

# insight

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### **Sankara Nethralaya – The Temple of the Eye.**

It was in 1976 when addressing a group of doctors, His Holiness Sri Jayendra Saraswathi, the Sankaracharya of the Kanchi Kamakoti Peetam spoke of the need to create a hospital with a missionary spirit. His words marked the beginning of a long journey to do God's own work. On the command of His Holiness, **Dr. Sengamedu Srinivasa Badrinath**, along with a group of philanthropists founded a charitable not-for-profit eye hospital.

Sankara Nethralaya today has grown into a super specialty institution for ophthalmic care and receives patients from all over the country and abroad. It has gained international excellence and is acclaimed for its quality care and compassion. The Sankara Nethralaya family today has over 1400 individuals with one vision – to propagate the Nethralaya philosophy; the place of our work is an Alaya and Work will be our worship, which we shall do with sincerity, dedication and utmost love with a missionary spirit.

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# Evolution of Ophthalmic Anaesthesia

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The history of anaesthesia for eye surgery dates back 2,500 years. Sushruta, the ancient Indian surgeon first described couching—the depression of the cataract into the vitreous—around 600 BC.

The inhabitants of Peru knew that chewing on coca leaves caused a numbing of the mucous membrane in the mouth and this led to use of cocaine as a topical anaesthetic. Thus, using cocaine as topical anaesthesia drops the first eye operation was done in 1884, by Carl Koller.<sup>1</sup> In the same year, Herman Knapp used cocaine for retrobulbar injection and performed enucleation. Since that time, various local anaesthetic techniques have been developed and refined, including both akinetic (retrobulbar, peribulbar and sub-tenon's),<sup>2–5</sup> and non-akinetic technique (subconjunctival, deep fornix and topical anaesthesia).<sup>6–8</sup> With the advent of clear corneal phacoemulsification combined with foldable intraocular lenses, in 1992 topical anaesthesia got its resurgence as a safe and easy way achieving ocular anaesthesia.

Topical anaesthesia has its own limitations. Apart from surgical skill, the patient should be cooperative enough for successful completion of eye surgery under topical anaesthesia. For vitreo-retinal and corneal surgeries topical anaesthesia would not be appropriate. A recent study suggests that patients also prefer an akinetic regional ophthalmic block.<sup>9</sup> Hence, akinetic needle technique is still being practiced in ophthalmic anaesthesia. Of late, anaesthesiologists have become increasingly involved in performing these regional orbital blocks.

Most cataract surgery are performed on elderly patients, with correspondingly more systemic co-morbidities, that might put them at increased risk of adverse medical events during and after surgery. Hence, pre-operative identification of medical comorbidity is considered important for determining risk and patient management. The anaesthesiologists help to identify such underlying conditions in them, discuss with the surgeons and the patients the risks/benefit ratio associated with each type of anaesthesia and decide about the safe mode of anaesthesia to be used in them. Anaesthesia for eye surgery has its own implications and these would be better understood by anaesthesiologists practicing ophthalmic anaesthesia.

The role of anaesthesiologists in providing local anaesthesia for intraocular surgery has changed over the past two decades. In 1987, Ophthalmic Anaesthesia Society (OAS) held its first meet in the USA, then in the year 1998 British OAS was formed in the UK. In 2009, Ophthalmic Forum of Indian Society of Anaesthesiologists (OFISA), affiliated to Indian Society of Anaesthesiologists (ISA) was started. It has now more than 250 members registered in it, including both Ophthalmologists and Anaesthesiologists not only from India but all over the globe. The main aim of this forum is to ensure high quality anaesthesia care is provided to patients undergoing cataract and other ophthalmic surgical procedures. The society holds 2-day meetings every 2 years where matters of importance to the field, new research and education are discussed. Apart from these, World Congress of Ophthalmic Anaesthesia (WCOA) which was started in the year 2004 in the UK meets once in 4 years.

The associations and meetings of such kind provide a common platform for anaesthesiologists, ophthalmologists and clinicians practicing ophthalmic anaesthesia to share their experiences to promote a high standard of patient care and to update themselves with the latest development in the field of ophthalmic anaesthesia.

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# Preoperative Orbit–Globe Examination for Regional Anaesthesia

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## Introduction

Local anaesthesia for ophthalmic surgery was first used in 1884 by Austrian ophthalmologist, Karl Koller, when he instilled cocaine into the conjunctival cul de sac.<sup>1</sup> Though now-a-days topical anaesthesia and sub-tenon's block are gaining popularity, still there remains a place for regional anaesthesia. Of these, retrobulbar block is rapidly getting obsolete due to higher incidence of retrobulbar haemorrhage, central retinal artery occlusion, optic nerve injury, globe perforation and intradural injection.<sup>2,3</sup> With the peribulbar block the complications is said to occur with lesser chances but still reported in literatures. These complications are said to occur as the rigid needles have to negotiate a curved globe which is housed in a pyramidal shaped bony space, the orbit. The two shapes are dissimilar and even in health their dimensions can be unpredictable and become more so in disease. The knowledge of spatial relationship of orbit, globe, needle and the injectate have an important bearing on the safety of the orbital blocks.<sup>4</sup> Hence, in this chapter, the author summarizes the information related to anatomy of globe, orbit and their relationship, size and type of the needle to be used for a safe conduct of regional eye blocks in patients with normal and abnormal globe.

## Orbital anatomy

### Orbit

The orbit is a bony pyramid with its apex pointing towards the middle cranial fossa. The orbital rim overhangs the structures within to provide protection. The distance from orbital rim to optic foramen is 42–54 mm in adults. The apex of the orbit is crowded with large number of nerves and vessels, thus increasing chances of injury the those structures should a needle penetrate to that depth.<sup>1</sup>

### Globe

The eyeball is situated in the anterior part of the orbital cavity closer to the roof than the floor and nearer the lateral than the medial wall. The position of the globe in relation to the orbital opening varies in normal individuals and with pathology (e.g. tumours or thyroid disease). Highly myopic eyes may develop staphylomata when the posterior globe is enlarged with thinning of the sclera. Eyes with posterior staphylomata are more susceptible to needle trauma.<sup>1</sup>

### Muscles

The extraocular muscles arise from the orbital apex in the form of the annulus of Zinn. The connective tissue septae connect the recti to form a cone which is deficient posteriorly. The sensory nerves supplying the globe pass within the cone, as do cranial nerves III and VI.<sup>4</sup>

### Nerves

The optic nerve inserts in the medial aspect of the globe and travels medially in the orbit to the optic foramen. In this position, it may be vulnerable to damage from deep medial injections.

The sensory supply of the globe is via the long and short ciliary nerves, which are branches of the nasociliary nerve, itself a branch of the ophthalmic division of the trigeminal nerve. It enters the orbit via the superior orbital fissure and enters the fibrotendinous ring. The motor supply of the extraocular muscles is via the oculomotor (III), trochlear (IV) and abducens (VI) nerves.<sup>4</sup>

### Blood vessels

The structures within the orbit receive their blood supply from the ophthalmic artery, which enters the orbit via the optic canal within the dural sheath of the optic nerve. The central artery of the retina is one of the smallest branches and runs within the dural sheath of the optic nerve.

Venous drainage of the orbital structures is via the superior and inferior ophthalmic veins. The superior ophthalmic vein passes through the superior orbital fissure and drains into the facial vein. The inferior ophthalmic vein passes through the inferior orbital fissure and connects with either the superior orbital vein or the cavernous sinus.

The blood vessels congregate at the orbital apex. The infero-temporal and medial parts of the orbits are relatively avascular while the superonasal part is vascular.<sup>4</sup>

### Orbit Vs Globe

The volume of an average orbit is 30 ml and that of the average globe is ~7 ml. This volume may differ depending on the size of the globe and in large myopic eyes it can be as much as 20 ml. The growth of the orbit levels off after puberty while the globe may continue to grow. This makes internal spaces rather limited. The axes of globe and that of orbit do not correspond with each other.

Normally, the equator of the globe is at or slightly anterior to the lateral orbital rim and the spatial relationship between them is assessed by measuring the distance the globe (top of the cornea) extends over the infraorbital rim and this distance is generally about 8 mm.<sup>5</sup>

### Forward set globe

The globe extends quite forwardly over the infra-orbital rim (>8 mm) and associated eye lids will be lax with wide palpebral fissure and high brows. Here, the structures in the apex of the orbit are vulnerable to get injured with needle blocks.

### Deep set globe

Enophthalmic globes are deep set. The arching bony ridges of orbital opening make the insertion of needle for akinetic blocks difficult. In this condition, there is high chance for the needle to come in contact with the globe. Associated eyelids will be short and tight. From the point of insertion, at the inferolateral quadrant, the needle must not be angulated more than 10° elevation from the transverse plane.

## Preoperative examination and considerations

### Medical assessment

Although a full clinical examination is not necessary, an assessment of general health with evaluation of concurrent medical conditions should be done. In addition, patient characteristics such as claustrophobia, panic attacks, lumbar spine problems and obesity (can affect positioning), and communication problems should be looked for prior to surgery.<sup>6</sup>

### Ocular examination

*Importance of previous eye surgery:* Elements of ophthalmic evaluation which are important for a regional block should begin with appropriate history from the patients. Patients having undergone previous vitreoretinal surgeries like encircling sclera bands may alter the anatomy of the globe sufficiently to create an hour glass shape thus increasing the risk of the inadvertent needle puncture. In addition, scleral explants may also cause physical obstruction to the needle advancement and prevent adequate spread of the local anaesthetic due to local scarring.

Patients with history of surgery for choroidal melanoma may have very thin sclera coats and comprise a contraindication for peribulbar blocks.

### Check for gaze

Patients with nystagmus or a restrictive squint with the eye fixed in a particular gaze make needle placement difficult during peribulbar blocks.

### Check for axial length of the eye

Axially long myopic globe grows not only in length but also in height. The width however does not increase as much. The globe therefore tends to encroach more onto the superior and the posterior orbital spaces. The increase in axial length is usually accompanied by stretching and thinning of sclera which in turn leads to out-pouching (staphyloma) of the entire globe wall. The incidence of staphyloma increases from ~15% of eyes with an axial length 27–29 mm to ~60% with an axial length >31 mm. The staphylomas occur at the posterior pole or posteroinferior aspect of the globe. Block techniques employing the lateral, inferolateral or superior approaches are therefore dangerous. A careful single medial extraconal approach is considered to be safer as there are no staphylomas at the medial aspect.<sup>7</sup> The axial length and the presence and location of staphyloma can be known from B-scan echography, which is usually done, before cataract surgery, for diopter power calculation.

The other things to look into during examination are congenital abnormalities such as buphthalmos where the eye is very large and fragile. Thyroid orbitopathy is another common situation where anatomy of the globe, the extraocular muscles and supporting orbital structures is distorted. Even small volumes of local anaesthetics in these patients may cause subluxation of the globe. Presence of space occupying lesions of globe or other orbital structures are also cause for concern. External abnormal features such as obscure medial canthus, blepharospasm and pterygium may also make safe needle passage difficult.

Other possible relative contraindications to needle blocks would include one-eyed patients as well as patients with high intraocular pressures, where there is a possibility to further increase intraocular pressure due to volume of local anaesthetic injected.<sup>6</sup>

## Orbital and adnexal examination

Patients with a narrow palpebral fissure or an epicanthal skin fold covering the medial canthus (when planning a medial peribulbar block) will make needle placement difficult.

The space between the orbit and the globe in the inferotemporal quadrant may be assessed by placing a finger between the two at the desired site of needle entry (finger index). If the space is inadequate, peribulbar block may be difficult and an alternative means of anaesthesia may be considered.

Patients with enophthalmos are more susceptible to globe trauma by needle, when blocking from an inferotemporal approach.<sup>6</sup>

In patients with shallow orbits, there is a greater chance of penetration of the globe or the

optic nerve sheath and as such, 3.5 cm needles should be avoided in such cases.<sup>8</sup>

In patients having proptosis with an anterior displacement of the globe, injection of local anaesthetic is expected to have a higher risk of complications due to an existing high intraorbital pressure (Figure 1). Clarke and Kozeis<sup>9</sup> have reported a case of globe luxation in a patient of thyroid orbitopathy following peribulbar block. Hence, in such cases general anaesthesia may be a better modality (Figure 2).

Patients with narrow palpebral fissures and enophthalmic eyes may also pose a difficulty to transconjunctival peribulbar blocks and a transcutaneous route may be planned in such cases (Figure 3).<sup>8</sup>

### Considerations of injection technique

#### Needle length and size

Traditionally 3.8 cm needles were used for needle blocks. However, they have been shown to have a high risk of impaling the optic nerve. Shorter 2.5 cm needles are recommended now for peribulbar blocks although several authors have reported using 2.0 as well as 1.5 cm needles successfully with a low complication rate.

Recommended needle size is 25 G or less with some authors using 30 G as well.<sup>8</sup>

#### Sharp Vs blunt tipped needle

Traditional teaching favoured blunt tipped needle with the supposed advantages that the intraocular structures like blood vessels and nerves are pushed aside rather than traumatized and tissue planes like piercing a septae can be appreciated with it. Blunt tipped, as opposed to steep bevel cutting needles, have been shown to require more force to penetrate the globe, but translation of this into a reduction in globe perforation has not been demonstrated.<sup>10</sup> The sharp narrow-gauge needles (25–31 gauges) reduce the discomfort on insertion<sup>10</sup> at the expense of a reduced tactile feedback with a theoretically higher risk of failing to recognize a globe perforation.

#### Placement of needle

The classic site of insertion of needle at the junction of lateral one-thirds and medial two-thirds along the inferior orbital rim is no more recommended. The reasons cited are: the needle being nearer to the globe, inferior rectus muscle and also closer to the neurovascular bundle supplying the inferior oblique. Several cases of diplopia owing to iatrogenic needle injury to inferior rectus and oblique muscles following needle entering at this site have been reported in literature.<sup>11,12</sup>

In the modern peribulbar block, 23 G, 25 mm long needle, with bevel facing the globe, is inserted through the skin in the inferotemporal quadrant as far laterally as possible, just above



**Figure 1:** Patient with proptosis of the left eye showing anteriorly displaced left globe relative to right.



**Figure 2:** Patient of thyroid related orbitopathy showing bilateral proptosis and soft tissue signs.



**Figure 3:** Patient with bilateral enophthalmos with resultant deep set eyes.

the junction of inferior and lateral orbital walls. At this extreme corner, it is easier to stay far away from the globe and would prevent any needle injury to the inferior rectus muscle or its neurovascular bundle.

Medial peribulbar block is usually performed to supplement inferotemporal peribulbar injection, particularly when akinesia is not adequate. A 25G or 26G needle is inserted in the blind pit between the caruncle and the medial canthus to a depth of 1.5–2.0 cm.<sup>8</sup>

#### Volume of local anaesthetic agent

Between 5 and 10 ml of local anaesthetic agent is required for prebulbar blocks with a short needle

as described. When supplementing with a medial peribulbar block, no more than 3–5 ml should be injected.<sup>8</sup>

#### Transcutaneous Vs transconjunctival route

Transconjunctival route is preferable since the conjunctival cul de sac can be anaesthetized by topical anaesthetic agents prior to injection and it also avoids bruising of the skin, seen at times with transcutaneous injection.<sup>8</sup> However, as mentioned above Transcutaneous route should be used in patients with deep set eyes or short palpebral fissures.

#### Summary

The various regional anaesthesia techniques available are generally safe but although rare, serious sight- and life-threatening complications have reported to occur. Currently, there is no absolutely safe ophthalmic regional block. The choice of the technique of block must be based on the orbit and globe relationship, which varies from one individual to another. Hence, it is very important for an ophthalmic care provider to have a thorough knowledge about these before administration of block in the eye.

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# Local Anaesthetics and Adjuvants

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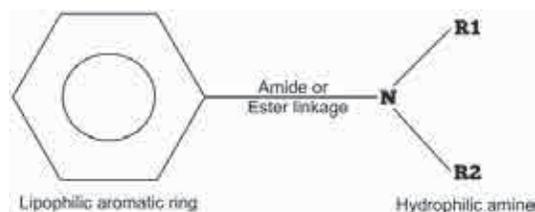
## Introduction

The development of 'Procaine' and the introduction of 'Retrolubar' injection by Atkinson<sup>1</sup> are the two most important events that brought a new life to the field of ophthalmic local anaesthesia. Local anaesthetic (LA) agents and injection methods have since been refined and LA techniques are increasingly popular for ophthalmic surgery. Despite improvements, still potential local and systemic complications<sup>2-4</sup> have been reported following these procedures. To reduce such risks, it is very important for an ophthalmic care provider to have a thorough understanding of the chemistry of various LA agents, their mechanism of action, indications for use, contraindications and last but not the least the adverse effects reported to occur following their usage. In this chapter, the above issues will be dealt in detail.

## Basic chemical structure of LA molecule

It consists of mainly three parts

- 1 *Lipophilic aromatic group*, usually an unsaturated benzene ring.
- 2 *Hydrophilic group*: a tertiary or quaternary amine derivative with proton acceptor
- 3 *Intermediate bond*: a hydrocarbon connecting chain, either an ester (-CO-) or amide (-HNC-) linkage. The intermediate bond determines the classification of LA into two main groups: ester and amide.



ESTERS	AMIDES
Benzocaine	Bupivacaine
Chloroprocaine	Lignocaine
Cocaine	Articaine
Proparacaine	Dibucaine
Tetracaine	Mepivacaine
	Prilocaine
	Ropivacaine

Unlike the ester group of drugs all amide LAs contain 'i' in their generic name before the '-caine'.

Esters are relatively unstable in solution and are rapidly hydrolysed in the body by plasma cholinesterase. One of the main breakdown products is para-amino benzoate (PABA) which is responsible for allergic and hypersensitivity reactions that has been reported with this group of drugs.<sup>5</sup> In contrast, amides are relatively stable in solution, are slowly metabolized by hepatic amidases and hypersensitivity reactions to amide LAs are extremely rare. In current clinical practices, ester group have largely been superseded by amide group of LA agents.

## LAs as isomers

LAs may also be considered in terms of their stereoisomerism. This term describes the existence of molecules with the same molecular and structural formula, but different spatial orientation around a particular atom, the chiral centre. This is like the right and left foot being mirror images of each other. Stereoisomerism occurs in the case of bupivacaine which has two stereoisomers, known as R and S forms, and also in the case of prilocaine. The combination of equal amounts of the two stereoisomers of a particular drug is known as a racemic mixture.

## Why might this isomerism be important?

The different arrangements of the R and S forms of bupivacaine are thought to be associated with differences in potency and side-effect profile. This is easy to understand if you were to try and put your right foot in your left shoe—it does not work as well and causes side-effects (pain)! This is the reason why more drugs are being prepared as a single stereoisomer such as levobupivacaine. In contrast, amethocaine (an ester) and lidocaine are achiral, i.e. they have no stereoisomers.

## Physiologic activity of LAs are functions of the following:

- Lipid solubility
- Diffusibility
- Affinity for protein binding
- Per cent ionization at physiological pH
- Vasodilating properties.

**Lipid solubility**

Potency is directly related to lipid solubility, because 90% of the nerve cell membrane comprises lipid. Increased lipid solubility leads to faster nerve penetration and blockade of sodium channels.

**Diffusibility**

Diffusibility of the LA through tissue other than nerve tissue also influences the speed of onset of action.

**Protein binding**

Protein binding is related to the duration of action. The more firmly the LA binds to the protein of the sodium channel, the longer the duration of action.

**Percent ionization at physiological pH**

LAs are weak bases and contain a higher ratio of ionized (cationic) water soluble form compared with non-ionized, un-charged lipid soluble form. The measurement pKa expresses the relationship between the non-ionized and ionized concentrations. *Specifically, pKa is the pH at which the ionized and non-ionized forms of the local anaesthetic are equal.* It is only the non-ionized form of the drug that diffuses across the lipid membrane of the nerve to produce the conduction block. Hence, increased concentration of non-ionized form will speed up the onset of action. In general, LAs with pKa values approximating to physiological pH (7.4) have a higher concentration of non-ionized base form resulting in a faster onset. On the other hand, LA with a pKa value far from physiological pH will have more ionized form slowing the onset time of action. This explains the fact that lignocaine has a faster onset of action compared with bupivacaine as their pKa values are 7.8 and 8.1, respectively.

Inside the cell, the non-ionized and ionized forms equilibrate. The ionized form of the LA binds with the sodium channel. Once 'bound' to the sodium channel, impulses are not propagated along the nerve.

Alternatively, adding sodium bicarbonate to commercial preparations of LA solution increase the amount of non-ionized form which will hasten the onset.

*One millilitre of 8.4% sodium bicarbonate should be added to each 10 ml of lignocaine or mepivacaine and 0.1 ml of 8.4% of sodium bicarbonate should be added to each 10 ml of bupivacaine.*<sup>6</sup>

Increasing the volume of sodium bicarbonate, as mentioned above, may lead to precipitation. In peribulbar anaesthesia, addition of sodium bicarbonate to LA solution is known to improve the quality of the block and also decreases the pain associated with injection.<sup>6,7</sup>

**Vasodilating properties**

All LAs, with the exception of cocaine, are vasodilators. Vasodilatation occurs via direct relaxation of peripheral arteriolar smooth muscle fibres. Greater vasodilator activity of an LA leads to faster absorption and, thus, shorter duration of action.

LA	Lipid solubility	pKa	Protein binding	Speed of onset	Duration of action
Lignocaine	2.9	7.7	65	Rapid	Medium
Bupivacaine	8.2	8.1	96	Slow	Long
Ropivacaine	8	8.1	93	Slow	Long

**Mode of action**

It is possible for an LA agent to interfere with the excitation process in a nerve ending in one or more way:

- 1 Altering the basic resting potential of the nerve membrane.
- 2 Altering the threshold potential (firing potential)
- 3 ↓ the rate of depolarization.
- 4 Prolonging the rate of repolarization.

**Mechanism of action**

- Blocks the sodium channel
  - Wide ranging effects on the nervous system
- LAs blocks the channel from the intracellular side
  - Must enter the neuron to work
  - increased lipophilicity is associated with increased potency
  - Increased un-ionized fraction increases potency
    - The un-ionized molecule crosses the cell membrane
    - Adding bicarbonate increases the un ionized fraction

**Dissociation of LA molecules**

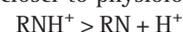
LAs are available as salts. In solution, it exists as:



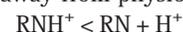
The RN is the base form and RNH<sup>+</sup> is the cationic form of the drug.

The relative proportion of each ionic form varies with pH,

At pH value closer to physiological pH:



At pH value away from physiological pH:



When pKa = pH: 50% RNH<sup>+</sup> and 50% RN  
pKa is called the dissociation constant

The percentage of drug existing in each form can be calculated by the

Henderson-Hasselbalch equation:

$$\text{Log} \frac{\text{base}}{\text{acid}} = \text{pH} - \text{pKa}$$

The two factors involved in the action of LA are:

- diffusion of the drug through the nerve sheath
- binding at the receptor site

The diffusion of the drug is brought about by the base or the RN form of the drug and the RNH<sup>+</sup> or the cationic form of the drug binds to the receptor site.

### Pharmacokinetics

#### Absorption

When injected into the soft tissues all LA cause vasodilatation except cocaine. Procaine is a potent vasodilator.

The absorption of LA depends upon

- 1 Route of administration
- 2 Vasoconstrictor
- 3 Site of injection
- 4 Quantity of the drug
- 5 Type and size of nerve
- 6 Potency of drug

#### Distribution

The blood level of LA is influenced by the following factors:

- 1 Rate at which the drug is absorbed into CVS
- 2 Rate of distribution from the vascular component to tissues
- 3 Elimination of drug through metabolic and excretory pathways.

#### Metabolism (Biotransformation)

Ester LA's are hydrolysed in plasma by the enzyme pseudo-cholinesterase. More allergic reactions to ester linked LA is due to *para*-amino benzoic acid (PABA) which is a metabolite of hydrolysis of the drug. 1 out of 2800 persons has atypical pseudocholinesterase.<sup>8,9</sup> In these patients administration of ester linked anaesthetics may give rise to toxicity.

Amide LA undergoes biotransformation in liver. Their metabolism is much more complex as compared to ester linked agents. More than 70% of these drugs metabolized in liver in normal function. In patients with low hepatic blood flow like in patients with congestive heart failure or

poor liver function like hepatitis or cirrhosis, biotransformation does not occur at a normal rate and thus toxicity increases.

#### Excretion

Kidneys are primary excretory organs for both ester and amide types of LA and their metabolites. A percentage of given LA is excreted unchanged. Patients with significant renal impairment are unable to eliminate the drug, leading to increased blood level and subsequent toxicity.

### LA's of importance to Ophthalmology

#### Proparacaine

Proparacaine Hydrochloride Ophthalmic Solution USP, 0.5% is a topical anaesthetic prepared as a sterile aqueous ophthalmic solution.

Proparacaine 0.5% ophthalmic solution  
Composition

Proparacaine hydrochloride U.S.P. 0.5%

Chlorbutol (as preservative) I.P 0.5%

Aqueous base q.s

Proparacaine is a rapid acting LA suitable for ophthalmic use. With a single drop, the onset of anaesthesia usually begins within 30 s and persists for 15 min or longer.

#### Indications

- 1 Measurement of intraocular pressure (tonometry)
- 2 Removal of corneal and conjunctival foreign body
- 3 Removal of sutures from the cornea
- 4 Conjunctival scraping in diagnosis
- 5 Gonioscopy
- 6 Laser procedures
- 7 To augment the anaesthetic effect of local anaesthesia

#### Contraindications

- 1 Patients with known hypersensitivity to any component of the solution.
- 2 Presence of a penetrating injury in the eye.

NOT FOR INJECTION: FOR TOPICAL  
OPHTHALMIC USE ONLY

Prolonged use of a topical ocular anaesthetic may produce permanent corneal opacification with accompanying loss of vision.

#### Adverse reactions

- 1 Little irritation, stinging or sometimes burning sensations
- 2 Conjunctival redness
- 3 Lacrimation

- 4 Increased winking
- 5 Rarely, a severe, immediate-type, apparently hyperallergic corneal reaction may occur which includes acute, intense and diffuse epithelial keratitis; a gray, ground-glass appearance; sloughing of large areas of necrotic epithelium; corneal filaments and, sometimes, iritis with descemetitis<sup>10</sup>
- 6 Softening and erosion of the corneal epithelium and conjunctival congestion and haemorrhage have been reported<sup>10</sup>
- 7 Allergic contact dermatitis with drying and fissuring of the fingertips has been reported<sup>11</sup>

#### Dosage for instillation of Proparacaine drops

##### *For cataract extraction*

Instill 1 drop every 5–10 min for five to seven doses.

##### *Removal of sutures*

Instill one or two drops 2 or 3 min before removal of stitches.

##### *Removal of foreign bodies*

Instill one or two drops prior to operating.

##### *Tonometry*

Instill one or two drops immediately before measurement.

#### **Lignocaine Hydrochloride**

Belongs to amide group.

In ophthalmic practice

- 2% lignocaine solution is used for administering regional ophthalmic blocks,
- 2% lignocaine gel is used as a topical agent,
- 1% intracameral lignocaine,
- lignocaine with adrenaline is used mostly in oculoplasty cases.

Dose: 3–5 mg/kg without adrenaline.

5–7 mg/kg with adrenaline.

2% lignocaine solution contains 20 mg per ml

Onset of Action: 45–90 s.

Duration: 45 min to 1 h.

Elimination half life: 90–120 min.

#### **Bupivacaine**

Available as 0.5% solution.

Dose: 2–3 mg/kg.

0.5% bupivacaine solution contains 5 mg per ml

Onset of action: 1–2 min.

Duration: 2–9 h.

Elimination half life: 3–4 h.

#### **Ropivacaine**

Belongs to amide group.

Available as 0.5% solution.

Dose: 2–3 mg/kg.

0.5% ropivacaine solution contains 5 mg per ml

Onset of action: 2–4 min.

Duration: 4–8 h.

Elimination half life: 14 min to 2 h.

### **Adjuvants**

#### **Vasoconstrictors**

Addition of vasoconstrictors (epinephrine and felypressin) decreases the absorption of LA into the plasma and it tends to increase the duration of action of the drug and minimizes bleeding occurring from small vessels. Hence, it is mainly used for oculoplastic surgical procedures. Epinephrine at a dilution of 1:200,000 has no systemic effects.<sup>12</sup> It is important to remember that it may cause vasoconstriction of the ophthalmic artery, compromising the retinal circulation.

The use of epinephrine-containing solutions should also be avoided in elderly patients suffering from cerebrovascular and cardiovascular diseases.<sup>12</sup> Phacoemulsification cataract extraction is usually of short duration; hence, the duration of block achieved by lignocaine without epinephrine usually suffices.

#### **Hyaluronidase**

Hyaluronidase is an enzyme, which reversibly liquefies the interstitial barrier between cells by depolymerisation of hyaluronic acid to a tetrasaccharide, thereby enhancing the diffusion of molecules through tissue planes.<sup>13</sup> It is available as a powder readily soluble in LA solution. Hyaluronidase has been shown to improve the effectiveness and the quality of needle as well as sub-Tenon's block<sup>14,15</sup> but its use remains controversial.<sup>16</sup> The amount of hyaluronidase used in published studies varies from 5 to 150 IU/mL. The UK data sheet<sup>17</sup> limits the concentration to 15 IU/mL. Orbital swelling due to rare allergic reactions<sup>18</sup> or excessive doses of hyaluronidase-54 and orbital pseudotumour<sup>19</sup> has been reported. Excellent blocks can be achieved without hyaluronidase<sup>20</sup> but there are reports of muscle dysfunction when it is not used during needle block.<sup>21</sup>

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# Systemic Effects of Ophthalmic Medications

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## Introduction

Topically applied eye drops can enter the systemic circulation through an extensive network of conjunctival vessels and via nasolacrimal duct from highly vascularised nasal mucosa.

Quantitative data on the systemic absorption of drugs after conjunctival instillation indicate that 30–80% of a retained topically applied dose enters the general circulation.<sup>1</sup> These systemically absorbed drugs escape first pass metabolism in the liver and peak plasma concentration reached between 5 and 13 min after topical installation.

Simple eyelid closure and punctual occlusion for at least 2 min after eye drop instillation reduces systemic absorption of any topical drug by up to two-thirds.<sup>2,3</sup>

Infants and children have increased potential for systemic drug-induced adverse reactions for several reasons. Ocular doses in children are not weight adjusted and are similar to doses used in adults. However, systemic absorption may have a greater impact in children than in adults due to their lower body mass with potentially higher plasma concentrations reached. In infants, toxicity may be compounded by altered metabolic capacity and an immature blood brain barrier.

In adults, the risk of systemic effects substantially increases in the presence of underlying diseases and with the use of concomitant medications which may interact with ocularly administered drug.

Commonly used ophthalmic drugs with significant systemic effects include:

1. Dilatation drugs
  - Sympathomimetics—phenylephrine.
  - Para-sympatholytics—Atropine, Homatropine, Cyclopentolate and Tropicamide.
2. Anti-glaucoma medications
  - Alpha-adrenergic agonist—Brimonidine,
  - Para-sympathomimetic drugs—Pilocarpine,
  - Beta blockers—Timolol, levobunolol and betaxolol,
  - Carbonic-anhydrase inhibitors
  - Mannitol.

## Dilatation drugs

### Phenylephrine

#### Mechanism of action

Phenylephrine is a direct acting sympathomimetic agent. It predominantly acts on alpha adrenergic receptors.

#### Clinical uses

Phenylephrine Hydrochloride Ophthalmic Solution, 2.5 and 10% is used for dilatation of pupil. Conjunctival instillation of Phenylephrine Hydrochloride results in maximal dilatation between 45 and 60 min and recovery occurs in about 6 h. Darker irides tend to dilate slower than lighter irides.<sup>4</sup>

Dilatation of the pupil with 2.5 and 10% preparations has been studied and the results show that the higher concentration does not necessarily produce a significantly greater mydriasis.<sup>5</sup>

#### Dose<sup>6</sup>

Adults: Apply one drop to each eye. If necessary, this dose may be repeated once only, at least 1 h after the first drop.

Children and the elderly: The use of phenylephrine 10% solution is contraindicated in these groups because of the increased risks of systemic toxicity.

Recommended dose is one drop of 2.5% phenylephrine solution.

#### Systemic reactions

Single drop of 10% Phenylephrine eye drop contains 4 mg of drug and multiple application may result in over dosage, especially if absorption from site of administration is enhanced or if the patient is compromised by age, body size, use of concomitant medications or trauma.

#### Systemic side effects<sup>7–10</sup>

- Hypertension
- Occipital headache
- Subarachnoid haemorrhage
- Ventricular arrhythmias
- Tachycardia
- Reflex bradycardia

#### Patients at increased risk for side effect are those with<sup>7</sup>

- Insulin-dependent diabetes
- Idiopathic orthostatic hypotension
- Cardiac disease
- Hypertension
- Thyrotoxicosis
- Aneurysms
- Advanced arteriosclerosis
- Atropine premedication
- Extremes of age (very young and old)

- Disturbed Corneal epithelial barrier (Intraop/trauma/inflammation)
- Decreased lacrimation (Under general anaesthesia)

#### Contraindications

In patients who are taking monoamine oxidase (MAO) inhibitors (upto 3 weeks after their discontinuation), tricyclic anti-depressants as they potentiate vasopressor effect of phenylephrine and beta-blockers.

#### Parasympatholytics (anticholinergics)

##### Mechanism of action

Parasympatholytic agents blocks the cholinergic response of the iris sphincter and ciliary muscle, causing mydriasis and cycloplegia (paralysis of accommodation)

##### Clinical uses

- Mydriasis and/or cycloplegia
- Cycloplegic refraction and
- Pupillary dilatation desired in inflammatory conditions of the iris and uveal tract

### Ocular anticholinergic agents

Drugs	Time to maximal mydriasis (min)	Recovery (h)	Time to maximal cycloplegia	Recovery	Dose
Atropine	30-40	7-10	3-6 h	7-14 days	1% One drop
Cyclopentone	30-60	1	25-75 min	6-24 h	0.5, 1% One drop
Homatropine	20-30	1-4	30-60 min	1-2 days	2, 5% One drop
Tropicamide	20-40	6	30-40 min	2-6 h	0.5, 1% One drop

#### Systemic adverse effects

Central anti-cholinergic syndrome is a clinical entity which shows central and peripheral effects produced by over dosage or abnormal reaction (idiosyncratic response) to clinical dosage of parasympatholytic (anti-cholinergic) drugs.

The central nervous changes may range from hallucinations to unconsciousness This behaviour consists of agitation including seizures, restlessness, hallucinations, disorientation or signs of depression such as stupor, coma and respiratory depression. Patients might present with tachycardia, hypertension and hyperthermia. They may also display urinary retention, and decreased bowel activity.

#### Mnemonics to remember signs and symptoms of the anticholinergic syndrome are

- *Red* as a beet (cutaneous vasodilation)
- *Dry* as a bone (anhidrosis)
- *Hot* as a hare (hyperthermia)

- *Mad* as a hatter (psychosis/agitation)
- *Blind* as a bat (non-reactive mydriasis) and
- *Stuffed* as a pipe (ileus and urinary retention)

#### Atropine

Atropine is the most potent mydriatic and cycloplegic agent.

##### Systemic reactions

Two mechanisms appear operative in cases of atropine poisoning.<sup>12,13</sup>

First, in some children a definite idiosyncratic response occurs, consisting of acute systemic toxicity and even death after the instillation of only one or two drops in each eye.

The second mechanism of atropine toxicity is overdosage following multiple instillations of the drug, often when early toxic symptoms are not recognized. Single drop of atropine drops 1% (i.e. 0.05 ml) contains 0.5 mg of atropine. Atropine appears rapidly in blood and plasma concentration peak approximately 10 min after conjunctival instillation.

##### Symptoms of atropine toxicity<sup>7</sup>

- Dry mouth
- Diffuse cutaneous flush
- Fever
- Urinary retention
- Tachycardia
- Somnolence
- Excitement and hallucinations

Parents must be advised of the early signs of toxicity. Drying of the mouth is the first sign of toxicity, slightly higher doses produce facial flushing and inhibit sweating. CNS manifestations occur later. Infants and young children have fewer symptoms of CNS excitation and are more likely to show CNS depression with drowsiness and coma.<sup>16</sup> Hyperpyrexia may reach alarming levels in infants (109°F [41.1°C] or greater), and abdominal distention usually is pronounced.

##### Patients at increased risk for side effect are

- infants<sup>14</sup>
- blond children
- children with spastic paralysis or brain damage<sup>14,15</sup>
- children with akinetic seizures<sup>17</sup>
- down's syndrome<sup>18-20</sup>

#### Homatropine hydrobromide (1%)

Homatropine is a weaker cycloplegic agent than atropine.

##### Systemic reactions

Systemic toxic reactions following ocular instillation are similar to those for atropine. Walsh and

Hoyt<sup>21</sup> stated that untoward reactions are milder with homatropine than with atropine, but Hoefnagel<sup>16</sup> did not find this so in his study.

#### **Cyclopentolate**

Cyclopentolate hydrochloride has a rapid onset of action and shorter duration of action than atropine or homatropine. The cycloplegic effect is superior to that of homatropine.

#### *Systemic reactions*

The onset of cyclopentolate toxicity occurs within 20–30 min of drug instillation, and although usually transient (subsiding in 4–6 h), the symptoms can last 12–24 h.

Systemic toxicity induced by the ocular administration of cyclopentolate is similar to that produced by atropine, except that cerebellar dysfunction, visual and tactile hallucinations are more constant and striking features of cyclopentolate toxicity. This is not surprising, because cyclopentolate is structurally similar to atropine but contains a dimethylated side group (–N–[CH<sub>3</sub>]<sub>2</sub>) also found in some tranquilizers and hallucinogenic drugs.

#### *Systemic adverse effect*

- Drowsiness
- Disorientation
- Restlessness
- Cerebellar dysfunction (incoherent speech, ataxia)
- Visual and tactile hallucinations
- Gastrointestinal toxicity

Seizures and acute psychosis are especially prominent in children<sup>22–31</sup> and elderly.<sup>32–35</sup> The psychosis is characterized by disorientation, dysarthria, ataxia, hallucinations and retrograde amnesia. This seems to indicate that CNS immaturity or aging is necessary for its potent psychotomimetic action to become manifest.<sup>26</sup>

Peripheral symptoms typical of atropine, such as flushing of skin and dryness of mouth is not been absorbed in cyclopentolate in children or adults.

Gastrointestinal toxicity consisting of ileus or gastroenteritis has been observed with cyclopentolate concentrations of 0.5% or greater in preterm infants, due to reduced gastric acid secretion and volume.<sup>26,27</sup> Gastrointestinal effects can be minimized by delaying feeding until after the application of eye drops and ocular examination have been performed.

A case series in 50 neonates confirmed a significantly higher incidence of feeding intolerance (abdominal distension and increased gastric aspirates) in the 24 h after ROP screening, using phenylephrine and cyclopentolate as mydriatics.<sup>36</sup> The pharmacological action of the drugs could be

compounded by the stress of manipulation. Awareness of the potential gastrointestinal complications after ROP screening using mydriatics should prompt clinicians and nurses to watch more closely for signs of feeding intolerance following ROP screening to help reduce serious complications such as necrotizing enterocolitis.

Toxic reactions in children and adolescents are much less common with the 1% compared with the 2% solution.<sup>24</sup> Systemic adverse reactions are rarely encountered with the use of the 0.5% concentration in children.

#### **Tropicamide**

Tropicamide (Mydracil) is a rapid-acting mydriatic with mild and transient cycloplegic action. In Down syndrome, mydriatic response is three times greater in comparison with healthy patients.

Tropicamide has shown to have a lower affinity for systemic muscarinic receptors. Therefore, lower incidence of systemic side effects.

#### *Clinical uses*

Since tropicamide is devoid of any vasopressor effect, it is probably one of the safest mydriatic in patients with hypertension, angina or other cardiovascular diseases.

### **Glaucoma medications**

#### **Pilocarpine hydrochloride**

##### *Mechanism of action*

Direct acting para-sympathomimetic (cholinergic) agent. It increases aqueous outflow.

##### *Clinical uses*

Used in acute angle closure glaucoma.

##### *Systemic adverse effects*<sup>7</sup>

- Rare but on repeated administration may increase parasympathetic tone
- Salivation
- Sweating
- Increased gastrointestinal motility (vomiting and diarrhoea)
- Relaxation of urethral and anal sphincters (incontinence)
- Bronchospasm in susceptible patients

#### **Brimonidine**

##### *Mechanism of action*

It is a selective adrenergic alpha 2 agonist that readily crosses blood drain barrier.

Brimonidine has a dual mechanism of IOP lowering: it both reduces aqueous humour production and stimulates aqueous humour outflow through the uveoscleral pathway.<sup>37</sup>

##### *Indications*

Reduction of IOP.

*Availability*

The original brimonidine 0.2% formulation has a pH of 6.4 and is preserved with benzalkonium chloride (BAK). BAK is the antimicrobial preservative most commonly used in ophthalmic solutions, but chronic exposure to solutions containing high concentrations of BAK has been associated with harmful effects on the corneal surface. More recently, a 0.1% formulation of brimonidine preserved with Purite at a pH of 7.7 was introduced.

*Systemic adverse effect*<sup>38-40</sup>

- Drowsiness
- Shortness of breath
- Dizziness
- Headache
- Low mood

The frequency of systemic adverse effects (drowsiness, shortness of breath, dizziness, headache, low mood) in adult series varies from 20 to 52%,<sup>41,42</sup> with one study showing them to be more common in patients older than 60 years<sup>42</sup> and another showing increased drug concentration to be a risk factor (three concentrations tested: 0.08, 0.2 and 0.5%).<sup>43</sup> Terminations of therapy because of adverse effects in adults were as low as 4%<sup>9</sup> in one study and as high as 26% in another 10 (approximately twice as many systemic as local side effects, a similar finding to our study in children). A minor reduction in adult systolic blood pressure (2.8 mmHg, SD = 20, *n* = 34) associated with brimonidine 0.2% has been reported with no effect on diastolic blood pressure or pulse rate.<sup>44</sup> Acute psychosis has been reported in one 68-year-old man.<sup>45</sup>

*Patients at increased risk for side effect are those with Cardiac disease (angina, infarction, heart failure),<sup>44</sup> Depression.*

*Contraindications*

Patients receiving MAO inhibitor therapy.

Patients on antidepressants which affect noradrenergic transmission (e.g. tricyclic antidepressants and mianserin).

Neonates and in children <2 years of age.

Under the age of 2 years, there have been reports of apnoea, bradycardia, hypothermia, hypotonia, lethargy and unresponsiveness on receiving brimonidine treatment.<sup>39</sup>

**Beta-blockers***Indications*

Open angle glaucoma.

*Commonly used agents*

Timolol, levobunolol, and betaxolol. Timolol and levobunolol are non-selective for beta1 and beta2 receptors, while betaxolol is beta1-selective.

*Mechanism of action*

Decrease the production of aqueous humour.

*Systemic adverse effects*<sup>7</sup>

Eye drops with beta blocking action can have a strong and prolonged systemic effects.

## Central nervous system

- Headache
- Lethargy
- Lightheadedness
- Weakness
- Depression
- Dissociative behaviour
- Memory loss

## Cardiovascular

- Bradycardia
- Palpitation
- Systemic hypotension
- Syncope
- Congestive cardiac failure

## Respiratory

- Bronchospasm
- Dyspnoea
- Pulmonary oedema
- Exacerbation of asthma

## Gastrointestinal

- Nausea
- Vomiting
- Diarrhoea
- Abdominal pain

## Orthopaedic

- Joint pain

*Patients at increased risk for side effect are*<sup>7</sup>

- Diabetes (May block the typical systemic manifestations of hypoglycemia)
- Hyperthyroidism since beta blockade may mask their symptom
- Cardiac failure
- First degree heart block
- Peripheral arterial disorders (Raynauld's syndrome)
- Myasthenia gravis
- Deaths secondary to bronchospasm and cardiac arrest have been reported in asthmatic and elderly patients

*Contraindications*

- In patients with history of asthma
- Second or Third degree heart block not controlled with pacemaker

*Interaction with other drugs*

Timolol may enhance the effect of the oral medicines beta blocker, ca channel blocker, digoxin, anti arrhythmics (amiodrone).

**Carbonic anhydrase inhibitors***Mechanism of action*

It decreases rate of aqueous humour production. The onset of IOP reduction begins 1 h and maximum IOP reductions occurs 2–5 h after oral administration. The duration of action is about 6–8 h.

*Dose*

Patients can be started on a low daily dosage of acetazolamide, such as 62.5 or 125 mg four times daily and advanced to 250 mg four times daily as necessary and tolerated. Dosages are generally limited to a total of 1000 mg daily because a higher dosage is associated with more frequent and severe side effects. The dosage in infants and children is 5–10 mg/kg administered every 4–6 h.

*Systemic side effects*

Relative hypokalemia and hyponatremia.<sup>46,47</sup>

Mild mixed respiratory and metabolic acidosis.<sup>47</sup>

Formation of renal stones.

Liver failure, characterized by confusion, asterix and elevated blood ammonia, may be seen in patients with chronic liver diseases. the mechanism by which carbonic anhydrase inhibitors (CAIs) cause liver failure remains unclear.

Blood dyscrasias, including aplastic anaemia, agranulocytosis, thrombocytopenia and neutropenia, have been documented in patients taking CAIs.<sup>48–50</sup> Blood dyscrasias may be idiosyncratic, occurring after as little as a single dose of medication, or they may be dose related.

A symptom complex of malaise, fatigue, weight loss, depression, anorexia and often loss of libido has been reported in up to 48% of patients. The patients in one study<sup>51</sup> who complained of this symptom complex were more acidotic than those without such complaints.

Paresthesias in the proximal and distal extremities have been reported in up to 75% of patients.<sup>52</sup> This side effect usually does not necessitate the discontinuation of the drug and tends to diminish with chronic use.

Patients may complain of strange tastes occurring during consumption of carbonated beverages. Similar complaints have been elicited when CA has been topically dispensed on the tongue.

*Used in caution*

Patients who are on diuretics.

Chronic obstructive respiratory disease.

Sickle cell trait.

Renal failure.

*Contraindications*

Hypersensitivity to sulpha drugs.

Hepatic cirrhosis.

Patient who are on high dose aspirin.

**I.V. Mannitol***Mechanism of action*

Hyperosmotic agent which reduces IOP by reduction of vitreous volume which results reduction from water transfer formed by osmotic gradient between retina, choroid and vitreous.

*Indications*

Short-term management acute and marked elevation of IOP and perioperative management of certain glaucoma patients.

Available as 20% IV solution.

*Dosage*

0.5–2 gm/kg body weight IV given over a period of 30–60 min.

Doses as low as 0.25 gm/kg body weight may be effective too. Lower dose may be effective if IOP is not very high or increase in IOP is due to inflammation.<sup>53</sup>

*Side effects*<sup>53</sup>

- Headache
- Pain in upper extremities
- Nausea and vomiting
- Diuresis
- Dehydration
- Potassium deficiency
- Vertigo
- Fever
- Confusion
- Disorientation
- Congestive cardiac failure
- Used with caution in patients
- Renal failure
- Congestive cardiac failure
- Electrolyte abnormalities
- Confused mental state
- Dehydration

*Absolute contraindication*

Hypersensitivity to mannitol.

**Conclusion**

The ocular medications have varying systemic effects ranging from trivial to life threatening signs and symptoms. These systemic effects can be caused by the ocular medications *per se* or may be due to interactions with oral medications taken for underlying systemic illness. Hence, before prescribing these medications, it is very important for an ophthalmologists to know about the patient's systemic conditions and current medications. In general, these medications should be used cautiously in extremes of age groups.

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# Systemic Evaluation of Patients for Ophthalmic Surgery under Regional Anaesthesia

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The practice of medicine has become more outcome driven and cost conscious and we clinicians need to re-evaluate and streamline methods of patient care.

A pre-operative evaluation is important to

- Screen for and optimize co-morbid conditions.
- Assess and lower the risk of anaesthesia and surgery.
- Establish baseline results to guide peri-operative decisions.
- Facilitate timely care and avoid cancellations on the day of surgery.

Ophthalmic procedures are considered low risk because of their general lack of physiological disturbances.<sup>1</sup> However, ophthalmic patients are often elderly and have multiple co-morbid conditions that are a constant threat to well being, even without surgery.

The goals of pre-operative evaluation are the following:

- 1 To evaluate patient readiness for anaesthesia and surgery.
- 2 To optimize the patient's health before surgery.
- 3 To enhance the quality of peri-operative care.
- 4 To reduce surgical morbidity and length of hospital stay.
- 5 To answer all questions and obtain informed consent.

At a minimum, a pre-operative visit should include the following:

- Interview the patient to review medical, anaesthesia, surgical and medication history.
- Conduct an appropriate physical examination.
- Review the pertinent diagnostic data.
- Refer the patient to primary care or specialist physician to manage new or poorly controlled diseases.
- Formulate and discuss care plan with patient or responsible adult.

## Pre-operative assessment

### History

The following should be noted during history taking.

- Patient's age.

- History of systemic disease with special emphasis on symptoms related to cardiovascular and respiratory system.
- The ability to lie flat.
- All current medications.
- Allergies, idiosyncratic drug reactions.
- Past surgery and any complications.
- Past anaesthetic procedures and any complications.
- Psychosocial matters including anxiety, confusion, panic attacks and claustrophobia.
- Communication issues with respect to dialect, deafness and dementia.

### Examination

- General examination.
- Cardiovascular system: heart sounds, murmur.
- Respiratory system: breath sounds and adventitious sounds.

### Investigations

In general, tests should only be considered when the history or physical findings would have indicated the need for an investigation even if surgery had not been planned.<sup>2</sup> However, some specific tests which are routinely indicated include the following.

- Clotting profile should normally be checked within 24 h of surgery for patients on anti-coagulants.
- Electrolytes on the day of surgery for patients on dialysis.

For the patient with no history of significant systemic disease and no abnormal findings on examination at the physician/anaesthetist led assessment, no special investigations are indicated.

## Specific disorders for consideration in pre-operative assessment

### Hypertension

Hypertension should be well controlled before the patient is scheduled for surgery and should not be lowered immediately prior to surgery. It is generally

recommended that elective surgery be delayed for severe hypertension until the blood pressure is below 180/110 mmHg. Patients who are taking anti-hypertensive medication should continue their drugs up to and including the day of surgery.

#### Diabetes mellitus

Poor glycaemic control is associated with increased risk of heart failure. Both systolic and diastolic dysfunction may be present. Tighter peri-operative control is warranted to reduce risk of infections. The American College of endocrinologists position statement recommends a target fasting glucose of <110 mg/dl and a post-prandial blood glucose of 140–200 mg/dl in non-critically ill patients.<sup>3</sup> The goal of peri-operative diabetic management should be to avoid hypoglycaemia and marked hyperglycaemia.

At present evidence suggests that a patient with good control of blood sugar pre-operatively can be taken up for surgery with random blood sugar levels up to 250 mg/dl. Diabetic patients should have their usual medication and diet if surgery is planned under local anaesthesia (LA).

#### Cardiac disease

Particular attention to be paid to the following:

- Need to identify the presence of heart disease.
- Need to know the severity of heart disease.
- Need to evaluate the significant risk of heart disease based on associated conditions (DM, renal insufficiency, cerebrovascular or peripheral vascular disease).
- Determine the need for pre-operative consultation and interventions to modify risk of pre-operative events.

Patients *with* high risk conditions like

- Unstable or recent onset angina.
- Decompensated heart failure.
- Significant arrhythmias.
- Severe valvular disease.

Would require cardiology consultation for stabilizing their medical condition prior to surgery.

Patients with myocardial infarction should not have surgery within 3 months of the infarct.

Non-cardiac surgery soon after bypass grafting or percutaneous coronary interventions is associated with high risk of peri-operative cardiac morbidity and mortality.

Patients who have had a recent cardiac therapeutic intervention have a higher risk of subsequent myocardial events. If anti-platelet therapy

needs to be stopped for surgery, then elective surgery should be deferred for 12 months after drug-eluting stent implantation and at least 6 weeks following bare metal stent insertion.<sup>4</sup> If there are concerns that anti-platelet agents may complicate surgery, then the medical team that started treatment should be consulted to discuss stopping these agents.

#### Valvular heart disease

There is no need for systemic antibiotic prophylaxis for ophthalmic surgery.<sup>5</sup>

#### Pacemakers and implantable cardioverter defibrillators

Management of these complex devices should be directed at protecting the patient and preventing inappropriate functioning. The cardiology team should be consulted to identify the device and advise whether it needs to be disabled or re-programmed in the peri-operative period.

#### Chronic obstructive pulmonary disease

Patients who have chronic obstructive pulmonary disease, asthma or a cough may not be able to lie supine for an extended period of time. Hypoxemia can occur in the elderly purely by adopting the supine position. Treating exacerbation of their disease like infection or bronchospasm may make it possible for them to remain recumbent and still and this is necessary to decrease complications. Oxygen supplementation is recommended. Accumulation of carbon dioxide occurs with several types of draping system.<sup>6</sup> This can lead to anxiety, as well as hypertension and increased choroidal blood flow. An open draping system, suction or a simple high flow oxygen-enriched air system below the drapes may reduce carbon dioxide accumulation.<sup>7</sup>

#### Chronic renal failure

The focus of the pre-operative evaluation of patients with renal insufficiency or failure should be on the cardiovascular and cerebrovascular systems, fluid volume and electrolyte status. Chronic metabolic acidosis is common but usually mild and compensated for by chronic hyperventilation.

The preparation of patients undergoing dialysis requires close liaison with the dialysis unit. Blood biochemistry should be optimized and careful attention paid to the patient's hemodynamic status and ability to lie flat. Arterio-venous fistula should be noted and protected. The blood pressure cuff should not be applied to the same limb as the fistula. Intravenous access should be secured at a site remote from arterio-venous fistulae.

#### Neurologic diseases

A history focused on recent events, exacerbations or evidence for poor control of the medical

condition is necessary for a patient who has neurologic disease like stroke, seizure disorder, multiple sclerosis, Parkinson's disease. If a stroke or transient neurologic deficit has not been fully evaluated or has occurred within 1 month, elective surgery should be delayed pending complete evaluation. Patients who have significant movement disorder or poorly controlled seizures may require general anaesthesia.

### Anaemia

Consequences from moderate levels of anaemia and Hb levels  $\geq 7$  gm/dl in patients without CAD are minimal. The focus of the pre-operative visit is to determine the aetiology, duration and stability of the anaemia, and the patient's co-morbid conditions that may impact oxygenation, such as pulmonary, cardiovascular and cerebrovascular disease.

### Anti-coagulated patients

Many patients undergoing ophthalmic surgery have significant co-morbidity. Many take anti-coagulant or anti-platelet drugs. Stopping these drugs in patients with heart or vascular disease may result in death from a thromboembolic episode. The risk of this must be balanced against the risk of bleeding. In general, the risks of stopping these drugs outweigh the risks of ophthalmic surgery, which is in most cases confined to the eye. The majority of eye surgery is now performed under LA. There is no strong evidence currently to favour blunt cannula techniques such as sub-Tenon's block over traditional sharp needle peribulbar block in patients on anti-coagulant or anti-platelet therapy.

### Recommended best practice based on the clinical experience of the British Ophthalmic Anaesthesia Society Anti-coagulant Guideline Development Group<sup>8</sup>

- 1 In general, patients with prosthetic heart valves and coronary stents should not have anti-coagulant or anti-platelet agents discontinued for cataract surgery.
- 2 We recommend continuing warfarin for routine cataract surgery. The International Normalized Ratio (INR) must be checked close to the time of surgery, ideally on the same day, and the INR should be within the range that is determined by the condition for which the patient is being anti-coagulated.
- 3 Patients who self-medicate or receive prescribed low-dose aspirin may have a slightly increased risk of haemorrhage but the benefit

to be derived from stopping aspirin is, at best, questionable. It is therefore recommended that low-dose aspirin should not be stopped prior to cataract surgery under LA.

- 4 Patients on clopidogrel, dipyridamole or combinations of these with aspirin are usually on these drugs for sound medical reasons. Withdrawal of the drugs in these circumstances may lead to dangerous thromboembolic events. It is therefore recommended that these drugs should not be stopped for cataract surgery.

### Conclusion

The prevention of complication during and after procedure is the most important goal of pre-operative evaluation. Identification of risk requires good medicine, system of care, clinical and lab assessment and experienced, knowledgeable, dedicated health care providers.

Risk reduction is the ultimate goal of preoperative assessment and management.

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# Preoperative Instructions and Preparation of Patients Posted for Cataract Surgery

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## Introduction

Patient education and adequate time to listen and respond are integral components in an outpatient cataract surgical approach.<sup>1</sup> The provision of good-quality preoperative information facilitates patients' active involvement in their care, and therefore may contribute to an overall increase in satisfaction.<sup>2</sup> Delivery of a safe anaesthetic requires current, objective information prior to the surgical procedure. The patient's medical status should be stable, optimized and documented. Laboratory testing is warranted under certain circumstances, although these requirements are becoming less frequent. This article discusses two important aspects: Preoperative instructions and preparation of patients posted for cataract surgery under local anaesthesia.

## Preoperative instructions

### Who should give instructions?

This has to be a teamwork of ophthalmologist, paramedical staff, physician and anaesthetist who should work as a unison in giving instructions. It is a good idea to divide the task as follows:

- a Ophthalmologist: Gives instructions regarding eye medications.
- b Paramedical staff (Surgery Fixing centre): Gives instructions related to the need for attendant, arrival time at hospital and general instructions.
- c Anaesthesiologist/Physician: Gives instructions regarding the preoperative fasting and systemic medications.

### When to give instructions?

Preferably all instructions should be given within a week of a planned ocular surgery. Once, after evaluation by an ophthalmologist, the patient agrees for the surgery, the instructions can be given by the ophthalmologist during the same visit.

The paramedical staff should give the instructions when the planning for surgery is done; and anaesthetist/physician should give instructions during the preoperative evaluation.

### Verbal Vs Written?

It is good to have both, written and verbal. Hayward *et al.* had shown that structured information given to patients prior to surgery reduced

postoperative pain.<sup>3</sup> Similarly, Giraudet-Le Quintrec *et al.* also showed that a multidisciplinary standardized information session also significantly minimises both preoperative anxiety and postoperative pain in patients undergoing surgery.<sup>4</sup>

### Whom to give instructions?

It should be given to the patient; however, in cases of paediatric cases and in cases where patient cannot comprehend and understand the instructions, it should be given to the attendant adult. Preferably the instructions should be given in local vernacular language.

## Instructions related to systemic medications?

### Antihypertensive medicine

Patients commonly present with either diagnosed or undiagnosed hypertension. Even if a patient carries the diagnosis of hypertension and takes antihypertensive therapy, the hypertension may be poorly controlled. Patients should continue taking preoperative antihypertensive medications throughout the entire perioperative period. Patients with hypertension are at a higher risk for labile BP and for hypertensive emergencies during surgery. They should continue the medication even on the day of surgery.<sup>5</sup>

### Medicines for cardiac illness

Many studies have shown a significantly higher odds Ratio of various cardiovascular disorders and cardiovascular risk factors in cataract patients undergoing surgery.<sup>6-8</sup> It is advisable to continue the medications in perioperative period and on the day of surgery.

### Antidiabetic medications

Patients with type 2 diabetes are advised to continue routine oral hypoglycaemic medications along with their regular breakfast. Blood sugar to be determined on the day of surgery. In patients receiving insulin, adjust insulin dosage before the surgical procedure to avoid hypoglycaemia. Administer subcutaneous correction dose insulin with target glucose between 140 and 180 mg/dl. Maintain postoperative glucose levels (premeal and fasting) in the range of 100–180 mg/dl in patients undergoing surgical procedures that are not long or complex. Continue intraoperative management strategies into the postoperative period if the patient remains unable to eat normally. Resume the

patient's outpatient diabetic diet and treatment regimen once he or she is eating well.<sup>11</sup>

#### Antiplatelets and anticoagulants

In general, patients with prosthetic heart valves and coronary stents should not have anticoagulant or antiplatelet agents discontinued for cataract surgery. We recommend continuing warfarin for routine cataract surgery. The International Normalized Ratio (INR) must be checked close to the time of surgery, ideally on the same day and the INR should be within the range that is determined by the condition for which the patient is being anticoagulated. It is also recommended that low-dose aspirin should not be stopped prior to cataract surgery.<sup>12</sup>

#### Steroids

The exogenously administered corticosteroids suppress the hypothalamus–pituitary–adrenal axis, thereby inhibiting normal endogenous adrenal cortical function and subsequent release of cortisol. Furthermore, during conditions of stress, failure to increase plasma levels of cortisol can increase the risk of morbidity and/or mortality (i. e. inadequate or 'failed' stress response). Although the potential consequences of a failed corticosteroid response are varied, the most life-threatening includes refractory hypotension and shock states.<sup>9</sup>

If the patient has stopped oral steroids >3 months ago, no additional perioperative steroids are required. If he has stopped <3 months back, the perioperative steroid schedule is followed as if the patient is on steroids. If patient is on steroids (<10 mg/day) no additional steroid coverage is required. However, if patient is on >10 mg/day steroid, besides the usual perioperative steroids, on the day of surgery injectable bolus dose of steroids (25 mg Hydrocortisone) is needed. If patient is on high dose immunosuppressant's e.g. 60 mg Prednisolone, the immunosuppressant's are continued in perioperative period, and a higher bolus dose required on day of surgery (250 mg Hydrocortisone).<sup>10</sup>

#### Other medications

Antidepressants, antianxiety, thyroid reflux medications, asthma medications, heartburn or medications and antiseizure medications should be continued in the perioperative period and also on the day of surgery.

#### Instructions related to surgery

The ophthalmologist gives the instructions and counselling regarding benefits and risk involved in cataract surgery. Patient is informed about the position in which he/she has to lie down, about the nasal cannula that will be kept for oxygen and drape covering over the face during surgery. It is always wise to encourage the patient to inform pain, if there is any, orally to surgeons

without moving the head. The patient has to be informed that his general health will be monitored, and an anaesthesiologist will start his intravenous line and administer appropriate sedation.

#### Instructions related to hygiene

Shower and head bath on the day of the surgery to help maintain a clean surgical environment is advised. Patients should also wear clean, comfortable clothes, and avoid wearing eye make-up.

#### Instructions related to food intake

Patient is advised to be *nil per oral* 2 h before the cataract surgery. He is also advised to take only a light breakfast. As a general rule, patients are asked to refrain from alcoholic beverages for at least 24 h prior to surgery.

#### Preoperative preparation

##### Consent

Increasing medico-legal litigation, and the desire to provide patients with more say concerning their own treatment, has highlighted the issue of informed consent and how it is obtained. In order for a patient to make a sensible decision concerning his or her treatment, they need appropriate information. This may occur via discussions with medical/nursing staff, via the media/internet, or from speaking with friends who have undergone a similar procedure. However, it chiefly occurs during the acquisition of informed consent, during which the risks and benefits of any surgical procedure are explained.

Informed consent for elective surgery is often obtained by concern doctor during pre-assessment clinics, or on the day of surgery. For consent to be valid the patient must be competent to take the particular decision and should have received sufficient information to make a decision.

Sufficient information to make a decision should also include an explanation of (1) the risks and benefits involved; (2) any alternative treatments and (3) the risks and benefits of doing nothing. The consent should be signed by patient if he/she can comprehend and understand and are aged >18 years and if age is <18 years and cannot comprehend and understand the parent/relative should sign the consent.

##### Preparation before arrival

**Drops:** It should be ensured that patient had received instructions for appropriate drops to be put before surgery. These include antibiotic prophylaxis, antiglaucoma agents in selected cases or steroid drops in selected cases.

**Clothes:** Patient is advised to wear comfortable loose fitting clothing on the day of surgery

**Cosmetics:** Patient should not wear any cosmetics or have makeup, lotion in and around the



**Figure 1:** Preoperative preparation for cataract surgery.

eye. Patient should refrain from wearing any kind of jewellery.

#### **Preparation in the ward**

All patient change their dress to a clean loose OT dress before shifting to the theatre. They should have an identity tag on the wrist to confirm identity and to avoid any untoward incident. The eye to be operated is identified by means of a sticker stuck on the forehead (orange for right and green for left). Eye drops for dilatation usually sympathomimetic mydriatic (such as phenylephrine 2.5%) and parasympatholytic cycloplegic (such as tropicamide or cyclopentolate 1%) are used.

A checklist is prepared in the ward regarding eye to be operated, investigations, status of fasting, etc. The patient is either shifted from the inpatient ward or the ambulatory ward by means of a stretcher or a wheel chair.

#### **Preparation in operation theatre**

Once patient is received in receiving room patients name, operating surgeons name and eye to be operated is confirmed. Intravenous cannula is put by either anaesthesiologist or trained nurses. Blood pressure is checked and if it is higher it is optimized before surgery. The checklist is rechecked in OT.

#### **Preparation after shifting of patient from receiving room to operation theatre**

OT stretcher is wheeled into the OT with the patient and the patient is transferred to the OT table. Stretcher is wheeled out and the main doors are kept closed till surgery is over. The patient is placed comfortably on the table and kept warm with a blanket. Alternative warming device such as the electric warmer or therma drape are used to keep the patient warm.

A multiparameter monitor for recording BP, HR, ECG and SPO<sub>2</sub> are attached to the patient. A nasal cannula is put for all patient for oxygen at a flow rate of 2 l/min. An arch/frame is put so that surgical sterile drape would not cover nose and mouth, see Figure 1. For patient under local anaesthesia, monitored anaesthesia care is given

when indicated. All events preoperative, intra-operative and postoperative are documented at regular intervals in an anaesthesia chart. There are separate charts made for only systemically high-risk patients.

#### **Methods of monitoring in OT**

There are guidelines on monitoring in ophthalmic practice but the most important aspects are<sup>13-15</sup>

*Clinical observations:* These include the patient's colour, respiratory movements, pulse and responses to surgical stimuli. *Pulse oximetry (SpO<sub>2</sub>), Electrocardiogram (ECG) and Non-invasive blood pressure* are the basic monitoring required. The minimum monitoring (e.g. for a fit person having routine surgery under topical anaesthesia) is clinical observation, communication and pulse oximetry. The ECG and blood pressure should be monitored in sedated patients and those who are at risk of cardiovascular complications (e.g. hypertensives, patients with pacemaker, diabetics) during surgery.

#### **Conclusion**

During a preoperative consultation all patients should be given clear oral instructions regarding the type of anaesthesia to be administered, about the surgery and its prognosis, continuation of medications both oral and topical and time of nil per oral to be followed. The goal of preoperative evaluation is to identify and optimize conditions so has to reduce perioperative morbidity and mortality. Preoperative investigations are helpful to stratify risk, direct anaesthetic choices and guide postoperative management, but often are obtained because of protocol rather than medical necessity. The decision to order preoperative tests should be guided by the patient's clinical history, comorbidities and physical examination findings.

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# Choosing the Type of Anaesthesia for Cataract Surgery

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## Introduction

Good anaesthesia is essential for the performance of safe intraocular surgery. Advances in cataract surgery techniques have presented surgeons with new options for ocular anaesthesia. As cataract surgery has become faster, safer and less traumatic, the need for akinesia and anaesthesia has declined significantly. In the present era anaesthesia for eye surgery aims at creating a comfortable environment for the patient and the surgeon during surgery and a quick recovery of function without inherent added risks. Today there are numerous modes of anaesthesia from which surgeon can choose. The main aim of this article is to review the different choices for ocular anaesthesia, compare their efficacies and helping to select the most appropriate type of anaesthesia for patients posted for cataract surgery.

### Choices for ocular anaesthesia

Regional and general anaesthesia

#### Regional Anaesthesia

##### Akinetic techniques

*Needle-based technique*

Retrobulbar

Peribulbar

*Cannula-based technique*

SubTenons block

##### Non-Akinetic technique

Topical anaesthesia

## Akinetic techniques

### 1. Needle-based technique

#### Modern retrobulbar block

The aim is to block the oculomotor nerves before they enter the four rectus muscles in the posterior intraconal space. In the modern retrobulbar block, 23 G, 31 mm long needle, with bevel facing the globe, is inserted through the skin in the inferotemporal quadrant as far laterally as possible, just above the junction of inferior and lateral orbital walls, see Figure 1.<sup>1,2</sup> The atkinson's or classic insertion site, i.e. the junction of medial two-third and lateral one-third of the lower orbital margin, is no more recommended. The reasons cited are: the needle being nearer to the globe, inferior rectus muscle and also closer to the neurovascular bundle supplying the inferior oblique. Several cases of diplopia owing to iatrogenic needle injury to inferior rectus and oblique muscles following needle entering at this site have been reported in literature.<sup>3,4</sup>

From the extreme corner, it is easier to stay far away from the globe and would prevent any needle injury to the inferior rectus muscle or its



**Figure 1:** For inferolateral peribulbar injection recommended percutaneous needle entry site is at the junction of lateral wall and floor of the orbit and the traditional (Yellow dot) point at medial 2/3rd and lateral 1/3 rd of the inferior orbital margin is avoided.

neurovascular bundle. The initial direction of the needle is tangential to the globe. Once past the equator, as gauged by the axial length of the globe, the needle is allowed to go upwards and inwards.<sup>5</sup> With the eye in primary gaze, 4–5 cc of local anaesthetic agent is injected.

All extraocular muscles can be paralysed by this technique except superior oblique. The entire globe is anaesthetized as a result of blocking the nasociliary and long ciliary nerves.

### Advantages

It produces excellent anaesthesia and akinesia.

The onset of the block is quicker than with peribulbar.

Low volume of anaesthetic result in a lower intraorbital tension and less chemosis than with peribulbar blocks.

### Disadvantages

Orbital complications:

Optic nerve injury due to inadvertent trauma from needle.

Retrobulbar haemorrhage.

Globe perforation.

Systemic complications:

Inappropriate large dose.

Accidental intravascular injection.

Intraarterial injection with retrograde flow.

CSF spread within the dural cuff around the optic nerve—Brain stem anaesthesia.

Other disadvantages are:

All extraocular muscles can be paralysed by this technique except superior oblique as it is supplied by the trochlear nerve (IV nerve), which lie outside the muscle cone.

Akinesia of the eye lids may be incomplete. A separate eye lid block, using 2.5 cc of 1% lignocaine solution injected 0.5 cm below (lower lid) and 1.0 cm above (upper lid) the middle of the canthus, might be required.<sup>6</sup>

### Modern Peribulbar block

Due to several potential orbital and systemic complications reported with retrobulbar block, gradually it was replaced by a safer and equally effective peribulbar block.

The principle of this technique is to instill the local anaesthetic outside the muscle cone and avoid proximity to the optic nerve. In the modern peribulbar block 23-G, 25 mm long needle is inserted as far laterally as possible in the inferotemporal quadrant. Once the needle is under the globe, it is directed along the orbital floor, passing the globe equator to a depth controlled by observing the needle/hub junction reaching the plane of the iris.<sup>7</sup> After negative aspiration for blood, with the globe in primary gaze, 4–5 cc of local anaesthetic agent is injected.

### Advantages

By this procedure, all extraocular muscles including superior oblique can be paralysed.

Thus, effective analgesia and akinesia of the globe.

The risk of local and systemic complications associated with this technique is lower.

The local anaesthetic solution diffuses through the orbital septum and resulting in the paralysis of orbicularis muscle. Thus, a separate eye lid block might not be required with this technique.

### Disadvantages

Onset of action is slower compared to retrobulbar technique.

More amount of LA volume might be required.

Greater incidence of periorbital ecchymosis and conjunctival chemosis can occur.

Akinesia of the extraocular muscle may be less complete.

Following a fractionated inferotemporal injection, intraocular pressure increases significantly and this may lead may lead to vitreous loss during intraocular surgery.<sup>7</sup> Hence, adequate compression of the globe either by using digits or Honan Intraocular pressure reducer should be done.

After adequate compression, if significant movement of the eye still persists then supplementary injection, medial peribulbar block is administered. The administration of this supplementary injection depends upon the type and duration of the procedure to be performed, the experience



**Figure 2:** Medial peribulbar block performed with 26G 1/2 inch needle entering into the blind pit between the medial caruncle and the medial canthal angle.

of ophthalmologist, and preference of the anaesthesiologist.

### Medial Peribulbar block

It is given using 26 G, 1/2" disposable needle. With the bevel facing the medial orbital wall, needle is passed into the blind pit, between the medial caruncle and canthus, see Figure 2. It is passed backwards in the transverse plane, directed at 5° angle away from the sagittal plane and towards the medial orbital wall. If the medial wall is contacted, the tip is slightly withdrawn and needle is redirected to a depth of 15–20 mm and after negative aspiration for blood, 3–5 cc of local anaesthetic solution is injected.<sup>5</sup>

### Advantages

Helps in the supplementation of the primary intra or extraconal blocks.

This extraconal space is an excellent site for administering local anaesthesia, as it communicates freely with the intraconal space. Also, with this injection, eyelids may fill with the anaesthetic solution which provides excellent orbicularis akinesia too.

Given as primary injection in patients with high axial length or those with posterior staphyloma.<sup>8</sup>

### Disadvantages

Orbital cellulitis or abscess.

Haemorrhage.

Globe perforation has been reported.<sup>9</sup>

## 2. Cannula-based injection technique

### Subtenon's block

It was introduced into clinical practice in the early 1990s as a simple, safe, effective and versatile alternative to needle block.<sup>10,11</sup> It is also known as parabolbar, pinpoint anaesthesia<sup>12</sup> or episcleral block.<sup>13</sup> Local anaesthetic eye drops are instilled onto the conjunctiva. Under sterile conditions, at the inferonasal quadrant, 3–5 mm away from the

limbus, the conjunctiva and Tenon capsule are gripped with non-toothed forceps and a small incision is made through these layers with Westcott scissors to expose the sclera. A blunt curved posterior sub-Tenon's cannula mounted on to a 5 ml syringe with local anaesthetic is inserted through the hole along the curvature of the sclera. Injection of local anaesthetic agent under the Tenon capsule blocks the sensation from the eye by action on the short ciliary nerves as they pass through the Tenon capsule to the globe. Akinesia is obtained by direct blockade of anterior motor nerve fibres as they enter the extraocular muscles. Two percentage lidocaine is the most commonly used local anaesthetic agent.<sup>14</sup>

### Advantages

Simple, safe and effective alternative technique to needle block.

It is well tolerated by patients.

Can be used safely in patients on anticoagulants, those with high myopic eyes, etc.

Very minimal chance for optic nerve getting injured especially when smaller volumes of LA is injected anteriorly.

### Disadvantages

Requires surgical skills.

Chemosis and sub-conjunctival haemorrhage can hinder the surgical field, it can also stimulate postoperative scarring later.<sup>5</sup>

Not a suitable technique in patients who had multiple surgeries owing to scarring.

Leakage of local anaesthetic solution from the injection site which decreases the effectiveness of the block.

Akinesia is variable and volume dependent.

Orbital and retrobulbar haemorrhage, globe perforation, the central spread of local anaesthetic and orbital cellulitis have been reported to occur.<sup>15-17</sup>

### Non-akinetic Technique

#### Topical anaesthesia

It can be achieved either by instilling local anaesthetic eye drops (0.5% Proparacaine Hydrochloride or 2-4% lignocaine)<sup>18</sup> or application of lignocaine gel<sup>19</sup> and found to be useful for cataract, glaucoma surgery like trabeculectomy<sup>20</sup> and secondary intraocular lens implantation. Topical anaesthetic agents block trigeminal nerve endings in the cornea and conjunctiva, leaving the intraocular structures in the anterior segment unanaesthetized. Thus, manipulation of the iris and stretching of the ciliary and zonular tissues during surgery can irritate the ciliary nerves, resulting in discomfort. A modified technique consists of combining topical anaesthesia with 0.5 ml of 1% lignocaine (preservative free) injected through the side port incision after evacuation of aqueous (intracameral anaesthesia).<sup>21</sup> It provides sensory blockage of the iris and

ciliary body and thereby relieves discomfort experienced during intraocular lens placement.

### Advantages

It avoids the systemic and local complications associated with eye blocks.

No fear or pain of injection of the needle.

Rapid visual rehabilitation occurs just after the procedure.

### Disadvantages

Apart from surgical skill, the patient should be cooperative enough for successful completion of eye surgery under topical anaesthesia.

Not suited for patients who are young, anxious, patients who display a marked squeezing or muscular spasm during tonometry or indirect ophthalmoscopy.

Not a technique of choice in patients with small pupils, very dense cataract, complicated cataract, etc.

Retained visual sensations that include seeing light, colours, movements and instruments during surgery are expected to occur more frequently under topical anaesthesia because optic nerve function is not affected. Although majority of patients feel comfortable with visual sensations they experience, a small proportion find the experience unpleasant or frightening.<sup>22</sup> Preoperative counselling and IV Midazolam are known to alleviate the fear caused by intraoperative visual images seen.<sup>23</sup>

### General anaesthesia

General anaesthesia provides excellent anaesthesia, analgesia and akinesia. In addition, the duration of anaesthesia can be varied to accommodate the length of surgery. Modern health care, where time and cost efficiency are significant factors, renders general anaesthesia unlikely for the bulk of cataract surgeries. But still there are some absolute and relative indications for administering it.

### Absolute indications

- Patient refusal to regional anaesthesia.
- Mentally retarded patients.
- Local infection.
- Paediatric patients.
- Allergy to local anaesthetic agents.

### Relative indications

- Younger adults.
- Patients on anticoagulants.
- Very anxious patients.
- Inability to lie flat.
- High myopia.
- Prolonged complex surgeries.
- Uncontrolled neurological movements.
- High myopia.
- Allergy.
- Nystagmus.

### Choosing anaesthesia for cataract surgery

Given the choices for ocular anaesthesia no single mode of anaesthesia can serve as a universal choice for all patients and all surgeons. For the same patient, different surgeons may select different techniques of anaesthesia. The skill and experience of surgeon, cooperation of patient, type of cataract, associated ocular comorbidity like corneal opacity, pupillary dilatation, etc. are important factors while deciding upon the type of anaesthesia. It is essential that the surgeon, patient and anaesthesiologist work together and be involved in the selection and execution of anaesthesia during the surgery. The ideal surgery is conducted under the safest conditions, is cost and time efficient and ultimately results in excellent outcomes as well as patient satisfaction. These are our goals with regard to the use of anaesthesia for cataract surgery.

As mentioned above, general anaesthesia for cataract has its own indications both absolute and relative. With regard to regional anaesthesia, retrobulbar block owing to potential orbital and systemic complications has become almost obsolete in clinical practice. Peribulbar anaesthesia is thought to decrease the likelihood of optic nerve and globe perforation while maintaining the desirable qualities of excellent akinesia and analgesia. However, the higher volume of injectate required and longer duration of onset may make it a less attractive alternative. Sub-tenon's injections with blunt cannula have an even lower risk of local complications. With all orbital regional blocks, cosmetic complications such as localized swelling, bruising and sub-conjunctival haemorrhage may lead to reduced patient satisfaction. In addition, eye movement and vision are affected for some time after surgery.

Topical anaesthesia is the most cost and time efficient. It does not affect vision or motility, so patients may have improved and useful vision almost immediately after surgery. There are also minimal cosmetic changes. Though it provides a least controlled environment for performing cataract surgery, with careful patient selection and appropriate counselling and with intravenous sedation, it may ultimately be the safest mode of anaesthesia. For many patients and surgeons this mode of anaesthesia fulfils most of the goals of anaesthesia in cataract surgery.<sup>24</sup>

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# Managing Awake Patients under the Drapes

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## Introduction

Most of the eye surgeries in adults are done under local anaesthesia. Generally with careful selection and explanation, most of them accept it. However, there always remain a proportion of patients who might benefit from sedation. Sedation is a very useful adjunct for the success of eye surgery under local anaesthesia. The ideal sedative for ophthalmic procedures performed under local anaesthesia should have a rapid onset and short duration of action to ensure rapid awakening and early discharge from hospital, especially in the setting of day surgery. Also, the agent should be non-toxic, non-accumulating and have predictable effects and should be cheaper. In this chapter, we will discuss the importance of sedation in eye surgery, the different sedative agents used, monitoring standards and complications involved in administration of sedation.

## What is Sedation?

The American Society of Anaesthesiologists policy statement on Continuum of Depth of Sedation.<sup>1</sup>

## Minimal sedation (Anxiolysis)

Drug-induced state during which patients respond normally to verbal commands.

Cognitive function and coordination may be impaired, but ventilatory and cardiovascular functions are unaffected.

## Indications

Anterior segment surgeries which are of shorter duration like surgery for cataract, glaucoma, etc.

## Moderate sedation/Analgesia (Conscious Sedation)

Drug-induced depression of consciousness during which patients respond purposefully to verbal commands, either alone or accompanied by light tactile stimulation.

No interventions are required to maintain a patent airway, and spontaneous ventilation is adequate.

Cardiovascular function is usually maintained.

## Indications

Posterior segment surgeries like vitreoretinal surgery, oculoplastic cases and strabismus surgery.

## Deep sedation/Analgesia

Drug-induced depression of consciousness during which patients cannot be easily aroused but

respond purposefully following repeated or painful stimulation.

The ability to independently maintain ventilatory function may be impaired.

Patients may require assistance in maintaining a patent airway, and spontaneous ventilation may be inadequate.

Cardiovascular function is usually maintained.

It is generally advised to *avoid deep sedation* in ophthalmic surgeries since the patients face will be covered with the drapes during surgery. General anaesthesia should be considered in such cases.

## Role of sedation in eye surgery

The patients posted for eye surgery are generally worried and anxious about their visual prognosis following surgery. Apart from this, these patients would be much concerned about the pain associated with administration of local anaesthetic solution using needle blocks. Pain, fear and anxiety are major predictors of lower patient satisfaction with ocular surgery.<sup>2</sup> Moreover, such affective components can complicate surgery on two levels. The intraoperative cooperativeness of the patients may be reduced, thereby increasing the risk of complications and making the continuation of surgery technically difficult. More importantly, they may cause an exaggerated neuroendocrine stress response. It is well established that sympathetic surges can lead to hypertension, tachycardia, ischaemic strain on the heart, hyperventilation and acute panic attacks. These effects are particularly detrimental in elderly patients with multiple co morbidities and lower physiological reserves.<sup>3</sup> Allaying undue anxiety in these patients not only tends to improve patient's satisfaction level towards surgery but also prevents any untoward complications occurring during the course of surgery. Although proper preoperative counselling and reassurance is known to reduce anxiety, in selected patients conscious sedation is indicated to reduce discomfort during block administration and surgery with added advantages of haemodynamic stability together with enhanced patient cooperation and satisfaction.<sup>4</sup>

In addition to physical pain from administration of local anaesthesia and surgery, frightening visual sensations/images can be perceived by patients (3–16.1%) during phacoemulsification cataract and other ophthalmic surgical procedures.<sup>5–7</sup> The retained visual sensations are expected to occur more frequently under topical

anaesthesia because optic nerve function is not affected. In an earlier study, 15.4% of patients are known to have experienced fear due to these visual sensations under topical anaesthesia.<sup>6</sup> Many authorities advocate preoperative counseling for alleviating fear caused by intra-operative visual images/sensations.<sup>7-9</sup> A recent survey has confirmed that although many ophthalmologists have become aware of the phenomenon of intra-operative visual experience still many do not counsel their patients.<sup>10</sup> Thus, the other method by perception of visual sensations by patients can be reduced is by administration of sedation. Sedation with intravenous midazolam 0.015 mg/kg reduces the ability to see and recall intra-operative visual images/sensations in patients undergoing phacoemulsification cataract surgery under topical anaesthesia. Patients sedated with midazolam experienced less disturbances to the light emanating from the microscope. We believe reduction of these unpleasant experiences can only improve patient's satisfaction.<sup>11</sup>

Administration of sedation in an eye surgeries depends upon various factors like patient's age and systemic co-morbidities, type of surgical procedure, mode of anaesthesia, surgeon's preference, etc.

## Sedative agents used

### Benzodiazepines

In general, benzodiazepines can be administered *via* oral and parenteral routes. Diazepam, midazolam and lorazepam are commonly used for sedation in ophthalmic procedures. Of these Midazolam is widely used all over in clinical practice. Midazolam has both amnesic and anxiolytic properties, lack of venous irritation and rapid patient recovery. It is given slowly intravenously in 1 mg increments, or 0.015 mg/kg. It takes nearly 5–10 min to act. In patients over 60 years and above, it is advisable to reduce the dose by 30%. It can result in respiratory depression or arrest that is more pronounced in the elderly, alcoholics or when used in combination with other sedative agents. Caution also needs to be taken in patients with cardiac, renal or hepatic impairment. Midazolam prevents the increase in blood pressure (BP) associated with insertion of the peribulbar block.<sup>12</sup> It is commonly used either individually or in combination with other agents during a variety of ophthalmic procedures from cataract surgery<sup>20</sup> to oculoplastic<sup>21</sup> and vitreoretinal procedures.<sup>22</sup> Another advantage is that they are the only class of sedative hypnotic whose activity can be readily reversed by an antagonist (flumazenil).

## Intravenous anaesthetic induction agents

### Propofol

Propofol 2,6-diisopropylphenol is an important intravenous anaesthetic agent that has been

extensively used as a sedative agent for ophthalmic procedures due to its favourable pharmacokinetic properties. It has a distribution half-life of 2–8 min after intravenous administration and a short elimination half-life of 30–60 min. The onset of anaesthesia occurs within 30 s of the end of bolus infusion with the effect lasting 3–10 min, subject to dose and rate of infusion.<sup>16</sup> Rapid hypnosis and short duration of action with earlier patient recovery, which is especially important for ophthalmic day surgery.<sup>17</sup> Propofol has well-established anti-emetic properties<sup>18</sup> and is reported to lower IOP intraoperatively.<sup>19</sup> Increased IOP during surgery is common and may make the operation more technically difficult, hence increasing complication rates. Neel *et al.*<sup>20</sup> examined the effects on IOP, pulse rate and BP of low-dose intravenous sedation with propofol. It was found that propofol caused a 17–27% decrease in IOP compared with the baseline, with the effect taking place within the first minute and persistent even after 7 min. However, such IOP lowering effects are not unique to propofol; they are likely due to relaxation of the extraocular muscles rather than the sedative agents themselves.<sup>16</sup>

Respiratory depression and reduced BP are major side effects of propofol. However, it has been suggested that propofol may still be safely administered if given at a lower dose. Other side effects of propofol include pain on injection,<sup>16</sup> increased oculocardiac reflex,<sup>21</sup> anaphylaxis, patient movement<sup>22</sup> and sneezing.<sup>23</sup> The lipid-based formulation of propofol also supports rapid microbial growth at room temperature. Extrinsically contaminated propofol has been associated with postoperative endogenous *Candida albicans* endophthalmitis or fungemia.<sup>24,25</sup> Strict aseptic preparation and administration of propofol are therefore crucial for the prevention of such infections.

## Opioids and narcotic analgesics

### Fentanyl citrate

Narcotic analgesic that has been extensively used in ophthalmic procedures under local anaesthesia; these procedures include cataract surgery<sup>26</sup> and the repair of open-globe eye injuries.<sup>27</sup> It has a rapid onset of action and a short duration of action, about 30 min after a single dose with a half-life of 2–7 h. Given in a bolus dose of 25–50 mcg, it provides analgesia with minimal sedation.

Other opioids which are reported to be used for ophthalmic surgeries are Remifentanyl, Alfentanil and sufentanil. The role of remifentanyl in sedation under ophthalmic anaesthesia has been documented in previous studies. Remifentanyl was found to be superior to propofol when used as the sole sedative agent during combined peribulbar and retrobulbar block for cataract surgery.

Furthermore, respiratory depression with remifentanyl was mild and not clinically significant.<sup>23</sup>

### **$\alpha$ -adrenoreceptor agonists**

Dexmedetomidine is a selective  $\alpha$ 2-adrenoreceptor agonist that has been used for sedation in ophthalmic surgery, and its role is still expanding. Dexmedetomidine has anxiolytic, sedative and analgesic properties. Dexmedetomidine has been used for sedation in cataract surgery under local anaesthesia<sup>28,29</sup> and also as a supplement to general anaesthesia in vitreoretinal surgery.<sup>30</sup> A lower-dose intravenous regime of 0.5  $\mu$ g/kg/h dexmedetomidine for 10 min followed by 0.2  $\mu$ g/kg/h for 50 min was also found to be effective for providing sedation and safe in terms of BP and heart rate control.<sup>31</sup>

### **Monitoring during sedation**

The level of monitoring for sedation during ophthalmic local anaesthesia should be similar to that during general anaesthesia. All patients should receive oxygen at a flow of 2–4 l/min via nasal cannula placed near both the nostrils. Monitoring includes:

- Pulse oximetry,
- Electrocardiography,
- Non-invasive BP.

### **Complications of Sedation**

Complications of intravenous sedation are local, systemic and other non-medical adverse events.

**Local complications:** Failed cannulation, hematoma, phlebitis, pain, air embolism and inadvertent intra-arterial injection, other issues of deep sedation and adverse medical events may also arise.

**Systemic complications:** Overdose can be associated with cardiovascular and central nervous system depression thereby leading to hypoventilation, hypercapnia and airway obstruction.

**Other adverse non-medical events:** Oversedation can also lead to restlessness, and unexpected or unwanted movements during surgery. The loss of residual cooperation is especially prominent in dementia patients even with small doses of sedation.

### **Conclusions**

Adequate sedation in patients under going ophthalmic surgery under local anaesthesia improves patient's satisfaction, makes them more cooperative and helps the surgeon to complete the surgery uneventfully. Sedation should be individualized according to the patient, the type of surgery and surgeon's preferences. There are no 'ideal' drugs for sedation for cataract surgery; a good knowledge of the pharmacology of sedative agents and

a high level of monitoring for sedated patients is always recommended good clinical practice.

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# Systemic and Ophthalmic Complications Following Regional Block

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Ophthalmic surgery is particularly suited to regional anaesthesia. In recent years, topical anaesthesia has become a common modality of anaesthesia for cataract surgery. However, orbital regional anaesthesia is still preferred by many ophthalmologists for cataract surgery and according to recent studies many patients too prefer it.<sup>1,2</sup> Each technique has its own risk/benefit profile. Although serious life or vision threatening complications like brain stem anaesthesia, retrobulbar haemorrhage and globe perforation, are reported rarely, they can occur either due to local agents used or improper administration of regional block. To prevent such complications to occur a thorough knowledge of the anatomy of orbit and its contents and understanding the pharmacodynamics/pharmacokinetics of the agents used is of vital importance. These two factors are already dealt by other authors in this book, We will now focus on various complications their aetiology, risk factors, methods to prevent and treat them accordingly.

## Complications

Complications following regional blocks can be either Orbit or Systemic related.

### Orbital complications

Conjunctival oedema (chemosis) and subconjunctival haemorrhage (ecchymosis)

- More common with peribulbar block due to anterior spread of local anaesthetic (LA) agent.
- These minor complications usually resolve spontaneously within few hours and do not interfere with surgery.<sup>3</sup>

#### Prevention

- Decreasing the rate of injection.
- Adequate digital massage of the globe following injection.

### Retrobulbar haemorrhage

Caused by needle penetration of either the venous or arterial vessels in the orbit.

### Venous haemorrhage

- Slow in onset.

- Presents as markedly blood stained chemosis and do not ordinarily threaten vision.<sup>4</sup>

#### Treatment

- Intermittent digital pressure with a gauze pad over the closed lids is required to reduce the raised IOP, if it occurs.

### Arterial haemorrhage

It can be more serious.

#### Signs and Symptoms

- Proptosis, tight eye lids, ecchymosis, lid swelling and a dramatic increase in intraocular pressure.<sup>4,5</sup>
- A compressive retrobulbar haematoma may threaten retinal perfusion by causing central retinal artery occlusion.<sup>4</sup>

#### Treatment

- Firm digital pressure usually stops the bleeding. Most retrobulbar haemorrhage can be successfully treated conservatively.<sup>5</sup>
- The surgeon has to evaluate the extent of the haemorrhage and determine whether further interventions are necessary.
- IOP can be lowered with acetazolamide or intravenous mannitol.<sup>5</sup>
- Rarely, immediate lateral canthotomy or even paracentesis might be required to relieve orbital pressure.<sup>4</sup>

### Globe damage

#### Globe penetration

Has only wound of entry.

#### Globe perforation

Double puncture wounds (wound of entry and exit).

#### Risk factors

- Patients with axial length > 26 mm.<sup>1,5</sup>
- A deep set eye.
- Multiple injections.
- Previous sclera buckling.
- Lack of orbital knowledge or technique.<sup>6-8</sup>

#### Signs and symptoms

- Intense ocular pain.

- Sudden loss of vision.
- Hypotonus.

#### *Prevention*

- Insertion of the needle based on anatomical principles.
- Explain the procedure and motivate patients to co-operate while performing blocks.
- Prefer peribulbar rather than retrobulbar block.
- Using a needle of maximum length 25 mm.
- Awareness that ocular and orbital anatomy may be disturbed by pre-existing ocular pathology and surgery.

#### *Management*

- Surgery is deferred, ophthalmoscope examination or ultrasound is performed and patient is referred to retinal surgeon.

#### **Amaurosis**

Peribulbar injections of LA do not lead to temporary loss of vision, whereas retrobulbar injection causes this as a consequence of the optic nerve becoming blocked.<sup>3,9</sup>

Before surgery patients should be warned and counselled for this temporary phenomenon to allay undue anxiety and panic attacks during surgery.

#### **Optic nerve injury**

##### *Result from*

- Direct needle stick injury to the optic nerve.
- Secondary to haemorrhage within or around the optic nerve.
- Pressure necrosis from LA agent.<sup>4</sup>

##### *Signs and symptoms*

- Partial or complete loss of vision can occur.

##### *Risk factors*

- In smaller orbits.
- Placement of a long needle aiming towards the apex while performing blocks.

#### **Myotoxicity**

Damage to the extraocular muscles from orbital blocks can result in strabismus, ptosis and entropion.

##### *Possible mechanisms*

- Direct needle trauma.
- Ischaemic pressure necrosis caused by a large volume of LA.

- Use of high concentrations of Lidocaine.<sup>8,10</sup>
- This is most commonly seen if classical one-third/two-third approach to both peribulbar and retrobulbar block is used because this usually penetrates the inferior rectus muscle.

##### *Management*

- Often resolve spontaneously but if permanent may require strabismus surgery.

#### **Corneal abrasions**

This can occur from a compression device or post-operatively as the motor effects wear off, allowing the eyelid to open, thus exposing an anaesthetic cornea. When the lid function is impaired operated eye should be patched until sensation and motor functions return.

#### **Ocular explosion**

- Inadvertent injection of LA solution directly into the globe under high pressure until the globe ruptures or explodes.<sup>11,12</sup>
- It is a devastating injury that may go unrecognized.

##### *Prevention*

- Careful use of a syringe 10 mL with a blunt needle.
- Discontinue injection if resistance is met.
- Inspecting the globe prior to ocular massage or placement of a Honan balloon.<sup>11</sup>

##### *Treatment*

- When ocular explosion occurs, immediate referral to and intervention by a vitreoretinal surgeon is optimal.

Practicing ophthalmologists should be aware of this blinding but preventable complication of ocular surgery.

#### **Systemic complications**

LA solution toxicity and vasovagal reactions are the most common systemic complications associated with local anaesthesia. Systemic complications can range anywhere between a mild vasovagal attack to a life threatening emergency.

##### *Causes of LA toxicity*

- Inadvertent intra-vascular injection,
- Brain stem anaesthesia,
- Excessive dose of anaesthetic,
- Allergic reaction,
- Vasovagal reaction.

*Patterns of LA toxicity*

Neurological leading to cardiovascular collapse

- Numbness of tongue and circum-oral area
- Lightheadedness
- Visual disturbances
- Muscular twitching
- Unconsciousness
- Convulsions
- Coma
- Respiratory arrest
- Cardiovascular arrest

**Allergic reactions**

Allergic reactions from amide anaesthetics such as lidocaine and bupivacaine are rare.

**Hyaluronidase allergy**

Hyaluronidase, an additive used to promote the onset and quality of the block, may occasionally cause allergic reactions.

*Signs and symptoms*

Swelling of the same<sup>11-15</sup> and contralateral<sup>16</sup> orbital region owing to hyaluronidase allergy following regional block have been reported previously.

*Time of onset*

Variable

- Immediate (pre-operative or intra-operative),<sup>16</sup>
- Early (within a few hours),
- Intermediate (within a few days),
- Late (within weeks).<sup>11,12</sup>

*Differential diagnosis*

Although uncommon, allergy to hyaluronidase injected during ophthalmic blocks should be considered in a differential diagnosis of patients who present with acute post-operative orbital swelling and inflammation. In the absence of septic foci of infection, fever, altered blood count, etc. allergic response to LA and adjuvants used should be suspected.

*Diagnosis*

- Many of these patients gives history of exposure to agent (Hyaluronidase) suggesting it is due to Type I IgE mediated hypersensitivity reaction.
- Intradermal test can further confirm the diagnosis.

*Management*

- Systemic steroids.

- Oral chlorpheniramine Tablet.

**Brain stem anaesthesia**

It occurs when the injected anaesthetic gains entry into the subarachnoid space. The proposed mechanism is that the cerebral dura mater provides a dural sheath for the optic nerve as it passes through the optic foramen. This sheath fuses with the epineurium of the optic nerve and is continuous with the sclera, providing a potential conduit for LA to pass subdurally into the brain.

*Time of onset of symptoms*

- Variable,
- But major sequelae develop usually in the first 15 min after the injection.

*Signs and symptoms*

- Vary, depending upon which part of the CNS is affected by the LA<sup>17-19</sup>
- Intense shivering
- Vomiting
- Temporary hemiplegia
- Aphasia
- Contralateral cranial nerve palsy
- Generalized convulsions
- Blockade of the 8 to 12th cranial nerves will result in deafness, tinnitus, vertigo, dysarthria, dysphagia and aphasia<sup>20-23</sup>

These signs may present themselves in various combinations and the anaesthesiologist must be alert and prepared to provide cardiopulmonary resuscitation as an emergency, when there are apparent signs of local anaesthesia spreading to the CNS. While symptomatic and proper treatment can lead to total recovery of the patient, delay in diagnosing and treating could be fatal.

**Oculocardiac reflex***Mechanism of action*

Mechanical stimulation of the globe

Afferent pathway is via the ciliary nerves to the ciliary ganglion, then via the ophthalmic branch of the trigeminal nerve to the brain.

The efferent pathway is via the vagus to the heart.

Manifests as bradycardia, hypotension or cardiac arrhythmias.

*Can be encountered in*

- Squint surgery in paediatric age group
- During intraorbital injection of LAs
- Following digital massage to the eye

- Pinching of the conjunctiva with a forceps
- Postoperative pressure of the bandage<sup>24</sup>

#### Prevention

- Monitor ECG, pulse oximetry while performing regional block
- During surgery gentle manipulation of extraocular muscles to be given

#### Management

- Removal of the inciting stimulus is immediately indicated
- If bradycardia still persists or recurs, then Inj atropine or glycopyrrolate IV to be administered

#### Vasovagal reaction

This is a neurocardiogenic syncope. An abnormal autonomic response with vasodilatation and increased vagal tone. There may also be a reduction in cardiac filling and bradycardia.

#### Conclusion

Ophthalmic regional anaesthesia has evolved into a sophisticated art which requires a sound knowledge of orbital anatomy, physiology and pharmacology of ophthalmic drugs. The technique is not without complication. It is a must that adequate training under expert supervision is a prerequisite before attempting to perform regional block. Both ophthalmologists and ophthalmic anaesthesiologists must be prepared to deal with rare, but serious complications that can occur with any technique of orbital regional anaesthesia.

#### Clinical Practical Pearls to be remembered

- ✓ Bevel should face the globe, to reduce the chance of snagging of the globe by the tip of the needle.
- ✓ Eye should be in primary gaze position, to prevent any iatrogenic trauma to optic nerve.
- ✓ Aspirate before injecting LA solution.
- ✓ Injection should be done slowly, to decrease the pain perceived by patients during injection.
- ✓ Always feel the tension of the globe with fingers of the non-blocking hands.
- ✓ Stop injecting the LA solution when there is any atypical pain, any resistance felt or if there is any abnormal movement of the globe seen during injection.
- ✓ Always withdraw the needle along the line of insertion.

- ✓ Injection at superomedial quadrant should not be administered. Superomedial quadrant is more vascular in nature when compared with the remaining other three quadrants resulting in more chances of haemorrhage to occur in the lid and as the globe is closer to the roof than to the floor, superomedial block *per se* can result in perforation of the globe.<sup>25</sup>
- ✓ Once the local anaesthetic has been injected the most important thing to be done immediately is the gentle digital ocular massage for a period of 2 min.
- ✓ Always assess the initial block and if required perform supplementary injections.

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# Control of Intraocular Pressure for Insertion of Intraocular Lens

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**Intraocular pressure (IOP)** can be defined as the pressure exerted by the fluid in the eye against the walls of the eye ball. The average value of IOP is  $16 \pm 5$  mmHg.

In ophthalmic surgeries of the intraocular type such as phacoemulsification cataract surgery, extracapsular cataract extraction with or without intraocular lens implantation, small incisional cataract surgery, etc. it is important to prevent any rise in IOP before a surgical incision is made. As soon as the sclera is surgically incised, IOP equates atmospheric pressure.

If the pressure is high at the time of incision, the intraocular contents namely the iris, lens, vitreous and retina, may be expelled through the wound.<sup>1</sup> Sudden decompression of hypertensive eye may also increase the likelihood of rupture of a sclerotic short posterior ciliary artery in the choroid, thus producing an expulsive haemorrhage in the eye.<sup>2</sup>

It is therefore important to understand the various physiological and pharmacological factors that influence the IOP during the perioperative period so that it can be maintained at a low-normal level before a surgical incision is made.

The three main physiological factors affecting IOP during surgery<sup>2</sup> are:

1. Aqueous humour dynamics,
2. Blood volume in the eye,
3. Extraocular muscle tone and vitreous volume.

## Aqueous humour fluid dynamics

The major controlling influence on IOP is the dynamic balance between aqueous humour production and its drainage from the eye.

### Production of aqueous fluid

About 80% of aqueous is formed in the posterior chamber by the epithelial cells of the ciliary body by an active transport mechanism. The remaining 20% is formed in the anterior chamber by simple ultrafiltration of plasma through the anterior surface of the iris.<sup>3</sup>

### Drainage of aqueous fluid

About 85–95% of aqueous resorption occurs through the trabecular network and Schlemm's canal in the angle between the iris and the cornea, termed as canalicular outflow. The remaining 5–15% of aqueous resorption occurs

directly through the scleral interstitium known as the uveoscleral route or extracanalicular pathway.

The pharmacological agents which affect IOP by influencing either aqueous humour production or drainage are acetazolamide (by inhibiting carbonic anhydrase), topical drugs with sympathetic and parasympathetic effects, beta blockers, anaesthetic drugs (Thiopental sodium)<sup>4</sup>, etc.

## Blood volume in the eye

The choroidal circulation accounts for ~90% of total ocular circulation. The choroidal blood volume depends on a balance between the rate of arterial blood inflow to and the rate of venous blood outflow from the eye. Apart from this, the baseline intraocular blood volume depends on the tone of the intraocular blood vessels.

### Effect of Change of Systemic Arterial Pressure on IOP

The choriocapillaries have the ability to locally autoregulate and thus the choroidal blood flow remains constant through a range of perfusion pressures. But this autoregulation is a slow process, hence a sudden increase in systolic blood pressure produces a transient acute rise in IOP. Moderate decrease in arterial pressures has little effect on IOP, but below mean pressure of 90 mmHg marked reduction in IOP tends to occur.

### Effect of Change in Venous Pressure on IOP

Normally, the aqueous venous pressure (15 mmHg) inside the globe is higher than the episcleral venous pressure (10 mmHg) outside the globe. This pressure gradient helps in draining the choroidal venous plexuses in the eye. If episcleral venous pressure increases due to obstruction of the central venous return, then the above pressure gradient falls and blood begins to pool within the orbit thus resulting in increase in choroidal volume in the eye.

### Causes for Increased Central Venous Pressure:

The following factors can cause an increase in central venous pressure under local anaesthesia (remember the mnemonics 'ABC VSR')

- Anxiety,
- Bladder fullness,
- Cough,
- Vomiting,
- Straining and

- Restlessness.

#### Intraocular vascular tone and IOP

Intraocular vascular tone is predominantly affected by PaCO<sub>2</sub>, PaO<sub>2</sub>, systemic pH and body temperature.<sup>2</sup> A linear correlation exists between PaCO<sub>2</sub> and IOP. Thus, respiratory acidosis increases IOP, whereas respiratory alkalosis decreases IOP. On the other hand, metabolic acidosis causes reduction in IOP while metabolic alkalosis increases IOP. Hyperbaric oxygen tensions are associated with profound choroidal vasoconstriction and hence this decreases IOP. Hypoxaemia induces choroidal vasodilatation which elevates IOP. Systemic hyperthermia has been shown to increase in IOP in humans. Hypothermia induces a significant reduction in IOP due to decreased aqueous production and associated vasoconstriction.

#### Extraocular muscle tone and vitreous volume

The central nervous system was found to influence IOP directly through neurogenic control of extraocular muscle tone from central diencephalic control centres. IOP increases markedly following contraction of the extraocular muscle. General anaesthetic drugs decrease IOP partly by depressing these neurogenic centres.

The vitreous is an unstable gel, consisting mainly of water, whose volume can be radically altered by changing the osmolarity of the blood reaching it. Thus, acute reduction in IOP can be achieved by infusing 20% Mannitol 1.5 g/kg IV.

#### IOP in Regional Eye Blocks

##### Peribulbar block

There is a large and individual variable rise in IOP following peribulbar block.<sup>5,6</sup>

The degree of IOP elevation depends on the following:

- Volume of local anaesthetic injected
- Tightness of the orbital septae
- Type of local anaesthetic used

The lowest IOP elevation occurs with bupivacaine, a more marked effect is seen with lidocaine and the highest elevation occurs after mepivacaine injection.<sup>7</sup>

In peribulbar anaesthesia a much larger volume of local anaesthetic is required, as this has to diffuse through the orbital connective tissue septa and the muscle cone to block the motor and sensory nerves in the eye. A larger drug volume in turn raises the IOP to a greater extent compared with a retrobulbar technique where relatively less volume of the drug is required, as this is injected directly inside the muscle cone.<sup>8,9</sup>

#### Sub-tenon's block

It does not cause significant increase in IOP. However, a reduction in IOP was found to occur soon after sub-tenon's injection, possibly due to reduction in muscle tone.<sup>10</sup>

#### Ocular compression

A soft (normotensive) eye is preferred during cataract surgery, as in this state the vitreous phase will remain concave after lens extraction and minimize intraoperative complications. Hence, to aid in the diffusion of the drug more uniformly and also to make the globe softer, some form of ocular compression is necessary following a regional block around the eye.

#### Mechanisms by which Ocular Compression help to decrease IOP<sup>11</sup>

- By decreasing the volume of the vitreous, which is ~50% water in the elderly patients.
- By decreasing the volume of the orbital contents other than the globe by increasing the systemic absorption of orbital extracellular fluid, including, presumably, injected fluids such as anaesthetics.
- Increasing the aqueous outflow facility mechanism.
- Emptying the choroidal vascular bed.

#### Methods of Ocular Compression

1. The *Super pinky* is a hard hollow rubber ball, placed directly over the patient's eye with the help of an elastic strap that is threaded through it, see Figure 1.

2. *Digital ocular compression* can be done with the help of the middle three fingers placed over a sterile gauze pad on the upper eye lid with the middle finger pressing gently on the eye ball. For every 30 s pressure would be released for 5 s to allow for the vascular pulsations to occur. The disadvantage in both the above methods is that the pressure applied is not known, see Figure 2.



Figure 1. Super pinky.



**Figure 2.** Digital massage to the globe following injection of local anaesthetic solution.

3. One of the most popular methods of ocular compression worldwide remains the *Honan balloon*, officially known as the Honan IOP Reducer. This device has several advantages. First, it is easy and reliable to use. It allows the user to set a known and steady level of pressure. Normally, the Honan balloon is applied for 20 min at a pressure of 30 mmHg following an orbital block.

#### Control of IOP during Eye surgery

Although eye is made soft (normotensive) by giving an adequate globe compression, before a surgical incision is made, IOP can still raise during surgery causing technical problems for a surgeon, especially for implanting Intraocular lens.

It is therefore very important to determine the cause for rise in IOP and treat it appropriately.

#### Raise in IOP during surgery: different causes and its management

- Squeezing of the eye due to contraction of the orbicularis oculi following an inadequate block would result in a rise in IOP during surgery. Supplementation of the block with local anaesthetic especially a medial peribulbar may be considered. Always ensure that eye lid is anaesthetized before proceeding with the surgery. If not, a separate eye lid block has to be given.
- Lid retractors may press on the eye and cause bulging of the intraocular contents.<sup>12</sup> To reduce this extraocular pressure effect loosening the speculum and eyelid sutures would help.
- Inadequate block resulting in pain during surgery. Patient may strain resulting in raise in IOP. Assess the site of origin of pain. If the pain is from peripheral conjunctiva, then topical proparacaine drops may be instilled. If it is from limbal conjunctiva and other intraocular structures, sub-tenon's supplementation

may be considered, if conjunctiva is already incised or intraocular lidocaine may be administered intracamerally. Also, intravenous opioids/sedation may be given.

- The patient may strain due to fullness of the bladder especially seen in elderly patients. Always ensure that the patient has emptied his bladder before he/she is shifted into the operation theatre.
- Restlessness due to anxiety/phobic attacks can increase the IOP. Reassurance and sedation may help these patients.
- Posture of the head also influences the pressure inside the eye. An head-up tilt of 15° enhances venous drainage in the eye and a head down tilt produces venous engorgement resulting in raised IOP. So during surgery the patient's head must be appropriately positioned to avoid undue changes in IOP.
- In spite of the above remedial measures, if the posterior capsule is bulging during surgery, then consider 20% Mannitol 1–2 gm/kg IV. Mannitol acts by reducing the volume of vitreous. The mechanism of vitreous shrinkage is commonly considered to result from an osmotic gradient between the blood and ocular tissues, which initially pulls fluid from the eye. Its onset of action is within 20–30 min.
- For immediate reduction of IOP during surgery, lidocaine IV 0.5–1.5 mg/kg given over 15–20 s was found to reduce the IOP in about 60–90 s with a peak effect in 8–12 min after which the effect gradually wore off.<sup>13</sup>
- Thus by these technique IOP can be controlled both preoperatively and intraoperatively and helps a surgeon to complete the surgical procedure uneventfully under regional anaesthesia.

#### Conclusion

Even though there are many physiological and pharmacological factors that influence the IOP during surgery, it is the technique and the experience of the anaesthetist practicing ophthalmic anaesthesia, the skill of the ophthalmologists and the team work that determines the visual outcome of the eye surgery.

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# Peri-operative Management of Medical Emergencies

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The anaesthetic requirements for ophthalmic surgery are dictated by the nature of the proposed surgery, the surgeon's preference and the patient's wishes. The growing trend is towards local anaesthesia in preference to general anaesthesia in eye surgery. Complications arising from orbital regional anaesthesia may be local, or may manifest systemically and may arise immediately or may be delayed.<sup>1,2</sup> Complications are related to the method of administration or local anaesthetic agent and adjuvant used, and may range from trivial to the devastating, which may threaten sight or even life. In spite of taking necessary precautions at every step, still certain medical emergencies can occur in an ophthalmic setup. These emergencies may crop out anywhere along the way, starting from during administration of the block, during surgery or in the postoperative period.

In this chapter, we will look into these medical emergencies their causes and management.

## Vasovagal Attack

Vasovagal syncope is loss of consciousness caused by reduced arterial pressure and blood supply to the brain, mediated through neural mechanisms rather than primary cardiac dysfunction. Bradycardia and vasodilation are the characteristic changes that cause systemic hypotension.<sup>3</sup> Vasovagal attack termed as 'pre-syncope' or 'near-syncope' is used to describe a state that resembles the prodrome of syncope but which is not followed by LOC.<sup>4</sup> The trigger may be central, from psychic stress or pain, or may be initiated peripherally by a reduction in venous return to the heart.<sup>5</sup> The Bezold-Jarisch reflex overlaps with vasovagal syncope. It was initially described as a bradycardic response to injection of various alkaloid compounds, and later found to be mediated by chemoreceptors in the heart.<sup>6</sup> The term has now come to include reactions triggered by cardiac mechanoreceptor activation<sup>7</sup> and it has been used to describe perioperative bradycardia with hypotension.<sup>8</sup>

### Signs and Symptoms

- A feeling of heaviness in the legs
- Blurred vision
- Confusion
- Feeling warm or hot

- Lightheadedness, dizziness, a floating feeling
- Nausea
- Vomiting
- Sweating
- Yawning
- The person may be unusually pale
- There may be a *drop in blood pressure*
- There may be a *weak pulse, bradycardia*

In an Ophthalmic set up syncope of vasovagal type can occur in the following situations:

- While administering a regional block
- Pain during surgery
- Applying a tight patch over an operated eye
- Removing the patch for postoperative dressing
- Removing or tightening sutures under topical anaesthesia
- Intravitreal or subconjunctival injection of antibiotics

### Treatment

Mainly symptomatic.

- Elevation of foot end to improve cerebral perfusion,
- Hypotension can be treated with sympathomimetic agents,
- Bradycardia with anti-cholinergic agents.

### Brainstem anaesthesia

Brain-stem anaesthesia is a serious complication of orbital regional anaesthesia that may occur when the injected local anaesthetic agent gains access to the central nervous system. An unintentional injection under the dura mater sheath of the optic nerve or directly through the optic foramen may result in subarachnoid spread of the LA. This causes partial or total brainstem anaesthesia.<sup>9-11</sup> Failure to recognize the condition or to treat it adequately may be life threatening.

### Presenting Features<sup>12</sup>

Onset: The onset of signs and symptoms is inconsistent and known to range between seconds and

40 min after regional block. Commonly, the onset has been reported within 5–10 min after block with complete recovery of consciousness within an hour although wide variations exist.

- *Confusion, restlessness, slurring of speech, shivering, agitation and dizziness.*
- The cardiovascular system is manifested by cyanosis, hypotension and bradycardia but sometimes hypertension and tachycardia have been reported.
- The respiratory system is manifested by apnoea and pulmonary oedema.

However, other causes of cardiorespiratory arrest such as anaphylaxis, acute coronary syndrome, massive pulmonary embolism, stroke and seizure should be excluded.

#### Treatment

It is important to initiate appropriate treatment promptly.

If symptoms are mild like shivering, restlessness, etc. treatment includes administration of sedation (Midazolam 0.5–1 mg IV), warm air to be blown with the help of warmer, reassurance and if vitals are within normal limits the surgery can be completed at the earliest time. Constant vigil monitoring of vital signs is very important not only till the surgery is over but also postoperatively such patients to be monitored in the ICU to look for any other signs of spread of local anaesthetic into other areas of CVS and respiratory centre of the CNS.

- If more serious signs and symptoms occur, patient to be resuscitated according to the principles of Advanced Trauma Life Support by securing the airway, assessing breathing and circulation.
- Supporting measures
  - ↳ supplemental oxygen if the patient is conscious
  - ↳ intravenous fluids
  - ↳ pharmacological circulatory support with the use of vasopressors, vagolytics/vasodilators
  - ↳ suppression of seizures if present
- Reassure the patient if still conscious.
- Patients who present with apnoea and become unconscious, the airway should be secured by endotracheal intubation and mechanical ventilation has to be performed rapidly.
- The vital signs of the patient have to be continually monitored and reassessed.
- In patients with eye signs and symptoms, visual acuity has to be ascertained.

*For patients who are stable and anaesthesia is adequate, surgery can usually be proceeded with.*

Attention has been focused on ocular position when regional anaesthesia of the eye is performed, in an attempt to avoid intrathecal injection and optic-nerve injury. With the globe in superonasal gaze, the optic nerve and the subdural space are in close proximity to the introduced needle.<sup>13,14</sup> In this position, the needle tip can reach the meningeal sheath surrounding the optic nerve, allowing local anaesthetic to diffuse towards the subarachnoid space. In keeping the globe in a positing primary gaze, the optic nerve sheath is less vulnerable to needle penetration.<sup>15</sup>

#### Acute exacerbation of chronic asthma

Asthma is a chronic respiratory condition of the lungs. It is caused by inflammation surrounding the airways, decreasing their ability to exchange air. An acute asthma exacerbation occurs when the symptoms of asthma worsen suddenly presenting with wheeze, cough and difficulty in breathing. Such acute exacerbations can occur in a known asthmatic patients especially if the face is covered with the surgical drapes and surgery is prolonged for over longer duration of time. Patient may complain of tightness of chest, may cough and wheezing may be heard. There may be also desaturation in arterial oxygen and associated tachycardia and rise in blood pressure due to restlessness in them.

#### Prevention

Preoperatively identify such patients and complete the surgical procedure at the earliest time interval possible.

Advise to continue bronchodilators (oral/inhalers) and steroids on the day of surgery.

Nebulisation with steroids and bronchodilators around 1 h before surgery can be done.

#### Treatment

Providing Oxygen  
Intravenous corticosteroids and bronchodilators.

Nebulization/inhalation of high dose steroids.

If not responding intubation, mechanical ventilation and shift to an Intensive Medical unit for further treatment and observation.

#### Seizure

During surgery under loco regional anaesthesia, convulsions may have several causes such as

- ↳ Hypoglycemia
- ↳ Medication errors
- ↳ Stroke, severe hypoxia caused by deep sedation
- ↳ Following a cardiac arrest complicating cardiac ocular reflex

- ⇒ Central nervous system intoxication by spread of local anaesthetic agent.

Several mechanisms may explain the spread of local anaesthetic agent used in peribular anaesthesia to brain structures causing various neurological signs.

The first mechanism is an *inadvertent intra-arterial injection in the ophthalmic artery or its branches*. The injection pressure can reverse the direction of blood flow in the artery and the anaesthetic solution flows back into the internal carotid artery and is delivered to the thalamus and other midbrain structures.<sup>16-18</sup> Indeed the ophthalmic artery is in an abnormal position inferior to the optic nerve in 15% of cases, this exposes inadvertent intra-arterial injection during a peribular

anaesthesia.<sup>16</sup> In this case, the direct exposure of brain structures to a low volume of local anaesthetic agent is similar to intoxication after inadvertent peripheral intra-arterial injection of a large volume of local anaesthetic agent, thereby clinical presentation is similar.

Clinical signs have rapid onset and can range from loss of consciousness to cardiac arrest. Convulsions may be present or replaced by an electric silence.<sup>19</sup>

The second mechanism is *inadvertent brainstem anaesthesia*.

Another mechanism that can be evoked is the *absorption of Local Anaesthetic agent by the arachnoid villi and spread to cerebral structures*. This absorption is favoured by manual compression and the use of hyaluronidase.<sup>20</sup>

Perioperative causes of convulsions and their management and prevention<sup>21</sup>

Causes	Signs & Symptoms	Management	Prevention
Oculocardiac reflex	Bradycardia/cardiac arrest	Release of muscle tension Injection of atropine	Gentle muscle tractions Injection of atropine
Drug errors	Tachycardia/bradycardia/ convulsions (depends on type of drugs injected)	Symptomatic treatment	Labelling of syringes Verification of syringes before injection
Hypoglycemia	Sweating, drowsiness, confusion, abnormal behaviour convulsions	Administration of 25% glucose	Perioperative monitoring of blood glucose
Hypoxia	Desaturation, consciousness disorders, convulsions.	Oxygen therapy, liberation of superior airways, intubation	Monitoring of oxygen saturation Systematic supplemental oxygen during sedation Monitoring of sedation
Stroke	Consciousness disorders, respiratory distress, haemodynamic instability, convulsions	Control of airway, control of haemodynamics parameters	Management of cardiovascular drugs Neurological monitoring Maintaining a stable haemodynamic and normal oxygenation
Toxicity of local anaesthetics	Somnolence, diplopia, shivering, Difficulty speaking, arrhythmias Convulsions, coma	Airway Management Oxygen Anticonvulsants	Aspiration before injection Reduction of local anaesthetic doses

### Allergic reactions and Anaphylaxis

A general term for a drug-related clinical event which either threatens life or disrupts the course of an operation.

It is a multisystem response to a drug, or drug combination, to which the patient may or may not have been previously exposed. In the ophthalmic setup allergies may be encountered with local anaesthetic agent or iodine which is used for cleaning.

Although the incidence of allergic reactions to local anaesthetics has decreased, they are still documented.<sup>27</sup> More than the local anaesthetic itself, it may be due to the additives used.<sup>22</sup> Allergic reactions to local anaesthetic agents may occur as a result of sensitivity to

- The ester or amide component, local anaesthetics of the ester type are more likely to produce allergic reactions as they are metabolised to para-aminobenzoic acid, which is an allergenic compound.<sup>23</sup>
- The methylparaben used as a preservative in the multiple dose vials.<sup>24</sup>
- Adjuvants-Hyaluronidase.<sup>25</sup>

### Presentation

Life threatening effects include cardiovascular collapse (90%), bronchospasm (30%), angio-oedema (25%) and pulmonary oedema (49%) (Fisher, 1992).

- 1 Cutaneous effects
 

These include flushing and urticaria and may cause significant fluid depletion. The development of a 1-mm layer of subcutaneous fluid over the whole body is approximately equivalent to a loss of 1.5 l of extracellular volume.
- 2 Cardiovascular effects
 

Features vary from moderate hypotension to cardiovascular collapse. Hypotension is secondary to release of histamine and other vaso-active amines. Changes in heart rate and rhythm accompany the hypotension. ECG changes most commonly observed was the supraventricular tachycardia (82%) (Fisher, 1986) and AV conduction defects.
- 3 Bronchospasm
 

It is serious and can lead to cerebral hypoxia if treatment is delayed.
- 4 Glottic oedema
- 5 Gastrointestinal effects—abdominal pain, diarrhoea and vomiting.

**Management**

- 1 Resuscitation
  - a) Stop administration of the suspected drug.
  - b) Administer 100% oxygen and maintain the airway.
  - c) Give adrenaline i.v., 50–100 mcg (0.5–1.0 ml of 1:10,000 solution) for cardiovascular collapse. Repeat as required.
  - d) Give crystalloid or colloid i.v 10 ml/kg rapidly to expand the vascular volume.
  - e) Manage the airway. In the presence of sever laryngeal oedema and failure of tracheal intubation, tracheostomy or cricothyroidotomy may be required.
  - f) Measure pH and arterial blood gases, acidosis may be treated with sodium bicarbonate.
- 2 Second line treatment
  - a) Antihistamines
 

Chlorpheniramine i.v., 10–20 mg given slowly over 1 min.
  - b) Aminophylline
 

A dose of 250–500 mg (5 mg/kg) given slowly over 20 min may be required if bronchospasm persists.
  - c) Corticosteroids

**Pulmonary Oedema**

Pooling of fluid in the lungs otherwise known as pulmonary oedema during the perioperative period of an ophthalmic surgery has been reported in literature.<sup>26</sup>

This is more commonly encountered in patients with underlying co morbid conditions like Coronary heart disease, Valvular heart disease, etc. Typically, the patient would complain of difficulty in breathing under the drapes and then start coughing. On auscultation of the lungs basal coarse crepitations can be heard. Pulse oximetry will show fall in arterial saturation level.

**Management**

- 1 If the patient is conscious, to be place in an upright position and oxygen administered.
- 2 Morphine i.v. should be given in 2 mg increments at 2-min intervals to a total of 10 mg this reduces preload by venodilatation and relieves agitation.
- 3 Frusemide i.v. 20–50 mg, especially if there is fluid overload. Acute venodilatation and subsequent diuresis results.
- 4 A vasodilator such as isosorbide dinitrate, nitroglycerine or nitroprusside may be used.
- 5 If the patient is in atrial fibrillation, control of the heart rate with verapamil 5-10 mg i.v. is given slowly or digoxin is required.
- 6 In severe myocardial dysfunction, a dilating inotrope such as dobutamine may be required.
- 7 If desaturation persists and patient is restless, tracheal intubation and controlled ventilation (Positive End Expiratory pressure) to be done.

**Conclusion**

Although eye surgeries are being treated as minor risk surgery, patients may present with systemic co-morbidities like cardiac, respiratory, renal disorders, etc. These disorders *per se*, superimposed by the stress of anaesthesia and surgery and the effects of anaesthetic agents can result in various medical emergencies like acute left ventricular failure, acute exacerbation of chronic asthma, pulmonary oedema, seizures, etc. Hence, it is very important for a surgeon to identify such cases pre-operatively, to remain extra vigil during surgery, if possible to do under topical mode of anaesthesia and complete the surgical procedure at the earliest time interval possible. Also, it is the duty of anaesthesiologists to provide a complete monitored anaesthesia care and to be prepared with all medical emergency drugs and kits both during and after surgery.

Always be alert while administering a regional block, keep conversing with the patient, keep your eyes wide open to identify tell tale signs and let your ears concentrate on the sounds of the monitor.

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# Management of Difficult Patients under Local Anaesthesia

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### Introduction

Our eye hospital is primarily a referral centre and we perform ~12,000 cataract surgeries under local anaesthesia in a year. Once surgery has been advised, patients undergo complete physical examination by our in house physicians, with routine lab investigations (Complete hemogram, blood sugar, ECG for 40 years and above and urine examination). The anaesthetists review and examine the patient on the day of surgery. The above protocol is followed routinely at our Institution for all patients. In spite of the above measures, some patients suddenly become uncooperative in the middle of surgery causing *difficulties* to both surgeon and anaesthetist. Difficult patients are those who were uncooperative, not able to please or satisfy them and requiring more efforts and skills from both surgeons as well as anaesthesiologists to manage them successfully. Thus, the main aim of this chapter is to discuss our Institutional experiences regarding the various causes which make a patient uncooperative suddenly during cataract surgery and how we manage these *difficult patients* on the table.

### Various causes which makes patients 'difficult' during surgery

#### Anxiety

Patients posted for cataract surgery usually worry about their postoperative visual prognosis, especially this more common with single eyed patients. They need to be explained the surgical procedure and the steps involved in administering local anaesthesia in simple, non-technical terms and in their native language to enable informed consent. With a proper preoperative counselling, holding the patient's hands with gentle reassurance during surgery and mild sedation with Inj midazolam 0.5-1mg IV mostly these types of patients can be managed.

#### Iatrogenic breathing difficulty

Difficulty in breathing due to surgical plastic drapes sticking to both the nostrils can cause some patients to gasp for breath and in turn makes them to move constantly during surgery. To avoid such an iatrogenic cause of upper airway obstruction, we have been using an indigenously designed frames, see Figure 1, which make the sterile plastic drapes to be lifted away from the face so that patient can easily breathe through their nostrils.

#### Claustrophobic patients

Some patients following the surgical drapes, they become restless, uncooperative and forcefully remove the drapings over their face. These types of patients can be claustrophobic in nature. It is very important to identify such patients during the preoperative visit or consultation. Once they are identified, before administration of regional block, we generally make them to undergo trail of drapings and see whether they are able to tolerate the coverings over the face. Sometimes we even teach the patient's attendant about these draping and ask them to do the same to the patient at home so that they can be mentally prepared for this during the day of surgery, see Figure 2. Apart from trail of draping, reassurance and sedation with Inj midazolam we manage these types of patients with a special indigenously designed frame by us, see Figure 3(A-D), which helps in lifting the drapes further away from the face compared with frames used in normal patients and thereby they can lie down flat comfortably till the surgical procedure is completed.

#### Difficulty in lying down flat

Obesity, kyphoscoliosis, joint ankylosis, etc. are some of the causes which make patients difficult to lie down flat in supine position for a long time. For patients who were obese extra arm support is attached to the operating table and for those who are kyphoscoliotic adequate postural support with pillows underneath is kept, to enable these patients lie down comfortably at their own posture, see Figure 4.

#### Pain during surgery

Failed regional block resulting in inadequate analgesia or under topical anaesthesia manipulation of iris can result in pain during surgery. Apart from sympathetic stimulation like rise in heart rate, blood pressure and sweating, patient moves or strains to bear the pain. We always encourage the patient to communicate with the surgeon orally if there is any pain during surgery. Analgesic supplementation is done either by instillation of topical proparacaine drops, if possible, parabolbar block given with 2% lignocaine 1-2 cc or injecting intracameral 2% lidocaine. Also, sedation with Inj midazolam 0.5-1 mg IV is given to allay any undue anxiety provoked by pain. But it is always wise to remember that 'IV Sedation alone will not help to reduce pain caused during surgery'.



**Figure 1:** Indigenous frame for Cataract surgery.



**Figure 2:** Patient and the attendant being counselled by the anaesthesiologist preoperatively.

#### **Inadvertent injection of local anaesthetic agent into central nervous system**

While performing regional block inadvertent dural sheath penetration around the optic nerve by the needle can result in the spread of local anaesthetic solution into central nervous system (CNS). The time of onset of symptoms is variable, but usually it develops in the first 15 min after the administration of local anaesthesia. It can present either after surgical drapings and before the start of surgery or during surgery too. A range of different cardiovascular and respiratory signs and symptoms can occur depending upon the spread of local anaesthetic solution into the CNS. It can be minor like shivering, restlessness, fall in blood pressure, bradycardia, vomiting, etc. to major like generalized convulsions, respiratory arrest etc. If it is minor it is treated symptomatically and surgery is completed but if it is major surgery is deferred and it is treated accordingly. Monitoring vital signs at regular interval and maintaining verbal contact with the patient during the block and after draping can help to detect early signs and

symptoms and so prevent further complications as a result to occur.

#### **Hard of hearing**

This is particularly seen in elderly patients who have sensory hearing deficit. This can lead to communication problem and they might follow surgeon's commands. We generally identify it in physical consultation and the same is noted in the file. Also, if hearing aid is used by them we allow it inside the operation theatre to enable them to follow oral instructions.

#### **Perception of visual sensations**

Au Eong and associates were the first to document that patients can have frightening visual experience during cataract surgery especially done under topical anaesthesia.<sup>2</sup> This fear and anxiety may cause such patients to become suddenly uncooperative in the middle of surgery, provoking panic attacks and thus potentially increase the intraoperative complications. Hence, we generally sedate the patients with Inj. Midazolam 0.015 mg/kg IV. It has found to reduce both the ability to see and to recall the visual images, after surgery.<sup>3</sup>

#### **Fullness of bladder**

Again this is found in geriatric patients in whom commonly hypertrophy of the prostate glands occurs and also in patients with diuretic therapy for antihypertensives. Bladder attains fullness in such patients more so following exposure to cold environment of the operation theatre and it makes the patient uncomfortable, strains, make unnecessary movements during surgery. Routinely, we ensure such patients empty their bladder before transferring them inside the operation theatre.

#### **Language barrier**

Our Institution being a tertiary referral centre this is a simple reason which we often encounter and which makes the patient unable to follow commands given by us. If the operation theatre team is not well verse with the language spoken by the patient, then we normally allow a language interpreter to be with the side of the patient in the theatre during surgery.

#### **Emotionally upset**

Patients may be mentally or emotionally disturbed due to personal conflicts and are often not forthcoming with their problems unless presented with an opportunity to 'pour their hearts out'. In such a frame of mind if a patient presents for eye surgery, we have come across few cases in which they suddenly become uncooperative (functional) during surgery. Only a detailed and thorough history both with the patient and attendants can reveal these.



**Figure 3:** (A) Indigenously frame view from Head-end, (B) lateral view, (C) under the drapes patient lying comfortably and (D) surgeon operating on a claustrophobic patient.



**Figure 4:** Adequate pillows and support being provided to an ankylosing spondylitis patient posted for cataract surgery under local anaesthesia

**Other medical causes**

Hypoglycemic attack can produce excessive sweating, restlessness and discomfort to the patient. If these are the symptoms present, then we check the random blood sugar level. If it is low, we administer 25% Dextrose IV. Acute cardiac failure with pulmonary oedema can cause dyspnea, restlessness, etc. in the patient. In such a condition, it is difficult for the patient to lie down

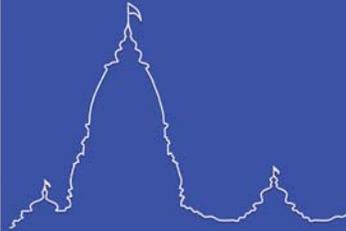
flat. Treating the patient symptomatically, we advise the surgeon to complete the surgical procedure at the earliest, if not to be abandoned.

**Conclusion**

The various causes which makes the patient to become uncooperative during cataract surgery are preventable causes. Thus, for a cataract surgery to be completed uneventfully always do a thorough preoperative evaluation, ascertain their native language beforehand, spend more time with them in the preoperative area, explain clearly about the regional anaesthesia and surgical procedure in their native simple language, advise them especially elderly to empty their bladder before shifting to the operation theatre, encourage them to use their hearing aid, if they are using it, maintain verbal communication during block and after draping, sedate them with short acting sedative agents like IV midazolam, constant reassurance and monitor vital signs at regular intervals.

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# OSKON 2015

2<sup>nd</sup> meeting of  
Ocular Surface and Keratoprosthesis



## World's Eye View of the Ocular Surface

Let our collective experience be effectively used to combat the complexity of ocular surface disorders. May it tinker with tear flow dynamics, may it facilitate straight talk between stem cells of the surface or cross talk with those of the mouth, may it help solder a bond between the biological eye and the plastic window to the world using a vibgyor of supports and prevent the two from parting ways. Fixing the defective shutter-optics – **the ocular surface** - of the enigmatic camera – **the eye** - has been an amazing journey combining faith and despair, hope and dreams.

A creative collaborative rhythm to march into the future - with ideas unleashed, hypotheses dissected, intricacies understood and challenges faced and shared- takes us from looking for the "light in the dark" in OSKON2012 to "a world's eye view of the ocular surface" in OSKON2015.

Do be there ....



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10<sup>th</sup> - 12<sup>th</sup> of July, 2015  
Sankara Nethralaya, Chennai, INDIA