereas akinesia was comparable among the subtenon's and the peribulbar groups. But peribulbar proved better for control of intraoperative lid movements. Complications like chemosis and SCH were significantly more in the subtenon's group. Other complications like ecchymosis and ptosis were significantly more in the peribulbar group. All the three groups were free of sight or life threatening complications.

According to the observations made in this study, it shows that subtenon's form of anaesthesia is safer than the peribulbar technique giving good analgesia during surgery and more efficient than topical anaesthesia with regards to intraoperative eyeball movements and lid movements.

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ANNEXURE - I

CONSENT TO PARTICIPATE

I, the undersigned, agree to participate in this study and authorize the collection and disclosure of my personal information as outlined in this consent form.

I have read or had read to me and understand the purpose of this study, the procedures that will be used, the risks and benefits associated with my involvement in the study and the confidential nature of the information that will be collected and disclosed during the study.

I have had the opportunity to ask questions regarding the various aspects of this study and my questions have been answered to my satisfaction.

I understand that I remain free to withdraw from this study at any time and this will not change my future care.

Subject's name and signature /thumb impression Date:

Name and signature of parent /guardian Date:

Name and signature of person obtaining consent Date:

ANNEXURE - II

PROFORMA

NAME: **IP NO:**

AGE/SEX: **DOA:**

ADDRESS: **DOS:**

DOD:

CHIEF COMPLAINTS:

H/O PRESENTING ILLNESS:

PAST HISTORY:

FAMILY HISTORY:

PERSONAL HISTORY:

GENERAL PHYSICAL EXAMINATION:

VITALS

PULSE: BLOOD PRESSURE:

RESPIRATORY RATE: TEMPERATURE:

SYSTEMIC EXAMINATION

CARDIOVASCULAR SYSTEM:

RESPIRATORY SYSTEM:

PER ABDOMEN:

CENTRAL NERVOUS SYSTEM:

OCULAR EXAMINATION

HEAD POSTURE:

OCULAR POSTURE:

	RE	LE
EYE LIDS:		
CONJUNCTIVA:		
CORNEA:		
ANTERIOR CHAMBER:		
IRIS:		
PUPIL:		
LENS:		

VISUAL ACUITY:

DISTANT		
PIN HOLE		
NEAR		

OPHTHALMOSCOPY:

1. DIRECT:

2. INDIRECT:

INTRAOCULAR PRESSURE:

LACRIMAL SYRINGING:

DIAGNOSIS:

KERATOMETRY:

Horizontal:

Vertical:

Axial length:

IOL POWER:

LAB INVESTIGATIONS:

BLOOD SUGAR:

URINE SUGAR:

INTRAOPERATIVE NOTES

TYPE OF ANAESTHESIA:

ONSET:

DURATION:

GRADING OF LID MOVEMENTS:

GRADING OF AKINESIA:

GRADING OF PAIN:

DURING ANAESTHESIA:

INTRAOPERATIVE:

6 HOURS POSTOPERATIVE:

ANY INTRA-OPERATIVE COMPLICATIONS:

POSTOPERATIVE MEDICATIONS

POST OPERATIVE FOLLOW UP

COMPLICATIONS:

	1st day	1st week	6th week
Chemosis			
Subconjunctival hemorrhage			
Ecchymosis			
Ptosis			
Globe perforation			

Grading of pain

Pain is graded as No pain (grade 0), No pain but slight sensation (grade 1), slight pain (grade 2), moderate pain (grade 3) and intense pain (grade 4).

Grading of lid movements

Lid movements is graded as Little or no lid squeezing (grade 0), Moderate or ill sustained squeezing throughout (grade 1) and Instantaneous sustained squeezing (grade 2).

Grading of akinesia during surgery

Akinesia is scored on a scale designed to measure ocular movements in each quadrant. No movement (grade 0), Mild movements (grade 1), Moderate movements (grade 2) and Severe movements (grade 3).

ANNEXURE - III

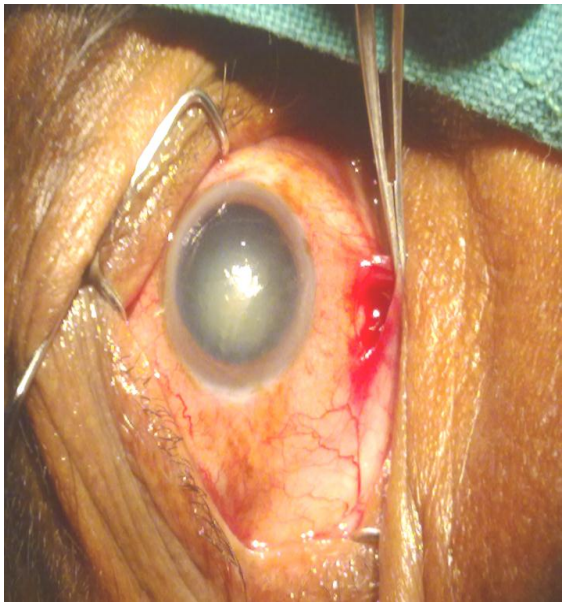
PHOTOGRAPHS

TOPICAL ANAESTHESIA

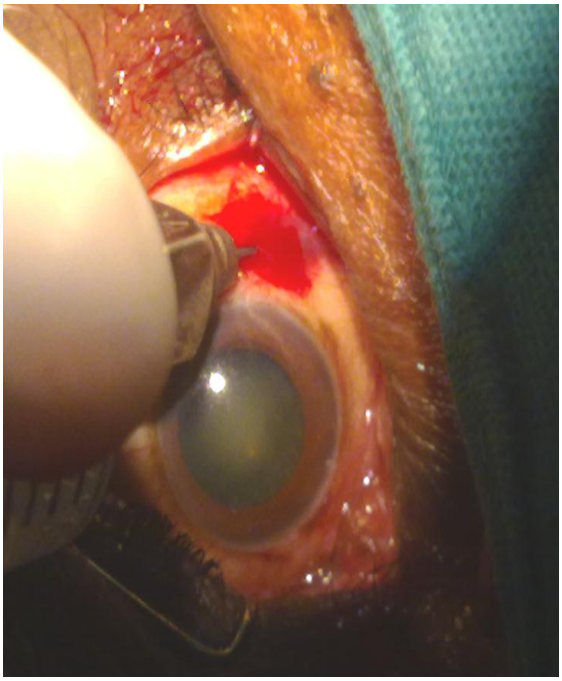
PHOTOGRAPH 1: 2% XYLOCAINE JELLY USED FOR TOPICAL INSTILLATION

SUBTENON'S ANAESTHESIA

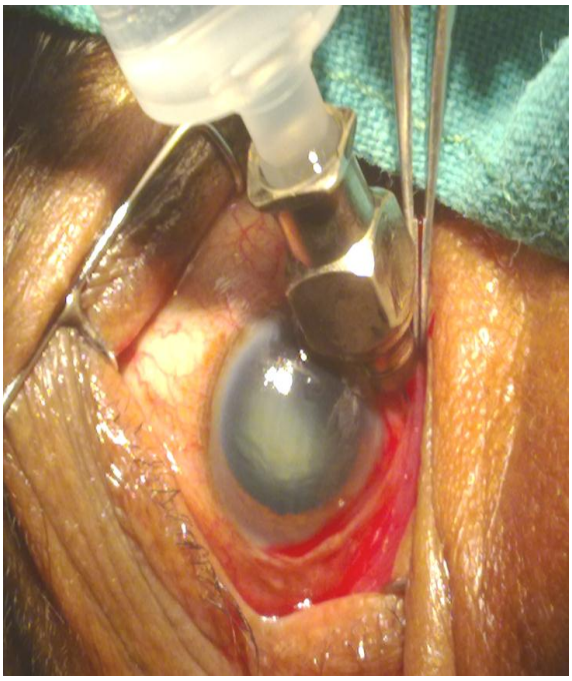
PHOTOGRAPH 2: FORMATION OF TENT AND INCISION OF CONJUNCTIVA



PHOTOGRAPH 3: INTRODUCTION OF CANNULA

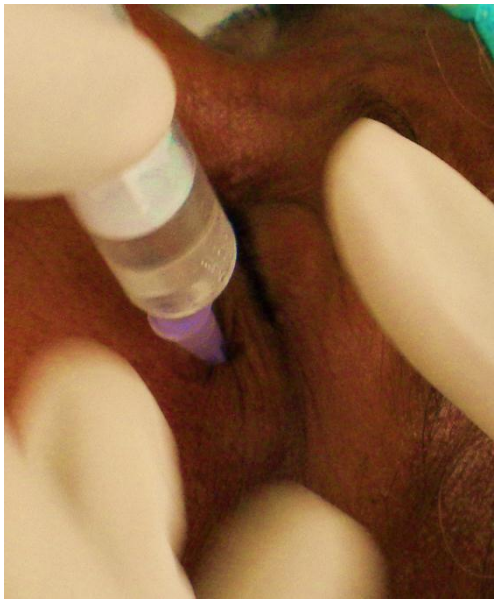


PHOTOGRAPH 4: INJECTING ANAESTHETIC MIXTURE

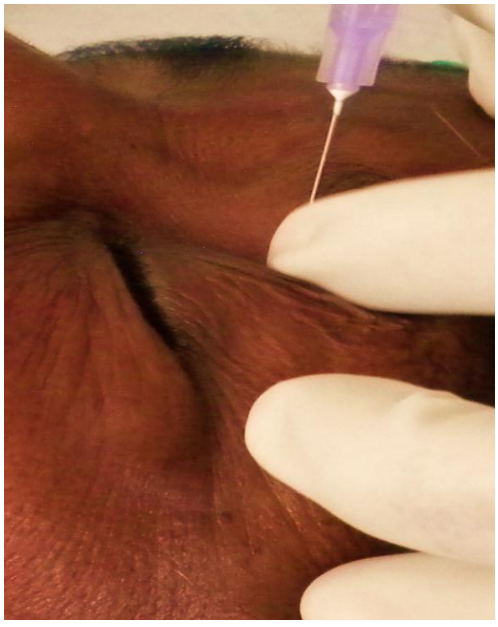


PERIBULBAR ANAESTHESIA

PHOTOGRAPH 5: INFEROTEMPORAL INJECTION



PHOTOGRAPH 6: SUPERONASAL INJECTION



ANNEXURE - IV

KEY TO MASTER CHART

SL. NO.	ABBREVIATION	FULL FORM
1.	SL. NO.	SERIAL NUMBER
2.	IP NO.	INPATIENT NUMBER
3.	M	MALE
4.	F	FEMALE
5.	RE	RIGHT EYE
6.	LE	LEFT EYE
7.	min	MINUTES
8.	SCH	SUB CONJUNCTIVAL HAEMORRHAGE
9.	SIMC	SENILE IMMATURE CATARACT
10.	SMC	SENILE MATURE CATARACT
11.	SHMC	SENILE HYPERMATURE CATARACT
12.	PSC	POSTERIOR SUBCAPSULAR CATARACT
13.	PPC	POSTERIOR POLAR CATARACT
14.	C	CORTICAL CATARACT
15.	PSP	PSEUDOPHAKIA
16.	NS 1	NUCLEAR SCLEROSIS GRADE 1
17.	NS 2	NUCLEAR SCLEROSIS GRADE 2
18.	NS 3	NUCLEAR SCLEROSIS GRADE 3
19.	NS 4	NUCLEAR SCLEROSIS GRADE 4