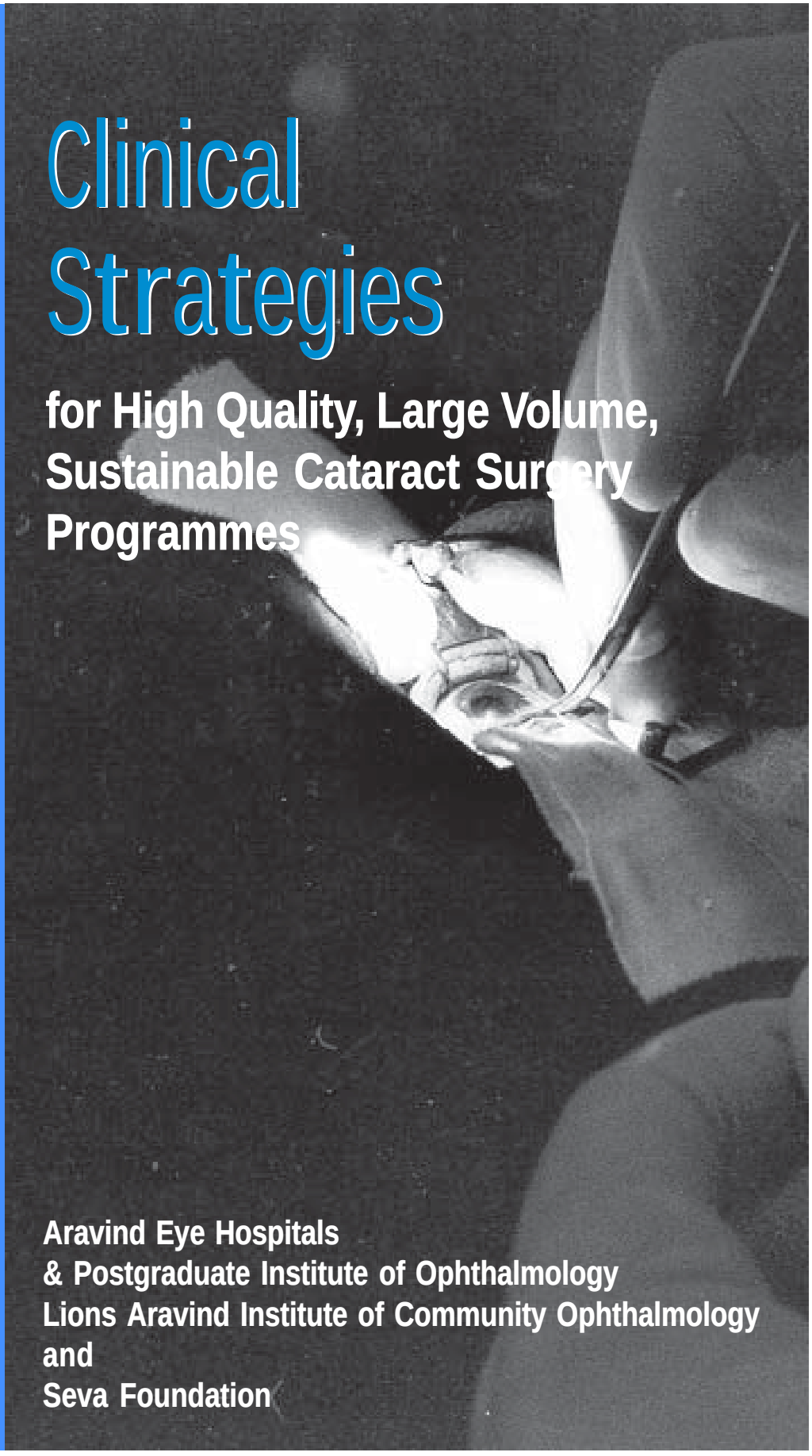
QCS SERIES

Clinical Strategies

for High Quality, Large Volume, Sustainable Cataract Surgery Programmes



Aravind Eye Hospitals
& Postgraduate Institute of Ophthalmology
Lions Aravind Institute of Community Ophthalmology
and
Seva Foundation

QCS SERIES

Clinical Strategies

for High Quality, Large Volume, Sustainable Cataract Surgery Programmes

The Quality Cataract Surgery Series is a set of modules explaining principles and techniques for developing high quality, large volume, sustainable cataract surgery programmes, especially in settings where cataract causes much needless blindness. Each module is based on the practices of Aravind Eye Hospitals in South India, with input from other successful programmes.

The set includes the following modules:

- Introduction
- Clinical Strategies
- Paramedical Contributions
- Management Principles and Practices
- Community Outreach Initiatives
- Financial Sustainability
- Architectural Design

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This series of modules can be improved with your help. If you have ideas or suggestions for ways the QCS series could better meet your needs, please write to the QCS Series Editor c/o Aravind Eye Hospitals. We welcome your comments and experiences. Thank you for your help.

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Dr.G.Natchiar

Introduction

Rationale

The number of people in developing countries who are needlessly blind from cataract and other eye disorders is increasing. Ophthalmologists trained in appropriate diagnostic, surgical and practice management techniques can make a vital contribution to the solution of this problem.

Eye care providers in developing countries face issues different from their colleagues in developed countries, including widespread poverty, overpopulation, illiteracy, malnourishment, limited resources, and an imbalanced distribution (between urban and rural) of an already insufficient number of eye care professionals. The problem, therefore, must be dealt with by an optimal utilisation of medical personnel and resources, in the most efficient and economical way possible.

The Clinical Strategies Module illustrates the role that ophthalmologists can play in high quality, large volume, sustainable cataract surgery programmes. It emphasises the integration of clinical skills and management practices, and outlines successful implementation strategies.

This module focuses on the opportunity of ophthalmologists and allied eye care professionals in developing countries to have an impact on the tragedy of needless blindness. Hence, it is not intended as a textbook, nor is it intended to teach cataract surgery. All information in this module should be used in addition to knowledge and skills gained from ophthalmological training and standard textbooks.

Objectives of the Clinical Strategies Module

1. To provide eye care practitioners and eye care facility administrators in developing countries with strategies for setting up high quality, large volume, sustainable cataract surgery programmes.
2. To show how practitioners and facilities can increase their volume, enhance their quality, keep costs and prices low, and achieve financial self-sufficiency.
3. To describe considerations necessary for choosing an appropriate surgical technique for a large volume setting, ensuring high quality and sustainability.
4. To provide details of facility layout, human resource utilisation, and equipment considerations for a large volume setting.
5. To record lessons learned in high quality, large volume, cost effective
   - Preoperative evaluation
   - Preoperative preparation and anaesthesia
   - Intraoperative considerations
   - Postoperative care and follow-up
6. To show how the management of paediatric cataract can be integrated into a large volume cataract surgery programme.

Intended audience

This module can be considered a handbook or manual of strategies for ophthalmologists who would like to take on the professional challenge of delivering high quality, large volume cataract surgery in a sustainable way. It is intended to be useful to:

- Ophthalmologists working in private practice, group practice, private eye clinics, charitable eye hospitals, or government eye care facilities
- Administrators of eye care / cataract surgery programmes
- Traditional healers and allied ophthalmic personnel in countries where these people are performing cataract surgery.

Baseline skills

It is assumed that practitioners benefiting from this module will have skills in microsurgery or a willingness to undertake microsurgical training. An open attitude and a willingness to adopt or adapt some of the strategies described will be helpful.

Examples and models

The Clinical Strategies Module represents 25 years of shared experiences of ophthalmologists and allied eye care personnels at Aravind Eye Hospitals in India. These eye care workers have been working towards successfully tackling the problem of cataract blindness since 1976. Their experiences have crystallised into a set of precepts that are representative of best practices in facilitating high quality, large volume, sustainable cataract surgery. The attached appendices focus on the processes of cataract surgery delivery developed at Aravind.

Benchmarks for monitoring quality, volume and sustainability

Benchmarks for Clinical quality and surgical outcomes

The case selection process in an eye camp or hospital and preoperative evaluations should incorporate necessary steps to ensure that the patient does not have any other co-existent infection, systemic diseases or eye diseases that could seriously compromise the outcome of the surgery. This can be easily achieved by establishing clinical guidelines and ensuring that they are followed.

- R. D. Thulasiraj and Dr. Allen Foster

1. ECCE with IOL (custom axial lengths) and sutures should have 40% of patients 6/12 or better uncorrected postop.
2. ECCE with IOL (custom axial lengths) and no sutures (superior incisions) should have 70% of patients 6/12 or better uncorrected postop. Temporal incisions should have 80% of patients 6/12 or better uncorrected postop. (Temporal incisions decrease astigmatism and are more stable.)
3. Vitreous loss in ECCE by expression should be less than 3%.
4. Vitreous lossin ECCE with sutureless phacoemulsification techniques expression should be less than 3%. (Manual sutureless should not involve expression.)
5. World Health Organization categories of visual outcomes with available and best correction at the first follow-up visit (4-12 weeks following surgery):

Postoperative visual acuity		Available correction*	Best correction**
Good	6/6-6/18	80%+	90%+
Borderline	6/18-6/60	15%-	5%-
Poor	<6/60	5%-	5%-

(Source: WHO/PBL/98.68)
* available correction=simple spherical correction, not a complete refraction with custom-made glasses
** best corrected=full refraction with custom-made glasses

Benchmarks for volume, productivity and cost

If the eye hospitals can live up to these benchmarks, eye care will be revolutionised!!

- Dr. Steve Miller, Seva Foundation Board of Directors

1. 6-20 IOL surgeries/day/ophthalmologist in a large volume setting. The Government of India has set a norm of 750 surgeries per ophthalmologist per year in the government setting, but more desirable is a number between 1000-1500 surgeries per ophthalmologist per year.
2. 50-80 surgeries/bed/year
3. 100% cost recovery. Ideally, after covering all the costs of operating the eye and other eye care facility, there should be 20+% of income left for depreciation and expansion.
4. Charges should approximate each patient's one month income.
5. Services should be provided for the poorest population groups.

Benchmarks for service standards

1. See all patients who come within 24 hours of their arrival at the eye care facility.
2. At least 50% of cataract operations should be done on women to equally serve women and men. Such a goal may require incentives, such as differential charges for women.

Evolution of Cataract Surgical Techniques

Sutureless Phacoextraction

Pros
- No suture-related complications
- Decreased surgically induced astigmatism
- Minimal discomfort
- Fast rehabilitation

Cons
- Expensive technology, costly breakdowns
- Lower patient turnover (4 - 5 cases/hour)
- More difficult with dense, mature cataracts (common in underserved areas)
- Fewer indications for dense, mature cataracts (seen in underserved areas)
- Complications more difficult to manage (vitreoretinal surgeon required)

Manual Sutureless (also called "manual phacoextraction")

Pros
- No suture-related complications
- Decreased surgically-induced astigmatism
- Minimal discomfort to patient
- Excellent rehabilitation (one follow-up visit for refraction at 40 days)
- Moderately easy to learn after mastery of ECCE with IOL (one month training)
- Similar simple instruments and equipment
- Low cost (fewer consumables than ECCE)
- Quick procedure (no time spent suturing)
- More affordable and sustainable than phaco, with similar results

Cons
- More difficult than sutured ECCE with PC-IOL
- More difficult in complicated cases

Manual ECCE with PC-IOL

Pros
- Safer than ICCE (if well executed)
- Better visual functioning and quality of life
- Better uptake of IOL than spectacles
- Requires only a 2-month microsurgical training course
- Simple instruments and equipment

Cons
- Suture-related complications (astigmatism, discomfort, infection)
- Repeated follow-up visits (difficult for isolated, rural patients)
- Sutures expensive

ICCE with AC-IOL

Pros
- Simple Instrumentation
- No need to learn ECCE

Cons
- Requires operating microscope
- Requires more skill than ICCE (poorly trained ICCE surgeons are tempted to try)
- Higher incidence of late complications
- IOLs must be of correct size
- Eye is less tolerant of poorly made AC-IOL than PC-IOL

ICCE with Aphakic Glasses

Pros
- Safer than couching
- Simpler than ECCE
- Not as dependent on operating microscope
- Sight restored with spectacles
- Still used in subluxated lenses

Cons
- High cumulative complication rate
- Low best corrected visual acuity, poor quality of vision
- Patients blind without spectacles
- Spectacles are heavy, inconvenient and distorting
- 50% have lost or broken spectacles within two years

Couching

Pros
- Lens pushed out of the way with needle
- Very small incision made
- Ability to see shapes ("road vision") restored

Cons
- Very high complication rate
- Performed by non-professionals with no follow-up
- Still very poor vision

Choice of Surgical Technique

for High Quality, Large Volume, Sustainable Cataract Surgery Programmes

Choosing the best cataract surgery technique for a large volume cataract surgery programme should be governed by the rule of appropriate technology, that is, whatever gives the best results on a locally sustainable basis. The choice will therefore be determined by several factors:

1. Training level and experience of ophthalmologist(s)
2. Level of support available (paramedical staff, supplies, maintenance)
3. Financial resources
4. Patient expectations

All said and done, in three months time a good ECCE IOL case, a good manual sutureless case, and a good phaco case, subjected to clinical examination and the criteria of patient satisfaction, will all look identical. Certainly a food processor can chop carrots quickly, but a skilled professional chef can chop them as fast with no fear of power outages or mechanical break-downs. And all carrots taste the same once in the soup!

- Dr. G. Natchiar

Advances in ophthalmology may be illustrated by the evolution of cataract extraction. By 1900 a reasonably satisfactory operation had replaced the ancient procedure of "couching" whereby the cataract was simply pushed down out of the line of sight. [R]emoval of the lens was made considerably more practical by the advent of local anaesthesia (introduced by an ophthalmologist, Carl Koller, in the late nineteenth century) and by sterile techniques. Over the years inumerable small improvements in instrumemts, suture materials and needles, and operative techniques have made the operation safer and more effective.

From Medicine, An Illustrated History, Albert S. Lyons, M.D. and R. Joseph Petrucelli, II, M.D.

ECCE with PC-IOL technique

It is now a given that sustainable high quality, large volume cataract surgery is only possible with IOL implantation. Patients are not beating down hospital doors asking for ICCE and aphakic spectacles. In fact, the global trend in developing countries in recent years has been to ECCE with posterior chamber IOL, where requisite skills and resources (that is, microsurgery training and operating microscope)exist. ECCE with PC-IOL offers much better visual outcomes and quality of life than ICCE, and soas a technique it is sought after by today's patients.

The resources available for ocular surgery in developing countries are limited and the number of ophthalmologists per population low. The backlog of cataract surgeries is enormous and the goal of ophthalmic workers is to operate on as many cataract patients as possible in the least expensive way, sometimes using modified surgical techniques.

- Dr. Larry Schwab, 1982

After a two-month microsurgical training course (with a long learning curve because of the adjustment to microsurgery), an ECCE surgeon can perform an average of 5 - 8 cases per hour instead of 2 per hour with ICCE. Once the operating microscope (one for every two operating tables) is purchased, instrumentation is simple and affordable.

The 10-12 mm incision of ECCE surgery is its main disadvantage because it necessitates sutures. Suture-related complications include astigmatism, patient discomfort and infection. Applying sutures takes extra surgical time, and pulling them out means late rehabilitation (about three months for the wound to heal) and repeated follow-up visits, which can be very difficult for poor rural patients.

Using a continous non-absorbable suture will reduce surgical time and lessen astigmatism and patient discomfort. But this necessitates the expense of suture, and the healing of the wound depends on a fragile thread for several weeks.

Manual sutureless technique

During the past few years, the technique of manually extracting the lens through a small sutureless valved incision has evolved as a safe and efficacious procedure. This technique consists of a 5.5 mm incision, a trapezoidal scleral tunnel that seals itself. Its obvious benefit is no sutures, which means greater patient comfort, minimal complications, and early visual rehabilitation with one follow-up visit for refraction.

At Aravind, manual sutureless technique has been rediscovered, has proved to be a boon in facilitating large volume cataract surgery with no compromise in quality.

- Dr. G. Natchiar

We suggest that "manual small incision sutureless cataract surgery" is the procedure of choice in developing countries facing huge volumes of cataract blind patients because the procedure provides the following advantages.

1. It yields excellent visual rehabilitation of pseudophakic vision.

2. It provides rapid visual rehabilitation, because of the absence of suture-induced complications, including astigmatism, irritation, infection and necessity of removal.

3. Simplicity of instrumentation is a key advantage, since it requires no expensive phacoemulsification equipment.

4. This surgery can be performed in four minutes, permitting highly efficient utilisation of operating theatre space and resources.

5. This technique is most suitable for the very mature cataracts often seen in underserved populations.

- Dr. L. Civerchia Balent and Dr. N.V. Prajna

Manual small incision sutureless cataract surgery is an efficient technique (averaging 8 - 12 operations per hour) because no time is spent on suturing, and because cortex aspiration is made easy by hydroexpression. It costs less than ECCE since it uses fewer consumables. Because this technique uses simple and cost effective instruments and equipment, it can be used in any remote area.

To date, 56,000 cases of manual small incision sutureless cataract surgery have been performed in the four Aravind Eye Hospitals in India. Their recent study on 1000 cases shows minimal intra and postoperative complications with acceptable postoperative astigmatism.

While there is less surgically-induced astigmatism with the manual sutureless technique, one complication to watch for is an against the rule drift of astigmatism, which decreases patients' uncorrected visual acuity.

Against the rule (ATR) astigmatism is seen more with a 12 O'clock incision than with a temporal incision, for three reasons:

1. Due to the elliptical shape of the cornea, placing the incision temporally is more astigmatically neutral, since the limbal incision is farther away from the centre of the cornea than a 12 0'clock incision.

2. An ATR astigmatism exists predominantly in the cataract age group and is exacerbated with an incision at the 12 O'clock meridian.

3. Eyelid pressure emphasises the ATR shift with a 120'clock incision. It has therefore been inferred and seen that a temporal tunnel gives astigmatically better results in terms of preventing an against the rule drift.

- Dr. Marty Spencer

Aravind Eye Hospitals have recently brought out practical text book-Manual Small Incision Cataract Surgery:an alternative technique to instrumental phacoemulsification which includes a CD that illustrates the technique in detail.

Phacoemulsification technique

It is obvious that sophisticated patients want what they regard as the most advanced technique possible. The surgeon will also want to perform the most sophisticated technique possible for reasons of professional pride. This can lead to the trap of attempting a technique that is inappropriate to the setting. Patients often request IOLs, and may ask for sutureless surgery-they rarely request phacoemulsification. More often, the demand for phaco is fueled by the surgeon. But a well executed manual ECCE-IOL with sutures will produce a much happier patient than a badly executed sutureless phacoemulsification.

- Dr. Marty Spencer

Increasing use of the phacoemulsification technique is perhaps doing a disservice to both patients and large volume cataract surgery programmes in developing countries. It is considered unsuitable and not easily applicable in large volume programmes, especially in rural settings. Phaco adds to the cost and complexity of cataract surgery, making it less affordable to those who most need access to low cost sight restoration procedure. Initial costs of phaco instrumentation are very high and breakdowns can be expensive. Phaco also calls for more consumables (Viscoelastics, Tips, Sleaves, Tubes) than the manual sutureless technique, increasing the per unit cost of surgery.

Phaco is slower than ECCE or manual sutureless technique; with phaco surgeons average 4 - 5 surgeries per hour. Furthermore, phaco is not useful in mature and hypermature cataract, since the emulsification of a hard lens, often seen in rural, isolated populations — takes longer than manual extraction and can cause corneal damage, and nucleus drop. Poorly learned phaco techniques can leave patients visually impaired.

There are advantages to phacoemulsification. In large urban centres, the allure of phaco can draw more paying patients to a cataract surgery programme, thereby subsidising more free surgeries.Generally, phaco offers the same advantages as the manual sutureless technique like no suture-related complications, decreased surgically-induced astigmatism, minimal patient discomfort, and early rehabilitation.

Conclusion

We are in a transition period, a time when ECCE-IOL surgeons who have been performing successful surgeries for years run the risk of feeling outdated. For this transition to come through with minimal damage, it is going to have to be gradual. Our tremendous backlog is reason enough for ECCE-IOL surgeons to continue their work.

- Dr. G. Natchiar

To deal with the massive backlog of cataract blindness in developing countries, either the number of cataract surgeons must increase or their output must go up without compromising quality. Since it will be difficult to increase the number of doctors overnight, a proven quick, safe and cost effective technique must be applied in large volume.

ICCE has the obvious disadvantages of image magnification, restricted visual fields, and the physical inconvenience of aphakic glasses.

With the transition from macrosurgery to microsurgery, ECCE with PC-IOL has proven itself with better visual outcomes than ICCE in large volume settings. But follow-up compliance and postoperative complications caused by the sutures have presented major challenges.

Phacoemulsification is inappropriate and unaffordable for many large volume settings in developing countries, due to lack of training, lack of reliable power, and lack of funds for initial investment in equipment as well as subsequent maintenance. Where it is feasible, phaco offers the same results as manual sutureless.

The "in-between" technique of manual sutureless surgery seems to be the

solution. The scleral tunnel (used in both phaco emulsification and manual sutureless) is a safer and astigmatically better incision, but while phaco is expensive, manual sutureless offers the full advantage of the phaco incision in an affordable technique. If cost effectiveness means getting good value for money spent, then high quality, large volume manual sutureless cataract surgery should perhaps become our goal.

Clinical Strategies

for ensuring High Quality, Large Volume and Sustainability in Cataract Surgery Programmes

High quality

(measured by patient satisfaction with visual outcomes and with the eye care facility's delivery systems)

1. Safety first

Safety must always be the highest priority, even in large volume cataract surgery settings. First, do no harm. Efficacy of the procedure (in terms of visual outcomes) is second. Even in large volume settings, each case must be considered individually. Systems must be set up to make all relevant investigations easy to order and perform. Regular infection control meetings, monthly quality assurance meetings, and quarterly morbidity meetings all contribute to consistently high quality outcomes.

Constant monitoring and assessment of various functions maintains quality control. There should be a formal system of evaluation in place. For example, at Aravind Eye Hospitals, quality checks on surgery are maintained by a detailed computerised record that includes details of a surgeon's hourly surgical output and intraoperative complications.

Holding regular staff meetings to assess and discuss performance and to plan further strategies helps a programme to evolve with the demand. For example, at Aravind, monthly infection control meetings are arranged by the Chief Medical Officer in co-ordination with the nursing supervisor. The meetings, attended by all doctors and paramedical staff, serve as checks to ensure that intraoperative and postoperative complications and infections that arise are within internationally acceptable limits. Each infection is discussed in detail with the nursing supervisor.

2. Use of IOL microsurgery technique

The goal of all cataract surgery is to restore functional vision, with as early rehabilitation as possible and minimum follow-up at low cost. These outcomes call for microsurgical IOL implantation. Since the price of IOLs has decreased, making them more accessible, ECCE with PC-IOL and manual sutureless are the surgical procedures of choice for cost effective large volume cataract surgery programmes.

Mastery of Surgical technique, standarisation of surgical procedures, availability of adequate sets of instruments, trained paramedical staff, and a conveyer belt working pattern are key factors in the success of the Aravind Model

- Dr. G. Natchiar

3. Standardisation

Standardising the clinical protocols be it for performing cataract surgery or diagnostic tests, in any setting-group practice or eye camp, makes high quality easier to ensure and guarantees the same standard of care for every patient. Furthermore, in a standardised setting, when an improvement or investigation needs to be made, implementing the change or the research is easy because everyone is doing the same procedure.

At Aravind Eye Hospitals, experimentation in technique is not allowed without prior review and authorisation by senior medical staff.

4. A-Scan measurement

Large postoperative refractive errors can be reduced or eliminated with careful biometry. Preoperative A-scan measurement of axial length should be done routinely in order to customise IOL power. Customisation leads to better visual outcomes without glasses, and greater patient satisfaction.

5. Case selection

Rigorous case selection is vital for ensuring high quality visual outcomes. Case selection will help to avoid, or at least predict, poor outcomes caused by pre-existing eye disease, surgical complications, or postoperative refractive errors. Even if something goes wrong, it will have been well explained to the patient prior to surgery.

6. Ensuring follow-up

The best surgery is not the end of it. The end of it is when the patient is seeing well after a good length of time and for a good length of time.

- Dr. N. V. Prajna

Although follow-up is a challenge in large volume cataract surgery programmes, especially those that draw many patients from isolated or rural areas, it is a crucial aspect of high quality. It is therefore important to set up systems to ensure that follow-up is done.

Aravind Eye Hospitals have increased their follow-up rate to over 95% by sending follow-up teams to screening eye camp sites 40 days after patients are given ample follow-up education by patient counsellors and discharged.

7. Patient counsellors (see Paramedical Contributions Module)

In a large volume setting, patient counsellors (PCs) can contribute to high quality in several ways.

- PCs in all departments help patients feel more welcome and relaxed, hence more cooperative and compliant.
- PCs in the outpatient department help patients who are advised for surgery to make informed decisions.
- The use of PCs in outreach screening camps and in wards prior to discharge to explain the importance of follow-up can lead to an improved follow-up rate.

Instrument maintenance is about constant care, periodic maintenance, and immediate repair of instruments when necessary. An instrument repaired is an instrument gained.

- Prof. V. Srinivasan, Consultant, Instruments and Equipment Maintenance Laboratory, Aravind Eye Hospitals

8. Continuous training and development

Providing and encouraging opportunities for research and regular CME sessions and training is a significant factor in ensuring consistently high quality eye care, without staff burnout. Training is also essential for standardising clinical protocols so that all staff are taught to fulfill their roles exactly.

9. Instrument Maintenance

The microsurgical instruments and equipment used in ECCE with PC-IOL and manual sutureless techniques require constant maintenance to ensure quality

surgery. Because instrument maintenance also contributes to efficiency and cost effectiveness, a large eye care institution will benefit from an in-house instrument and equipment maintenance department.

At Aravind, the Instruments and Equipment Maintenance Division ensures that all instruments and equipment are maintained in good working condition. Routine maintenance includes checking different parts of the instrument to ensure their proper functioning and rectifying any deficiencies, however minor. This will ensure longer life. For example, operating microscope maintenance, involving cleaning of the optics and checking controls and moving surfaces, is done frequently. This ensures optimum illumination and proper functioning of the controls at all times.

Large volume

(measured by efficiency of clinical and nonclinical delivery systems)

1. Streamlined patient flow

Intelligent layout of space and ergonomic positioning of equipment will allow efficient flow of patients through the eye care facility. Whether patients move to clinical staff (Aravind's assembly-line model), or clinical staff move to patients (restaurant fashion), thoughtfulness of the design will increase efficiency and volume of patients seen. (See Architectural Design Module for information.) Intelligent systems and procedures also contribute to greater efficiency. For example, charging one flat fee (at Aravind, 50 rupees) for an outpatient examination allows for standardised protocol and keeps billing and scheduling procedures from becoming cumbersome. The OP workup can be generally the same for all patients, with no specific workup for refraction or cataract.

2. Standardisation

By allowing staff to work more efficiently, standardising contributes to large volume as well as high quality. A "routinised" outpatient examination allows more patients to be seen per day. Standardisation of preoperative evaluation and preparation allows paramedical staff to do much of this work. Focus on routine ECCE with PC-IOL or manual sutureless technique will speed up surgery, allowing more patients to be treated per day. Standardised surgical instruments and postoperative medications make clinical work in the OT and wards much easier.

The change in the outlook of our doctors is the most important part of their 'Aravind Experience'. They now think of the national prevention of blindness and the huge cataract backlog as their personal concern and at the same time, want to improve their skills, increase income, and help deliver the gift of sight to the less fortunate who cannot afford surgical intervention. This change in social consciousness is one of the greatest achievements of the doctors' exposure to Aravind.

- Tomas Gualberto A. Meneses, Philippines SightFirst Project

3. Motivation to Work Hard

There is no question that large volume, high quality cataract surgery is hard work. Strong motivation is essential. The motivation to perform large numbers of cataract surgery can come from many sources:

- The setting of goals and targets
- The effort to match or surpass benchmarks or standards
- A drive to increase one's surgical statistics or "personal best"
- A spirit of friendly competition among colleagues, or between institutions
- A calling or vocation
- An altruistic commitment to service and compassion in action

- A yearning to make a difference in the world
- A desire to increase income

4. Two full-time ophthalmologists

For several reasons, no large volume cataract surgery programme should be without at least two full-time ophthalmologists. Since the eye care facility is ophthalmologist-dependent, it will have to shut down most services if the only doctor is absent due to illness, vacation, CME or outreach work.

- A solo ophthalmologist who never takes leave will quickly burn out or become inefficient.
- A solo ophthalmologist who doesn't attend CME will not be able to upgrade clinical knowledge and skills.
- A solo ophthalmologist who does not participate in community outreach activities will not be able to consistently attract large volumes of patients.

In its consulting work with over 100 eye hospitals in Asia and Africa, the Lions Aravind Institute of Community Ophthalmology (LAICO) has discovered that full-time employment of at least two ophthalmologists is crucial to the success of large volume cataract surgery programmes.

5. Regular working hours

With at least two full-time ophthalmologists on staff and working regular hours, an eye care facility can provide accessibility to more patients, at convenient times. Rigorous scheduling and staffing of work hours also means that patients can be examined and treated in a single visit, making screening eye camps in rural areas a more viable strategy for generating patients. (See Community Outreach Initiatives Module for information.) If surgery is performed every working day at the same time, it will be easier to implement standard procedures and protocols. If there are slack periods in patient volume due to weather or holidays, plan CME and maintenance tasks for those times.

6. Efficient resource utilisation

The number and distribution of staff at Aravind is such that each person has a definite role to play in the whole process of a patient undergoing surgery. Well-defined responsibilities facilitate quality work even when the whole process is repeated a number of times in an assembly line style. This process, of course, has to be intelligent and evolving, in both the short term and the long term.

- Dr. G. Natchiar

Implementing correct resource utilisation ratios will make large volume cataract surgery much easier to organise.

Ophthalmic assistants to ophthalmologists	5 : 1
Operating tables to ophthalmologists	2 : 1
Tables to operating microscopes	2 : 1
Instrument sets to ophthalmologists	6 : 1

Ensuring a high ratio of paramedical staff per ophthalmologist (5:1 is ideal) means that doctors can concentrate on diagnosis, treatment and surgery – making them much more efficient. Ophthalmic assistants (OAs) can be trained to perform a high proportion of the routine and repetitive diagnostic and refraction tests. In the operation theatre, a team approach with the use of one operating microscope, two tables and six instrument sets allows the surgeon to per-

form surgery on one patient while OAs serving as scrub and circulating nurses preparing the next case, then finish up the first. The productivity of the surgeon depends on the efficiency of the paramedical staff. The more efficient scrub nurses are assigned to faster surgeons to facilitate increased patient turnover. The OT team includes one opthalmic surgeon (plus one resident or fellow at a third table, if appropriate), two scrub OAs, one circulating OA, one sterilisation OA, and one blockroom OA, plus an orderly/theatre assistant and an OT coordinator. (See Paramedical Contributions Module for more information.)

Sustainability

(Financial and social sustainability are ensured by seeing that available human and material resources are used in the most judicious and cost effective way possible over time)

1. Implement fixed salaries

Implementing fixed salaries rather than fee for service for staff ophthalmologists leads to several benefits for a cataract surgery programme. Fee for service can lead to unhealthy rivalry between professional colleagues. A solo ophthalmologist might not welcome new doctors (viewed as competition for patient fees), which will prevent programme growth. For two or more ophthalmologists, fee for service leads to "ownership" of patients, which is inefficient in a large volume setting and could turn into personal reputation "gilding" rather than institutional image building. Furthermore, an unequal match in productivity or skill levels could deter colleagues from supporting each other and working as a team, which is essential in a large volume setting. Fair salaries, combined with equal rotation of postings, will not only encourage doctors to stay (aiding retention, hence programme sustainability) but will also help them concentrate on quality (of their work) rather than quantity (of patients and fees).

2. Stretching resources

Safe recycling of materials and wise use of resources lead to lower costs, hence a greater chance of sustainability. For example, one bottle of viscoelastics can be used for up to four cases. Sutures can be sterilised and reused. Wearing one set of scrubs for a full shift saves time as well as cleaning and replacement costs. Putting two or three operating tables in one theatre cuts down on the amount of space needed. A high ratio of paramedical staff performing repetitive tasks is a more cost effective use of labour. Low infection rates are possible without giving routine systemic antibiotics. Low complication rates are possible without submitting each patient to a large battery of unnecessary tests. Any strategies for stretching resources and lowering costs will contribute to sustainability.

3. Appropriate use of technology

Investing a lot of money in equipment that will sit unused for hours or days at a time, or that will be costly to repair, is not cost effective. Every machine and

piece of equipment should be in use for at least one full shift per day, in order to get full return on the investment and to lower maintenance costs. Sophisticated equipment for a new but unnecessary technique might force the increase in the price of service up, possibly lowering the number of patients served. For example, during cataract surgery, aspiration can be controlled by a pump or manually with a syringe; the latter is much cheaper and more reliable. ECCE with PC-IOL or manual sutureless technique will be more sustainable than instrumental phaco in a large volume setting where the power source is unreliable and where patients cannot afford an expensive procedure.

4. Increase patient volume per ophthalmologist

Increasing the patient volume per doctor reduces the cost per unit of surgery, since fixed costs remain the same no matter how many surgeries are done. (See Financial Sustainability Module for information.) A recent success story in Malawi saw new strategies of teamwork and efficiency jump the volume of surgeries from 500 per year to 500 per month. It is important to remember however, that large volume + high quality = sustainability, so good visual outcomes – and not impressive statistics – must remain the focus of the eye care programme if it is to be sustained.

5. Conduct community outreach

It is vital to organise and participate in screening camps and other community outreach activities in order to generate large demand for eye care services. Dimensions of outreach to be considered include availability, accessibility, and affordability. Outreach also serves to promote the image and services of the eye care facility in the community, again contributing to sustainability of the cataract surgery programme. (See Community Outreach Initiatives Module for information.)

The more people hear about the good you are doing, the more good you will do.

- Unknown

6. Use satisfied patients as motivators

Patient-centred policies and procedures (See Management Principles and Practices Module for information) will lead to patient satisfaction. Satisfied patients are the best "salespeople" for an eye care facility. Ensuring high quality visual outcomes, hygienic surroundings, courteous and helpful staff, and the same standard of care for every patient (paying or nonpaying) will, by word of mouth advertising, assure the sustainability of the cataract surgery programme.

7. Standardisation

Standardised postoperative medications are cheaper and less labour-intensive to administer. Standardised purchasing and inventory control will lead to economies of scale and lower costs. Keeping costs under control is an essential aspect of sustainability.

The process leading to large volume, high quality cataract surgery has two major elements - demand generation and efficient utilisation of resources to meet the demand, with the whole process governed by a certain attitude. For an eye care programme to achieve its maximum potential in performance, the top management must establish a work culture, ensure adequate demand, provide quality resources and establish systems that optimise utilisation of resources.

- R.D. Thulasiraj, Executive Director, LAICO-Aravind Eye Hospital

Aravind is a great integrated place where spirit, mind and hands are blending together to achieve excellent human performance. In my country, Egypt, we will work hard to develop our own model of eye care utilising the great experience that Aravind Eye Hospital has.

- Dr. Gamal Ezz el Arab, Al Noor Foundation

8. Committed Leadership, Dedicated Staff

Successful high quality, large volume, sustainable cataract surgery programmes depend on consistent leadership and long-term staff. Frequent changes in leadership and high turnover of doctors and ophthalmic assistants often mean failure in achieving targets. Training and motivation of staff should be an ongoing process.

At Aravind, for example, eighteen-year old nursing recruits are put through an intensive training that equips them with requisite skills for assisting in the operation theatre and other departments. Experienced nurses who are 35 or older are upgraded as "trainers," and become responsible for transmitting not only their knowledge and work experience but also Aravind's work culture. This practice has been introduced to counteract possible work related boredom and presbyopic effects that could hamper efficiency.

Creative and culturally sensitive strategies (for example, recognition events housing subsidies, CME allowances or salary bonuses) must be implemented to help attract and retain dedicated leaders (medical or administrative) as well as paramedical staff.

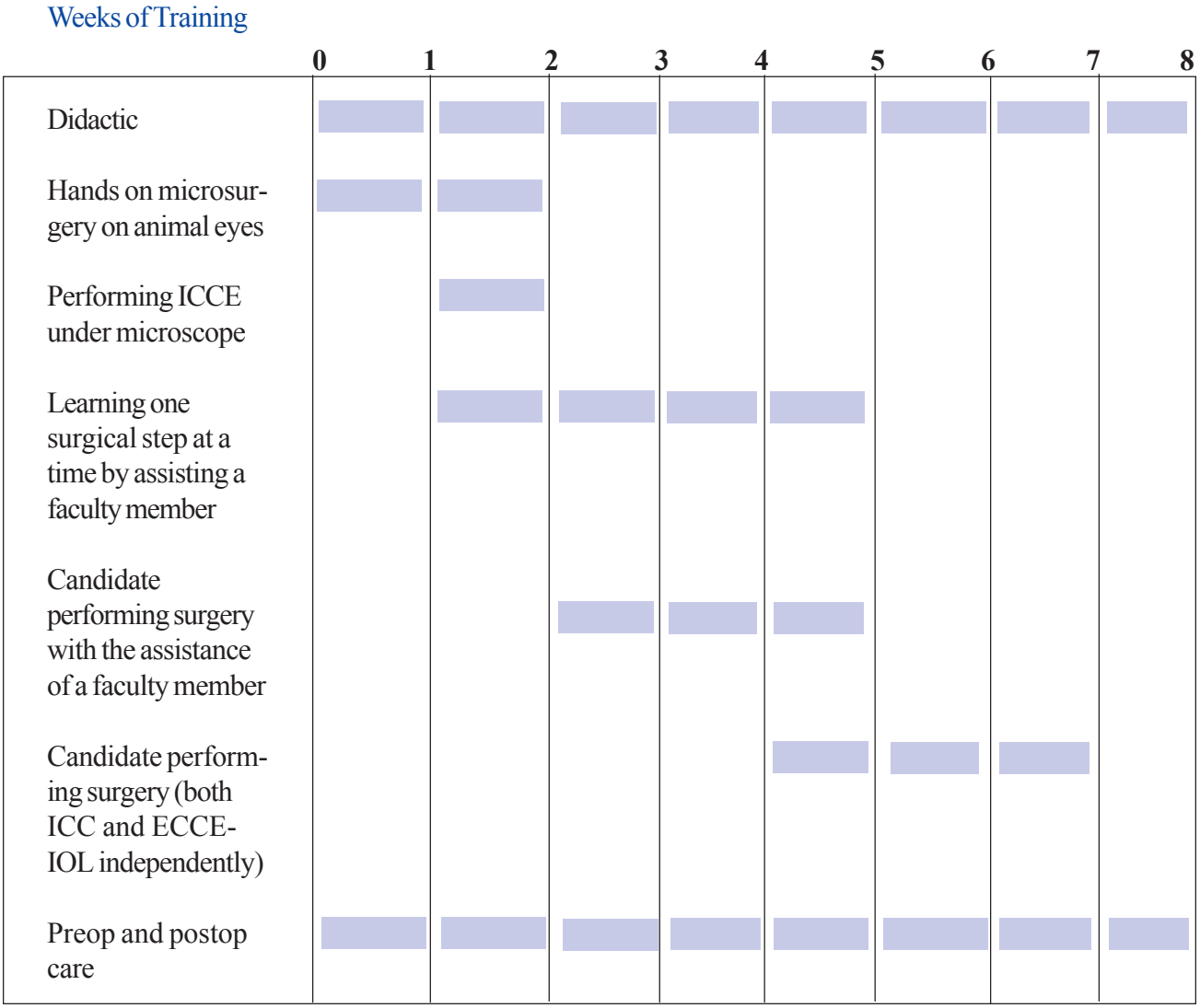
Conclusion

The strategies described here promise to contribute to the success of any high quality, large volume, sustainable cataract surgery programme. But, it is important to remember that, while based on Aravind's history and experience working with over 100 other hospitals, these strategies will have to be adopted and adapted in ways that fit the unique characteristics and needs of each eye care programme. Suitably adopted and adapted, they will work in a programme of any size; how they are implemented will have to be modified to match the scale of that programme.

IOL Microsurgery Training Course

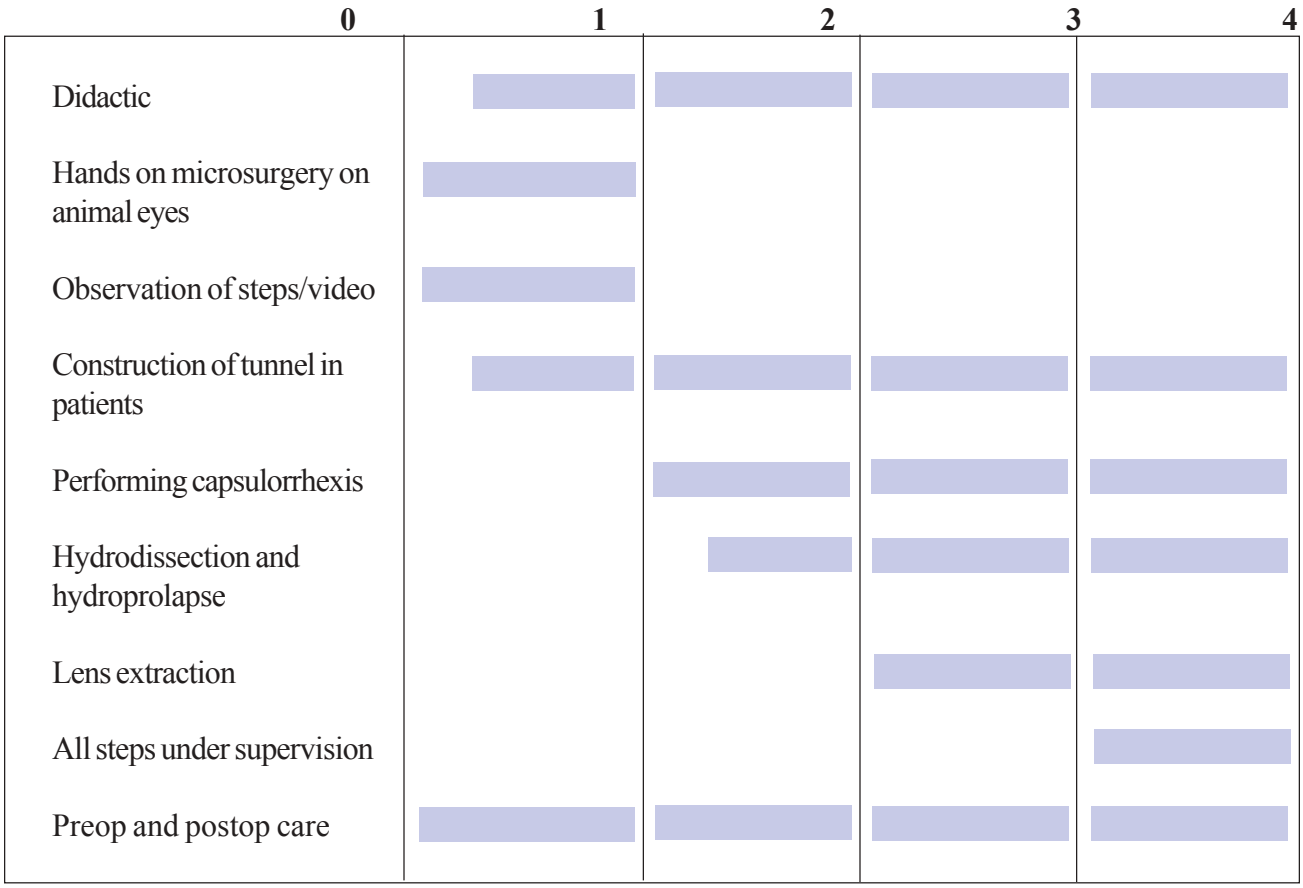
Curriculum

The course should consist of didactic lectures, hands on microsurgery on animal eyes, live surgical demonstration, intense training in each surgical step of microsurgery (ECCE with PC-IOL implantation), and the learing of preoperative work-up and postoperative follow-up, and the management of complications.



Manual Phacoextraction Training Course

Weeks of Training



Appendix 1

Preoperative Evaluation

Table of Contents

Because diagnostic, therapeutic, and practice recommendations may have changed since the publication of this series, because such recommendations cannot be considered absolute or universal in their application, and because the publication process contains the potential for error, Aravind Eye Hospitals and Seva Foundation strongly advise that the recommendations in this series of clinical submodules be verified, prior to use, and be considered in light of a particular patient's clinical condition and history. The reader is urged to review the package information data of the manufacturers of the medications and devices mentioned. Drug therapy is constantly changing. Consequently, it is the responsibility of the health care professional to seek additional and confirmatory information; to evaluate its appropriateness as it relates to the actual clinical situation; and to consider new developments. Because it is beyond the scope of this series to include all indications, contraindications, side effects, and alternative agents for each drug or treatment, and because standards for usage change, it is advisable to keep abreast of revised recommendations. Caution is especially urged when using new or infrequently used drugs. It is the responsibility of the physician to determine applicable federal status of each drug or device he or she wishes to use, and to use them with appropriate patient consent in compliance with applicable law. The ultimate arbiter of any diagnostic or therapeutic decision remains the individual physician's judgement.

Introduction

This appendix will describe considerations necessary for effective preoperative evaluation in a high quality, large volume, sustainable cataract surgery programme. It will also outline investigations that represent a standardised protocol particularly adapted to screening the maximum number of patients in the shortest possible time. Following a discussion on case selection and diagnosis, this appendix highlights the role of patient counsellors, shows patient flow in an outpatient department, divides preoperative evaluation into local (ocular) and general (systemic) investigations, and looks at special considerations.

Case selection for cataract surgery

Rigorous case selection through a comprehensive preoperative evaluation schedule will suggest the visual prognosis after cataract surgery based on the status of the eye. It also enables necessary precautions to be taken during anaesthesia and surgery.

The successful outcome of a cataract surgery depends on the preoperative status of the cornea, the retina and the optic nerve, the type of surgery (with or without IOL) and complications, if any, during surgery.

Cataract extraction is usually an elective procedure. An exception is hypermature cataract, which can cause uveitis or glaucoma when not extracted. Most ophthalmologists consider a visual acuity of 6/18 or worse (due to cataract) as indication for cataract extraction. However, it is important to bear in mind that each case must be individualised. For example, a watchmaker with 6/12 vision requires cataract surgery to function at his/her best.But an elderly, illiterate person may find 6/60 vision sufficient.

Visual function is a subjective phenomenon. Patients who do not complain of a visual defect even in the presence of an operable cataract, should not be forced to undergo surgery, although they may be counselled about their condition. The mere presence of lens opacity *per se* is no indication for surgery. Surgery is indicated only when the opacity interferes with the visual needs of the patient. The age, the occupation, the possible life expectancy and the visual needs of the patient, along with the type of cataract, are important factors in surgical decision-making.

Patients who have one eye equal to or better than 6/18 might not need or desire surgery in their worse eye, since they already have one good eye. The condition of the other eye should be ascertained before suggesting surgery. If the patient has had cataract surgery without an IOL in one eye, and would prefer the same in the other eye, he/she should be encouraged to abide by his/her choice. But, the patient will be counselled that unilateral pseudophakia is better than bilateral aphakia. A unilateral cataract patient (whose other eye is normal) should be advised to undergo an IOL implant by explaining the possible advantages and disadvantages.Vision with an intraocular lens has much less distortion and magnification than with an aphakic spectacle lens.

Before advising surgery, it is important to bear in mind to treat the patient as a whole and not the cataract in isolation and to find out whether the patient

wants surgery. Surgery is indicated when cataract causes reduced visual function. When visual impairment is severe, the decision is easy because there is much to gain and little to lose. However, for lesser degrees of visual impairment, the risk/benefit ratio changes.

A correct diagnosis is the first step in ensuring a successful cataract surgery. A complete evaluation comprising a detailed patient history, ocular examination, and relevant investigations are prerequisites for cataract surgery.

Diagnostic considerations

1. Visual disability with a Snellen acuity worse than 6/18 due to cataract

Cataract surgery is justified and appropriate when subjective, objective and educational criteria are met.

Subjective:

Surgery is indicated when visual loss interferes with a person's ability to carry out needed or desired activities. The patient's decision depends on his/her own assessment of visual disability (e.g. impact on driving, reading, special occupational or vocational needs) and his/her perception of the impact of the disability on life style (e.g., loss of income, independence)

Objective:

The best level of visual acuity with spectacles is 6/8 or worse visual acuity in the affected eye is being 20/50 Snellen or worse. The eye examination should confirm that the cause of visual impairment is cataract and rule out other factors that prevent visual improvement following cataract surgery.

Counselling:

The patient should be counselled about the risks and benefits of cataract surgery and any alternatives (since there are no alternative treatment for cataract surgery) enable him/her to make an "informed choice" about the timing of surgery.Simple counselling is best. For example, "Nine out of ten people like you will be able to see faces (or read) after surgery. One out of ten might not."

2. Visual disability with a Snellen acuity of 6/12 or better

The subjective, objective and counselling criteria for the preceding level of disability are also applicable here. As a general rule, the better the Snellen acuity, the greater the need for verification and documentation of visual disability. When the visual acuity is 6/12 or better, the risk relative to potential benefits means it is usually not worth doing the surgery. Only if the patient has very fine visual needs and fully understands the risks, should surgery be done when vision is 6/12 or better.

Ophthalmologists are usually conservative in operating on patients with 6/12 or better. But patients whose visual acuity improves to 6/12 or better with a correction of -4.00D, or patients with posterior subcapsular cataract (which progresses quickly) or anterior subcapsular cataract or diffuse scattered opacities should be encouraged to make an early decision about undergoing surgery.

It is always necessary to correlate the amount of lens changes to visual loss. This is an important step to prevent postoperative surprises and for proper preoperative evaluation, as one will look for other pathology if the lens

changes are not proportionate to visual loss.

Evidence of decreased visual function might include the following:

- Visual disability fluctuates as a result of environmental factors, such as dim illumination or glare.
- Impairment of ability to carry out needed or desired activities.
- Monocular diplopia or polyopia.
- Visual size disparity between the two eyes

3. Visual disability due to cataract in the one-eyed patient

A one-eyed patient is defined as one who has permanent legal blindness (6/60 or worse or less than 20^0 visual fields) in the other eye. It is the ophthalmologist's obligation to inform and educate such patients about the risk of total blindness after cataract surgery on the only eye. The worse the vision in the other eye, the greater the need for caution when considering surgery. When operating on a normal eye, the risk of developing worse vision that the pre-operative vision, from all causes (cornea clouding, retinal detachment, infection, etc.), is about 2%.

4. Bilateral cataracts

In patients with bilateral cataracts, the decision about which eye to operate first depends on the degree of defective vision. For example, if a patient has profound visual loss due to cataract in one eye more than the other, then surgery is first done on the eye with greater visual loss. If the visual defect due to cataract is equal in both eyes, then either eye can be operated depending on the patient's preference. If thereafter other eye pathologies that would limit the visual recovery after cataract surgery like retinal, corneal or glaucomatous nerve damage, the eye with the better potential must be operated first, because patients are unlikely to come for follow-up if results are poor.

5. Medical Indications for cataract surgery

In addition to restoration of visual acuity, medical indications for cataract surgery include:

- Leaking lens causing phacolytic glaucoma
- Swollen lens causing phacomorphic glaucoma
- Opaque lens that obscures the view of the fundus and thus prevents necessary treatment in the posterior segment, such as photocoagulation in diabetes
- Various types of subluxated and dislocated lenses

6. Contraindications for cataract surgery

Surgery to solely improve vision should not be done in the following situations:

- The patient does not want surgery
- Glasses/visual aids provide satisfactory vision
- Patient's lifestyle is not compromised
- Patient is medically unfit

2. Counselling and consent

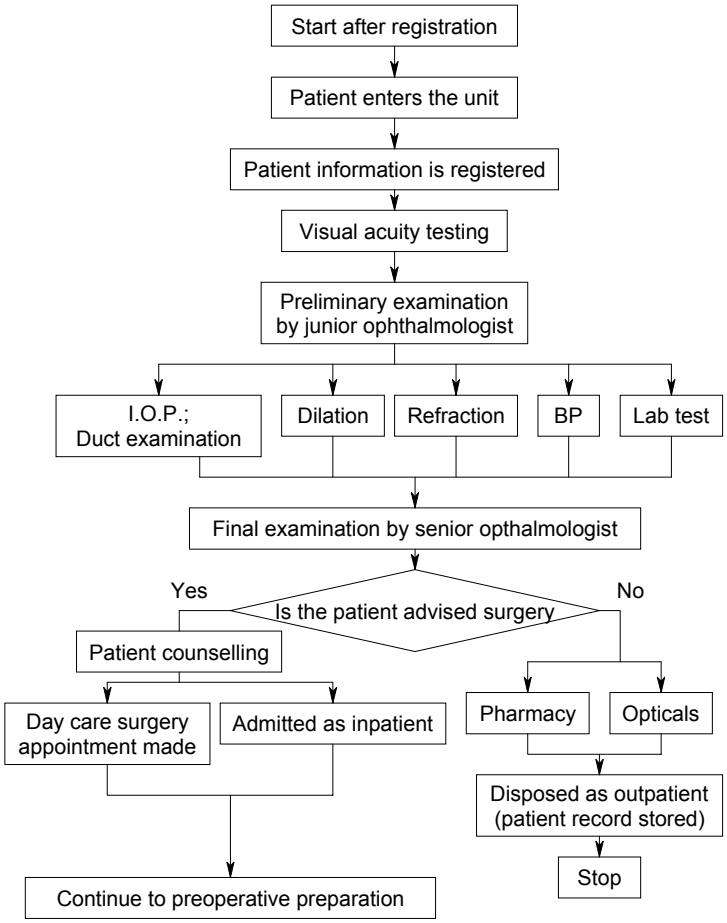
Effective counselling and informed consent play an important role in patient satisfaction. First, receiving informed consent from patients is a legal requirement before subjecting them to any procedures or surgery. Second, a trained patient counsellor (a social worker, an ophthalmic assistant (OA), or even a former patient who is volunteering)can counsel on the possible benefits and disadvantages of the various surgical procedures available. And third, empathetic patient counsellor is capable of evoking excellent co-operation from the patient.

Patient counsellors play a catalytic role in a high volume setting. The advent of IOL and the need for increased patient acceptance necessitated trained patient counsellors to serve as a link between doctors and patients. Aravind introduced counselling for cataract surgery in 1989. These patient counsellors are young women over 20 years of age, with excellent communication skills, fluency in two or more local languages, and a people-oriented approach. Selected candidates receive on-the-job training for one year, in the wards, outpatient department and operation theatre. In response to an expressed need, Aravind has developed a two-week course in patient counselling for high school graduates.

"Aravind's patient counsellors, in the free and paying sections, educate patients on the nature of cataract, preoperative preparation, surgical procedure and the outcome. As a result, the patient who goes in for surgery is "informed" in the true sense of the word. At Aravind, the large volume of patients demands separate preoperative and postoperative counsellors. The latter, stationed in the postoperative wards, educate patients on non-technical postoperative instructions. However, in a small setting, the same counsellor could steer the patient from admission to discharge. On discharge, "satisfied patients" often bring with them other patients requiring cataract surgery thereby increasing community participation. At Aravind, besides cutting down effectively on the surgeon's time, successful counselling, as indicated by a follow-up rate of 98.4%, contributes synergistically to the whole process of a successful cataract surgery.

- Dr. G. Natchiar

Flow of patients in the outpatient department



From a marketing perspective it is crucial that patients do not wait during their initial processing when they arrive at the hospital. During registration, we perform routine procedure quickly, efficiently, and carefully. We expedite the entire process and treat each patient as a "Most valued customer"

- Dr. G. Natchiar

Patient flow during preoperative evaluation is determined by the patient examination protocol. Standardisation of the patient exam, job allocation (training paramedical staff to perform most of the standard tests; ensuring adequate staff at the busiest times), and an assembly line approach are three crucial strategies in a large volume setting. These strategies must be designed and reviewed periodically to provide the necessary clinical services with emphasis on quality and cost effectiveness.

Ocular investigations

(Approximate testing time: 30 - 55 minutes per patient)

1. Visual acuity

(approximate testing time: 3 - 5 minutes per patient, by ophthalmic assistant)

Visual acuity is the aspect of visual function that receives prime attention with regard to cataract surgery.
However, one should be aware that other aspects of visual function such as visual field, colour vision, contrast sensitivity, adaptation and depth perception are also affected by cataract.

The preoperative evaluation of visual acuity should be performed under conditions that are comparable to real life situations such as testing for both distance and near vision for each eye, with and without spectacles.

Distant vision should be tested by using appropriate distant vision charts like the Snellen Chart and others. This should be followed by near vision evalution using near vision chart such as Reduced Snellen or Jaegers Chart. It is not uncommon for a discrepancy to exist between near and distance visual acuity in cataract patients. For example, patients with posterior subcapsular cataract frequently have better distance than near visual acuity, while those with nuclear sclerosis tend to have better near than distance visual acuity.

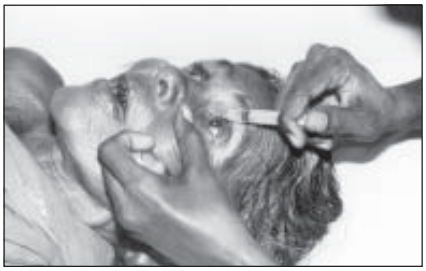
3.2 Refraction

(approximate testing time: 7-10+ minutes per patient, by OA trained in refraction)

In screening for cataract surgery, it is important to perform a careful refraction with pinhole and subjective correction. It is often found that cataract surgery can be deferred merely by making a change of eye glasses, especially in a patients with nuclear cataract. The ophthalmologist should defer surgery if he/she is not confident of achieving better postoperative vision, and if there is no urgency. Deferral also depends on the patient's need and occupation.

3. Examination of adnexa

(approximate testing time: 5-10 minutes per patient, by OA)



The eyelids and lacrimal apparatus should be carefully examined for blepharitis, hordeolum, sac infection and conjunctivitis. Blepharitis and congestion of conjunctiva, with or without a mucoid discharge, should be eliminated medically before cataract surgery. This is extremely important since it has been established that in a significant number of patients with postoperative endophthalmitis, the causative organism has been isolated from the conjunctival sac or lid margin. The lacrimal ducts should be syringed with saline to check for patency. Lacrimal obstruction and subsequent infection are major causes fo pneumococcal endophthalmitis. If frank pus or mucus is present with obstruction, the patient is first subjected to a dacryocystectomy or dacryocystorhinostomy, and cataract surgery is done after a 15 day waiting period.

Though other methods exist for testing the patency of lacrimal ducts, such as pressing over the lacrimal sac area or introducing a dye, it is preferable to perform routine syringing, especially in the context of developing countries where lacrimal sac infections are more prevalent.

- Dr. N.V. Prajna

4. Examination of the eye structures

(approximate testing time 5 minutes per patient, by junior ophthalmologist)

a. Cornea

The clarity of the cornea can be assessed by a flashlight (torch) examination and confirmed by slit lamp biomicroscopy. Corneal guttata, when identified by slit lamp examination, indicates a risk factor for early corneal decompensation. In such cases, extra care should be taken to prevent corneal damage due to corneal bending or excessive insertion of instruments into the anterior chamber. Excessive irrigation of the anterior chamber is necessary; viscoelastics (costly but essential for reducing complications) should be used liberally because of their ability to prevent corneal endothelial damage by deepening the anterior chamber.

b. Anterior chamber

It is important to detect anterior chamber depth. In patients with shallow anterior chamber, the angle should be examined by gonioscopy before dilatation to examine angle status, since pupillary dilation in such cases can precipitate an attack of angle closure glaucoma. During surgery on patients with shallow anterior chamber, it is important to prevent iridodialysis- especially when enlarging the incision with scissors-as well as inadvertent rupture of the fragile capsule surrounding a swollen lens. Pseudoexfoliation and possible anterior subluxation of cataract should be suspected in cases of unilateral shallow anterior chamber. Peripheral iridectomies should be considered in eyes with shallow chambers. Patients with pseudoexfoliation should have the IOL placed in the sulcus, not the bag, because of loose zonules.

c. Iris

Iridodonesis is the sign of a subluxated or dislocated lens. Extra care should be taken during capsulotomy and nucleus delivery. Facilities should be available to manage anticipated vitreous problems. A pars plana lensectomy or ICCE might be preferred technique in such cases. The IOL should be put in the sulcus or anterior chamber. Rubeosis of the iris should be specifically looked for, since it might be a sign of diabetic eye disease, and is strongly suggestive of diabetic retinopathy.

d. Pupils

A Marcus-Gunn or swinging flashlight test should be done. The pupillary response should be brisk, even in the presence of a white mature cataract. If this is not so, posterior segment pathology such as retinal detachment, optic neuropathy or a glaucomatous optic atrophy is likely to keep the vision poor even after cataract surgery.

The degree of pupillary dilation in response to mydriatics and cycloplegic solutions should be noted. If the pupil does not dilate fully, extra steps should be taken at the time of surgery to allow adequate access to the lens and subsequent safe delivery. This may consist of stronger mydriatics, topical non steroidal anti-inflammatory drops, epinephrine added to irrigating solutions, manual stretching of the pupil, iridectomy and/or sphincterotomy.

e. Lens

Ideally, the lens should be examined by flashlight and under slit lamp biomicroscopy after the pupil is fully dilated. The type and density of cataract should be noted. Special care should be taken to look for pseudoexfoliation of the lens capsule. An ultrasonogram can be used in cases of complicated cataract or unilateral mature cataract. The extent, density and the location of lens opacities should also be confirmed by distant direct ophthalmoscopy.

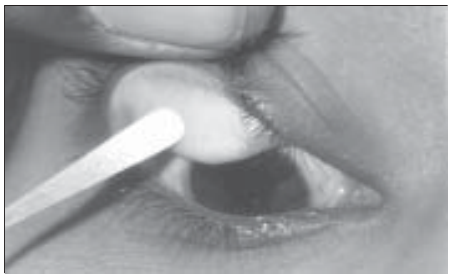
f. Posterior segment

Gross retinal function can be assessed by checking for light perception and projection. If retinal function is found to be defective, the visual prognosis should be explained to the patient. In this regard, the value of a thorough examination of the fundus in the incipient stage of cataract while the retina and optic disc are still visible is undeniable. Most often, even in the presence of advanced cataract changes, the fundus can be visualised by an indirect ophthalmoscope.

5. Conjunctival culture and sensitivity

(approximate testing time 2 minutes per patient, OA)

A routine conjunctival culture is unnecessary for most patients who will undergo cataract surgery. However, ideally it is done in cases of conjunctival discharge, altered lacrimal function, and where the other eye has been lost due



to postoperative sepsis. In such cases, surgery can be performed after the results of the culture test. If the results indicate the presence of normal flora, such as *Staphylococcus epidermidis*, surgery can still be performed if there are no other signs of infection. If organisms such as *Staphylococcus aureus, Pneumococcus* and *Pseudomonas* are cultured, then surgery should be deferred for at least three weeks while the patient is treated with topical antibiotic therapy until there is no more than light growth.

6. Measurement of intraocular pressure (IOP)

(approximate testing time 5 minutes, by OA)

Where a facility for applanation tonometry is not available, Schiotz tonometry is still a reliable screening test for measuring IOP in patients undergoing routine cataract surgery.

7. Evaluation of visual function in an eye with mature cataract

(approximate testing time 5-7 minutes per patient, by OA)

Two tests of primary importance in such cases are the pupillary response and light discrimination. The pupillary response should appear normal even in the presence of mature cataract. Light projection and two-point discrimination are crude forms of visual field testing. Nevertheless, they do provide important information about a visual function (the light sense) that is fundamentally different from that provided by testing of visual acuity.

Ultrasonography is usually employed in cases of complicated and traumatic cataract to detect presence of vitreous haemorrhage, retinal detachments, intraocular foreign body, or tumour.

8. Keratometry and A-Scan measurement

(approximate testing time 5-7 minutes per patient, by OA)

Preoperative refractive status and axial length of the eyeball differs from patient to patient. Because of this, precise calculation of the lens power through accurate keratometry and careful biometry using standard SRK formulas is essential for optimal benefits of IOL implant surgery.

Routine use of a standard lens power, although advocated by some surgeons, has not been proved by many studies to give a comparable visual acuity as that of a "customised" IOL power because the preoperative refractive status and axial length of the eyeball differs from patient to patient.

- Dr. N.V. Prajna

If there are no facilities for keratometry or A-scan, then a standard IOL power can be used (+19 - +21D), but this is not entirely reliable. With no facilities, the IOL power can be calculated by refracting the eye with vision. Or if the patient has been using spectacles, their bilateral cataracts who have never used glasses, a standard prescription of IOL fits most of them.

The extent of preoperative medical testing in healthy cataract surgery patients, including what constitutes "appropriate testing" has generated considerable debate in the medical community. The validity of preoperative medical testing is now being questioned and what is considered 'optimum preoperative care' is being reassessed from the perspectives of medical necessity and costs.

- Archives of Ophthalmology. 1995 (113): 1248 - 1256

It is advisable to repeat keratometry if:

- average keratometry (K) is less than 40D or greater than 47D;
- corneal cylinder does not correlate well with the refractive cylinder.
- there is a difference of more than 1 diopter in the average K readings of the two eyes.

Measurement of the axial length is best done with A-scan ultrasound. The machine should have a screen showing the spikes for ensuring correct measurement. It is recommended that the measurements be repeated if:

- measured axial length is less than 22mm or more than 25mm;
- axial length value does not correlate with refraction value;
- there is a difference of more than 1mm in the axial length of the two eyes.

The following factors should be considered in the choice of IOL power:

- the refraction and the presence or absence of cataract in the other eye;
- relevance of emmetropia, anisometropia or aniseikonia (for example, in patients with high hypermetropia or myopic error who have undergone an IOL in one eye, the second eye should also be made slightly hypermetropic or myopic to prevent diplopia);
- lifestyle of the patient (active patients might prefer emmetropia while sedentary patients might prefer myopia);
- it is preferable to aim towards slight myopia.

General investigations

A careful preoperative medical evaluation ensures a safe perioperative course for the patient. Preoperative medical evaluation and appropriate testing should be done on all patients undergoing cataract surgery.

Since 80% of cataract patients are otherwise healthy, a healthy cataract patient does not require a battery of extensive and expensive systemic tests before undergoing cataract surgery.

At Aravind, the following basic investigations have been found to be adequate for all patients undergoing cataract surgery.

1. **Pupillary function**
2. **Patency of lacrimal ducts**
3. **blood pressure and urine for sugar.**

However, in patients with diabetes and cardiac problems, the relevant investigations must be done. In all instances, patients are encouraged to consult with their family physicians thus cutting costs and saving time. All patients with systemic disorders have their charts flagged with brightly coloured stickers, indicating the systemic disease.

Two basic tests that are universally agreed upon are screening for diabetes mellitus and hypertension. A routine urine examination for checking sugar (Benedict test or strip test) is all that is required in the majority of cases.

Blood pressure recording is mandatory. If the patient is found to be hypertensive (repeated > 140/90), necessary medications may be given after consulting a physician (staff doctor or family physician). Certain drugs such as epinephrine (which cause further vasoconstriction resulting in increased blood pressure) should be avoided perioperatively.

An electrocardiogram (ECG) is reserved for cardiac patients. Blood urea and serum creatinine tests are mandatory for renal patients. A chest radiograph (P.A. view) is usually obtained for patients with respiratory disorders.

Systemic conditions like chronic obstructive pulmonary disease (COPD), constipation, chronic cough, and benign hypertrophy of prostate (BHP) should be looked for and treated to avoid complications like positive IOP during and after surgery.

Patients should be checked for drug allergies. Special consideration should be given to patients who are allergic to sulpha since carbonic anhydrase inhibitors (CAI) should not be administered to them to lower IOP levels. Xylocaine sensitivity should be checked before administering anaesthesia to patients. Beta blockers should not be used for asthmatics to lower IOP as it might precipitate asthma.

Special considerations

1. Pseudoexfoliation and cataract

Pseudoexfoliation is a common finding in many eyes presenting with cataract. The IOP is carefully checked in these patients to rule out co-existing glaucoma. The lenses of these patients are checked for subluxation so that adequate care can be taken during surgery. Such cases present with rigid pupil, endothelial dusting, weak zonules and sometimes subluxated lenses. These factors must be kept in mind while performing surgery for cataract associated pseudoexfoliation. Many surgeons put the IOL in the sulcus (not the bag) in pseudoexfoliation cases.

2. Co-existing glaucoma and cataract

As a general rule, a routine cataract extraction is done if glaucoma is under control. When the glaucoma control is poor and unrelated to the lens itself, such

as in chronic open angle glaucoma, a combined cataract / glaucoma procedure may be considered. Currently, most surgeons favour trabeculectomy combined with cataract extraction. In cases of glaucoma secondary to lens pathology, such as phacolytic or phacomorphic glaucoma, cataract extraction alone might control glaucoma. The surgeon might consider doing peripheral iridectomy in this case.

3. Co-existing cataract and corneal opacities

Patients with co-existing corneal opacities and cataracts often have an excellent visual result if cataract surgery alone is done, particularly if the opacity is paracentral and not associated with irregularity of the corneal surface. In a case of smaller central opacity, cataract surgery should be associated with sphincterotomy or a broad based iridectomy. In cases with dense central leukoma, many surgeons favour a triple procedure - cataract extraction with lens implantation and keratoplasty.

4. Complicated cataract

This is usually unilateral and might show other signs, such as keratic precipitates on the back of the cornea, festooned pupil and patches of iris atrophy. Active uveitis, manifested by flare and cells might or might not be present. These cases must be subjected to a routine ultrasonographic examination for assessing vitreous membranes or retinal detachments before surgery. Active uveitis should be controlled medically with topical steroids and cycloplegics, and surgery can be deferred until the eye is quiet. Intraocular lens implantation can safely be performed in these cases under a cover of steroids. These patients might require pupil stretching manouvres, multiple sphincterotomies or a sector iridectomy to ensure a safe cataract extraction.

5. Traumatic cataract

The preoperative assessment in cases of traumatic cataract should depend on the nature of the object causing injury. A routine X-ray of the orbit (P.A. and lateral views) is necessary to detect a radio opaque foreign body. An ultrasound will show vitreous membranes, retinal detachment, and blood in the eye if present. It is often prudent to do primary repair and defer lens extraction for a few weeks. However, if the traumatic lens is leaking or subluxated anteriorly, lens extraction can be performed at the time of the primary repair itself.

6. Day care (or ambulatory care) patients

Preoperative evaluation of day care patients is ideally done on the day before surgery. Day care patients should receive sutureless surgery, since it is safe and more stable. Day care surgery is only suitable for patients who live in hygienic settings suitable for the postopertive period and those, who can guarantee they will attend for follow-up.

Appendix 2

Preoperative Preparation and Anaesthesia

Table of Contents

Because diagnostic, therapeutic, and practice recommendations may have changed since the publication of this series, because such recommendations cannot be considered absolute or universal in their application, and because the publication process contains the potential for error, Aravind Eye Hospitals and Seva Foundation strongly advise that the recommendations in this series of clinical submodules be verified, prior to use, and be considered in light of a particular patient's clinical condition and history. The reader is urged to review the package information data of the manufacturers of the medications and devices mentioned. Drug therapy is constantly changing. Consequently, it is the responsibility of the health care professional to seek additional and confirmatory information; to evaluate its appropriateness as it relates to the actual clinical situation; and to consider new developments. Because it is beyond the scope of this series to include all indications, contraindications, side effects, and alternative agents for each drug or treatment, and because standards for usage change, it is advisable to keep abreast of revised recommendations. Caution is especially urged when using new or infrequently used drugs. It is the responsibility of the physician to determine applicable federal status of each drug or device he or she wishes to use, and to use them with appropriate patient consent in compliance with applicable law. The ultimate arbiter of any diagnostic or therapeutic decision remains the individual physician's judgement.

Introduction

Careful preoperative preparation of the patient, followed by satisfactory anaesthesia, is vital for preventing unwanted anaesthetic, surgical and postoperative complications, thereby ensuring a smooth and uneventful cataract surgery.

The term "preoperative preparation" as used here refers to the period that begins after admission and extends to the moment the patient is wheeled in for surgery. Admission is usually preferred one day before surgery. However, if "outpatient surgery" or "day care" or "ambulatory" facilities are available, a previously evaluated and fit patient can come on the day of surgery itself.

This appendix will share experiences learned in preoperative preparation and anaesthesia in a large volume cataract surgery setting. After discussing staffing considerations and block room set-up, it will outline a detailed step-by-step protocol for preparing patients for surgery, including local anaesthesia techniques, complications of local anaesthesia, guidelines for successful local anaesthesia, and important preoperative considerations in a large volume cataract surgery programme.

In a large volume setup, a separate team of personnel is used in each department. But in smaller institutions, many of the staff can play multiple roles according to the need.

- Dr. R. Kim

Staffing considerations for large volume

Ward personnel

- Ward doctor/s
- Ward paramedical staff (ophthalmic assistants and /or nurses)
- Patient counsellors

Activity profile of ward doctors

The ward doctor does the preoperative workup of the patients, which includes:

- Performing ocular examination to reconfirm all test findings and correlate with records.
- Obtaining conjunctival culture sensitivity for
  - One-eyed patients
  - Ducts partially free with clear fluid
  - Ducts not free with clear fluid
- Supervising administration of preoperative medications
- Checking with the patient for past history of sensitivity or allergy to anaesthetic agents.
- Deciding on the type of anaesthesia (local or general) that the patient will need, depending on patient's age, and physical and mental well-being
- Devoting special attention to complicated and high risk patients (one-eyed, glaucoma, high myope)
- Obtaining a physician's certificate of fitness for patients with systemic problems.
- Ensuring that appropriate identification stickers are placed on the case file covers for patients with Diabetes / Hypertension / Asthma / Cardiac / Allergies and for IOL / ECCE / Phaco cases.

At Aravind, preoperative sedation of cataract patients is not done as a routine. Only in a small percentage of cases who are restless or nervous sedation is indicated. In our experience, we have found effective counselling to be far superior to sedation in achieving patient compliance."

- Dr. G. Natchiar

NB: A physician's certificate is necessary only in special cases such as uncontrolled diabetes or recent cardiac problems. At Aravind, for example, the inhouse physician is consulted in such instances. However, in smaller settings, which do not have an inhouse physician, the patient's general physician's advice can be sought.

Block room (Anaesthesia area) personnel

- Doctor/s trained in handling emergency medicine and resuscitation
- Block doctor/s (anaesthesiologist, or ophthalmologist or general practitioner trained in blocking techniques)
- Block room paramedical staff (OAs, ophthalmic technicians, and/ or nurses)
- Theatre orderlies for shifting patients
- Patient counsellor/s

The number of surgeries performed by a well trained surgeon ranges from 10 to 16 surgeries per hour. A single block room doctor can block, on an average 40 to 50 cases per hour.

- Dr. R. Venkatesh, Aravind Eye Hospital

At Aravind Eye Hospitals, blocking is done by a resident ophthalmologist assisted by senior trained ophthalmic assistants. At smaller institutions, many block room activities are the responsibility of trained ophthalmic technicians.

Activity profile of block room medical staff

The block room doctor (or designated assistant) is responsible for:

- Being present in clean theatre wear, scrubbed and gloved, at least 30 minutes before the first surgery begins
- Consulting with the coordinator regarding the day's operation list
- Checking the stickers on case file covers to identify special cases (Diabetes/ Hypertension/ Asthma/Cardiac/ Allergies)
- Identifying, verifying and checking the eye that is to be operated to ensure full dilation
- Preparing anaesthetic solution
- Planning and giving proper block, to avoid unnecessary repetition
- Letting the surgeon(s) know when patients with systemic problems have been blocked
- Asking senior medical staff for assistance if ocular or systemic problems arise while blocking
- Recording any problems in the case sheet and referring, where necessary
- Taking extra precautions such as using two gloves and disposing of needles and syringes by incineration in HIV/AIDS and hepatitis cases

Formerly at Aravind, all patients who were to undergo surgery were brought from the wards to the block room. One of the problems faced was prolonged waiting time, leading to patient dissatisfaction, particularly for patients with systemic problems like diabetes and hypertension. These groups were prone to hypoglycaemic attacks and cardiac problems. Even patients undergoing minor surgery like pterygium had to wait for a long time unnecessarily. To avoid these pitfalls, the current practice is to block patients in batches according to the surgeon's capacity, (the surgeon's speed, and the nature of cases (complicated or simple), as well as to prioritise specific cases (diabetes, hypertensives, cardiac patients and the elderly) *and types* of surgery.

- Alees Mary Rajkumar, Nursing Training Co-ordinator, Aravind Eye Hospital

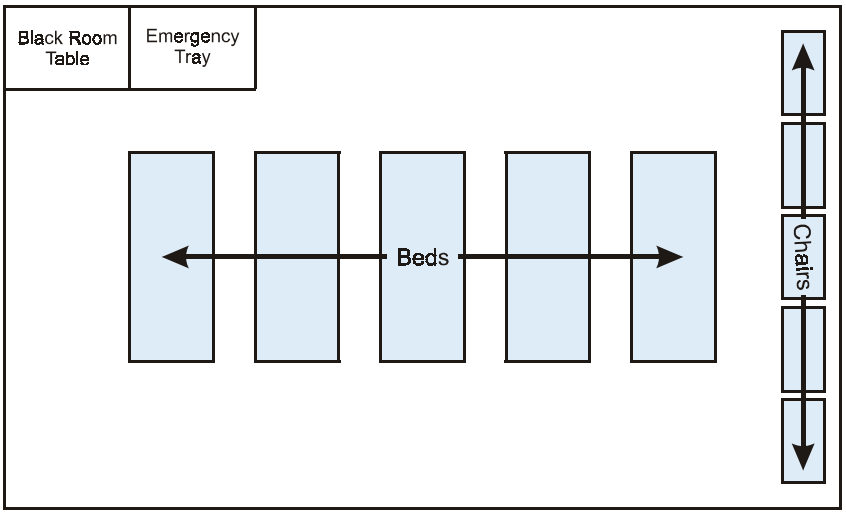
Aravind Eye Hospitals' Scheduling Guidelines (See Management Module for more information)

- **Schedule on an hourly basis so that doctors start with simple cases and work toward more complicated cases**
  - **First batch: clinically normal cataract, IOL, phaco, glaucoma**
  - **Second batch: asthmatic, hypertensive, cardiac, diabetic**
  - **Third batch: diabetic, cornea, septic (separate OT)**

- General anaesthetic cases will be scheduled in the first batch (and are usually dilated in the OT)
- Paediatric, retina and orbit scheduling is autonomous

Block room (Anaesthesia area) set-up for large volume

Location and layout of block room



The block room is the outermost room of the operation theatre complex where local anaesthetics are applied before surgery. The block room should be located adjacent to the operation theatre to guarantee efficient transfer of patients and effective communication between OT and block room staff. Clean, sterile and adequately ventilated, the block room should provide sufficient space for emergency drugs, easy accessibility during an emergency, and a calming atmosphere with comfortable furnishings and a toilet nearby for the patients.

Positioning of patients during block

The block may be done with the patient either sitting or lying down, depending on the number of cases and the doctor's convenience, although lying down has been found to be preferable. Accordingly, cots may be placed in parallel manner for patients to lie down or benches may be placed side to side against the wall for comfortable seating and easy mobility.

Formerly at Aravind Eye Hospitals, blocking was done with the patients seated. This method was found to cause problems such as vasovagal attacks, shock, and drop in blood pressure and pulse. This led to increased patient dissatisfaction, greater stress for doctors and nurses, dependency on ICU staff for even minor emergencies, and delay in surgery. In order to avoid these problems, the current practice is to block patients (in batches of ten) after having them lie down comfortably. Besides being safer, this position has been found to be helpful in massaging the eye after the block.
- Alees Mary Rajkumar, Nurses Training Co-ordinator, Aravind Eye Hospitals

The block room table

The block room table is a separate table holding all requirements for anaesthesia plus a fully equipped emergency tray. Contents of the block room table include:

Chances of perforating the optic nerve or injecting into the subdural space are greatly reduced if a 1 inch rather than a 1½ retrobular needle is used.
- Dr. Marty Spencer

- Local anaesthetic agents/ elements
  - Xylocaine 2%
  - Xylocaine 2% with Adrenaline (optional: epinephrine can be dangerous in cardiac patients)
  - Sensorcaine 0.5% (bupivacaine)
  - Topical Xylocaine 4%
  - Hyqlase (sodium hyaluronidase) with Xylocaine
- Mydriatic drops
- Antibiotic drops
- NSAID drops (optional)
- Tray containing sterile retrobulbar (23G needle - 3/4 or 1 inch) and facial needles (disposable variety 23G)
- 5 ml disposable syringes
- Tray containing sterile cotton swabs
- Empty tray for placing used needles
- Eye pads and bandages
- Balancing weights, pinky balls or Kulvari stand for sustained ocular hypotony

The emergency tray

Contents of the emergency tray include:

- Injection hydrocortisone
- Injection adrenaline
- Injection atropine
- Injection Diazepam
- Injection Deriphyllin
- Injection chlorpheniramine maleate (antihistamine)
- IV sets
- Syringe, needles
- Antihypertensive agents
- Normal saline, dextrose 5%, 20%
- BP apparatus, stethoscope

- Standby portable ECG machine
- Oxygen cylinder and nasal cannula
- Endotracheal Intubation tubes, ambu bag, laryngoscope
- Protocol for cardiac arrest management

Preoperative examination: Protocol for large volume

Preliminary preparation

Once a patient has been admitted, ward staff must conduct the preliminary preparation for cataract surgery, which includes:

- Checking that all necessary tests were done adn duly noted in the outpatient department
  - Duct examination
  - IOP measurement by Schiotz tonometry
  - Blood pressure recording
  - Urine sugar
  - Keratometry and A-scan in IOL cases (measurements for both eyes compared)

- Conducting inpatient test
- Checking that informed consent was obtained
- Clipping eyelashes of the eye to be operated, if applicable
- Performing conjunctival sac wash
- Informing the ward doctor of problems cases
- Instilling antibiotic eye drops four to six times a day, from the time of admission to the time surgery
- Ensuring that patients acquire the items required for surgery, according to prescribed list

Patient preparation on day of surgery

In the ward on the day of their surgery, patients are instructed to:

- take a bath and wash face
- tie up hair/put on hair cap
- eat a light breakfast to prevent prolonged fasting and hypoglycemia
- empty bladder

Medications

Two weeks before surgery

- ASA/aspirin and other strong NSAIDS (nonsteroidal anti-inflammatory drugs) should be discontinued two weeks before surgery.

A single application of topical 5% povidone-iodine has bactericidal effect that is equivalent to a 3-day course of topical antibiotics.

- S.J. Isenbergs etal: Archives of Ophthalmology 1985; 103:1340

One day before surgery

- Anti hypertensive agents and oral hypoglycemic agents should be given in indicated cases.
- Diazepam tablet in the night can act as an anxiolytic in indicated cases.
- Antibiotic eye drops 4-6 times a day (optional) and/or povidone-iodine (Betadine) as surgical prep (essential).

On day of surgery

At Aravind, systemic antibiotics, both preoperative and postoperative, are avoided because of their proven inability to influence the rate of infection. This practice has been found to save time and is cost effective, making it relevant in a large volume programme, with no compromise in quality.

Dr. M. Srinivasan

- Mydriatics (essential) are used usually three times every 15 minutes starting one hour before surgery. Commonly used preparations are:
  - tropicamide 1% with phenylephrine 5% (use phenylephrine drops with care in hypertensive and cardiac patients)
  - 1% cyclopentolate eye drops (the combination of tropicamide and phenylephrine with cyclopentolate maintains dilatation for a longer time)
- Flurbiprofen 0.03% eye drops(optional) have a prolonging effect on mydriasis. They are applied every 15 minutes in 4 doses one hour before surgery in addition to mydriatics.
- Antibiotics are considered optional. The role of preoperative systemic antibiotics is debated by many surgeons and may be used according to the norms of the institution.
- The ocular hypotensive agent acetazolamide (Diamox) 250mg is given orally one hour preoperatively, but is only indicated cases of severe glaucoma. Diamox will not significantly lower pressure in an eye that doesn't have elevated pressure. (Avoid giving this drug to patients with severe renal failure, sodium or potassium depletion, or sulfa allergy.)
- Drugs for chronic systemic diseases, apart from oral hypoglycaemic agents and insulin, should be taken with a few sips of water in the morning. The dose of antidiabetic and antihypertensive drugs will be monitored by the inhouse or family physician on the day of surgery and postoperatively.

Preparation of anaesthetic solution

At Aravind Eye Hospitals, the anaesthetic solution consists of
- **Xylocaine 2% with hyaluronidase 25 IU/ml of Xylocaine, therefore for 10 ml of anaesthetic solution, 250 IU of hyaluronidase is needed.**
- **50% mixture of Xylocaine and bupivacaine**

Local anaesthesia techniques

Retrobulbar injection with facial block (for akinesia of orbicularis oculi) is standard practice. The facial block can be done by O'Briens technique (described below), or by other less common methods.

Surgical intervention on the eye, the most precious of sense organs, arouses irrational but deep-seated fear. A satisfactory state of anaesthesia is essential in cataract surgery. The inadequately sedated patient may express his anxiety by restlessness, compulsive chattering, failure to co-operate, coughing, squeezing of eyelids and other reactions that increase the rate of operative complications. Aside from the desirability of having the patient conscious enough to respond to the surgeon's directions, general anaesthesia is contraindicated in elderly, artherosclerotic patients, complications like heightened intraocular pressure and risk of cardiac arrest in unconscious patients.

- Archives of Ophthalmology, 115 (10), October 1997

Retrobulbar Block

The eye is maintained in primary position. The retrobulbar needle (23G- 1 inch or shorter) is inserted at the junction of lateral one-third and medial two-third of inferior orbital rim into the muscle cone. The globe should be closely observed as the needle is advanced; any movement of the globe suggests the possibility of penetration of the scelera. Aspiration is performed to rule out intravascular placement and 2.5 cc of anaesthetic solution (with hyaluronidase) is injected slowly. Initially pressure is applied for a minute, and the eye is massaged gently (usually with constant weight pressure or pinky ball) to enable adequate hypotonicity of the globe before surgery.

Facial Block using O'Brien's technique

4.5 cc of the anaesthetic agent (Xylocaine 2%, with optional Adrenaline) is injected over the condyloid process of mandible. It is felt by asking the patient to open and close the mouth (it blocks the proximal trunk of the facial nerve). Following a facial block the eyelid should droop. There should be no massage following a facial block, since massage might give corneal abrasion if lids don't close.

NB: In a large volume setting, a prolonged waiting period following the block produces corneal dryness that causes corneal haziness when seen under the microscope. In case of delay, the eye must be temporarily bandaged or manually closed.

Other methods of facial block

- Van Lints method
- Atkinsons method
- Nad Baths method

These methods are less commonly used.

Peribulbar Block

Although at Aravind, the preferred practice is a combination of retrobulbar with facial block because of speed, simplicity and completeness of the block, some surgeons in more developed countries prefer the peribulbar block, which has the advantages of:

- Not requiring additional facial blocks
- Giving less chance of injury to vital structures within the muscle cone
- Being safer in high myopia and exophthalmos
- Giving less chance of retrobulbar haemorrhage

The choice of procedure depends on the surgeon's preference and the risk of retrobulbar to the eye.

Using a 22G 1" bevelled needle and maintaining eye in primary position, the first injection is given in the lower eyelid at the junction of inner two-third and outer one-third. The needle is inserted transcutaneously and passed along the orbital floor upto its hub. Aspiration is performed to rule out reflux of blood. Approximately 4 ml of solution is slowly injected, and the needle is then slowly withdrawn. At the level of orbicularis muscle, the remaining 1 ml of solution is injected to facilitate lid akinesia. The procedure is repeated in the supra orbital region at the junction of medial one-third and lateral two-third. The needle is passed along the orbital roof to avoid the globe and extra orbital muscles.

NB: After a block, check the eye for eyeball movements. Following an ideal block, the eye is soft and fixed. Only slow extreme movements are present. In instances of coarse, vigorous movements of the eyeball it is advisable to wait for a period of time and repeat blocks in small doses to inhibit movements.

Complications of local anaesthesia

Retrobulbar haemorrhage (1/ 50 cases)

Recognition

- Blood in the syringe
- Sudden taut swelling in either or both the eyelids
- Inability to open/close the eyelids
- Marked forward movement/sudden bulging of the globe (proptosis).
- Immobility of the globe
- Massive blood staining of the conjunctiva

Management

1. The person giving the anaesthetic must
   - Immediately apply pressure with two or three fingers over the closed lids
   - Inform the surgeon if the swelling is large and the orbit is tense
2. The surgeon
   - Assesses the intraocular pressure by palpation or tonometry
   - Assesses the state of the central retinal vessels by direct observation or consensual reflex. If high, considers
   - Further massage
   - Lateral canthotomy or direct drainage of the haemorrhage
   - Paracentesis
   - Osmotic diuresis (e.g. mannitol 20% 1gm/kg or acetazolamide (Diamox) 500 mg IV stat)

NB

a. Contraindications for mannitol: patients with cardiac failure, prostatic hypertrophy (as it is likely to precipitate urinary retention)

b. Contraindications for acetazolamide: allergy to sulpha drugs, severe renal failure, sodium or potassium depletion

3. Continue with surgery

- If the swelling is small and there is no further increase in swelling.
- If the lids, in particular the upper lid, is mobile, allowing adequate access to the superior limbus without pressure on the globe

Toxicity of the anaesthetic (1 / 100 cases)

The most important toxic effect of local anaesthetic is on the central nervous system, which occurs after accidental injection into the optic nerve sheath.

Although rare, the staff should nevertheless be made aware of the possibility of accidental injection into the optic nerve. Emergency life support measures (staff and equipment) should be immediately available in the block room area. As there may be a short delay in the onset of signs and symptoms, the patient should be observed and not draped for surgery until at least 15 minutes after the injection.

Recognition:

- Tremors
- Agitation and/or incoherence
- Nausea/vomiting
- Slurring of speech
- Difficulty in swallowing
- The extraocular muscles of the other eye start to become paralysed or there is loss of vision in the other eye
- Convulsions
- Respiratory depression and possibly arrest
- Cardiovascular collapse may follow there might be no stage of excitement but immediate respiratory collapse and loss of consciousness

Management

- Mechanical ventilation might be necessary for about 20 minutes if respiratory depression or arrest is evident
- Maintain the airway (insert an oral airway, if necessary)
- Apply a face mask
- Assist ventilation with an ambu bag (+/- oxygen)
- Monitor/record blood pressure, pulse and respiratory rate
- To prevent peripheral collapse, start and maintain an intravenous line
- Take appropriate steps if cardiac arrest occurs

At Aravind, we prefer retrobulbar block because of its quicker action, and longer duration of block-induced anaesthesia (around 40 minutes). The peribulbar method uses too much fluid and takes a longer time to act. Contrary to reports, in our experience, we have encountered globe perforation following a peribulbar block.

- Dr. G. Natchiar

Perforation of the globe during anaesthesia (1/1000 cases)

Recognition

1. The patient might
   - Complain of pain at the time of perforation
   - Describe the penetration as a "poking through" sensation
2. The person giving the anaesthetic might notice
   - Some resistance as the needle passes through the sclera
   - Movement of the globe as the needle advances or as the needle is moved from side to side before injection.

NB: Perforation is more likely in large myopic eyes or those with thin sclera.

Management

- Withdraw the needle
- Feel the ocular pressure

If pressure is high

- Massage immediately
- Inform the surgeon, who will decide whether to perform a paracentesis of the anterior chamber to relieve the pressure

If pressure is low

- Do nothing with the eye
- Inform the retina surgeon, who will evaluate the posterior segment.

At Aravind, intraocular pressure is reduced by either a digital massage or a stand with balanced weights for sustained ocular compression. The latter practice has been found to be particularly effective in a large volume setting where the exclusive use of digital massage would make huge demands on paramedical staff.

- Dr. G. Natchiar

Anaesthetic guidelines for successful cataract surgery

The ophthalmic assistant or block room doctor must immediately detect medical emergencies occurring in the block room and promptly manage them with the help of the anaesthetist or emergency physician on call.

After an adequate digital massage, the block room ophthalmic assistant rechecks the block, repeats if necessary, and then sends the patient to the OT.

The waiting period for patients, especially diabetic and cardiac patients and very old patients, should be reduced as much as possible.

A soft eye is most desirable for ECCE and IOL implantation. Following a block, place a gauze piece over the closed eye and apply gentle digital pressure for 10+minutes. Other methods of obtaining ocular hypotony folowing block include using a super pinky ball with rubber strap, a mercury bag, or a balanced weight. With Schiotz tonometer, a reading of 10 or above without weights is desirable.

Do's and Don'ts of ophthalmic anaesthesia

Do

- ✓ DO use primary gaze position, or consider "down and out" or "down and in".
- ✓ DO use a precision technique based on sound anatomical knowledge.
- ✓ DO measure axial length

The use of topical anaesthesia in cataract surgery has generated considerable debate. It has been proved to be safe in cataract surgery and has the added advantage of avoiding block-induced complications. However, in a large volume setting, topical anaesthesia involves prolonged patient counselling and thus has been found to be a time-consuming practice. It therefore has restricted use in a large volume setting because of these limitations. Although our experience with topical anaesthesia is limited, in a large volume setting, we have found a good block to be superior to topical anaesthesia and safer for both the surgeon and the patient.

- Dr. G. Natchiar

- ✓ Do take extra caution in myopic patients who are more likely to have staphyloma, coloboma, or scleral buckle.
- ✓ DO align needles tangentially to the globe for all injections.
- ✓ DO use avascular injection sites.
- ✓ DO inject no deeper than 31 mm from the inferior orbital rim.
- ✓ DO use fine, sharp 23 gauge reusable 35 mm needles. Importantly, together with good anatomical knowledge, this will result in better tactile discrimination, patient comfort, and a lower incidence of tissue trauma and haemorrhage.
- ✓ DO avoid extraocular muscles.
- ✓ DO use a well thought-out technique, volume, and concentration of chosen anaesthetic agent.
- ✓ DO give facial block first in cases of resurgency or traumatic cataract with open corneal wound. Then give the retrobulbar block. This prevents the patient from squeezing his/her eyes when the retrobulbar block is given. (In extreme cases, general anaesthesia is preferred.)

Don't

- ✗ DON'T use the "up and in" globe position for inferotemporal intraconal blocking.
- ✗ DON'T attempt a block without accurate anatomical knowledge.
- ✗ DON'T forget to check axial length.
- ✗ DON'T fail to check for globe anomalies or previous surgical intervention.
- ✗ DON'T angle needle towards optic nerve; keep it parallel to orbital wall.
- ✗ DON'T inject at other than tangential alignment of the needle to the globe.
- ✗ DON'T use the superonasal quadrant.
- ✗ DON'T inject at the orbital apex using long needles. (Use 1 inch or shorter)
- ✗ DON'T use too blunt tipped needles.
- ✗ DON'T inject into extraocular muscles.
- ✗ DON'T use unnecessarily high concentrations of anaesthetic agents.

Important considerations for preoperative preparation and anaesthesia in a large volume setting

- An uninterrupted and smooth flow of patients in and out of the operation theatres should be maintained, to keep blocked patients and OT staff from waiting.
- Patients can walk, assisted, from the block room into the operating theatre. Only in special cases must patients be sent into the OT in a wheelchair or on a stretcher.
- The block room ophthalmic assistants must alert operating surgeons to the problem cases assigned to them.
- The use of a flash autoclave that can simultaneously sterilise about 10-15 sets of surgical instruments plays a major role in reducing the time lag between a block and the surgery.

- To ensure conveyor-belt continuity, there has to be a two-way system of communication between the operation theatre(s) and the block room(s). Ideally, the rate of blocking must be directly proportional to the surgical capacity, as indicated by the surgeon's output.
- In a large volume setting, the block team must consist of a separate team of doctors and ophthalmic assistants.This practice will save considerable time by allowing the surgeons to concentrate on the surgical procedure itself.

Appendix 3

Intraoperative Considerations

Table of Contents

Because diagnostic, therapeutic, and practice recommendations may have changed since the publication of this series, because such recommendations cannot be considered absolute or universal in their application, and because the publication process contains the potential for error, Aravind Eye Hospitals and Seva Foundation strongly advise that the recommendations in this series of clinical submodules be verified, prior to use, and be considered in light of a particular patient's clinical condition and history. The reader is urged to review the package information data of the manufacturers of the medications and devices mentioned. Drug therapy is constantly changing. Consequently, it is the responsibility of the health care professional to seek additional and confirmatory information; to evaluate its appropriateness as it relates to the actual clinical situation; and to consider new developments. Because it is beyond the scope of this series to include all indications, contraindications, side effects, and alternative agents for each drug or treatment, and because standards for usage change, it is advisable to keep abreast of revised recommendations. Caution is especially urged when using new or infrequently used drugs. It is the responsibility of the physician to determine applicable federal status of each drug or device he or she wishes to use, and to use them with appropriate patient consent in compliance with applicable law. The ultimate arbiter of any diagnostic or therapeutic decision remains the individual physician's judgement.

Given the backlog of cataract blind and the level of incidence in many developing countries, there is an urgent need to move beyond the debate of whether high quality can be achieved in large volumes. The only way to solve the increasing backlog of cataract blindness is to do significantly larger volumes of cataract surgery. Given the limitations in creating additional resources and the delay involved, the only practical option available is to increase productivity. With proper organisation and the right attitude, it is not only possible to achieve large volume and high quality, but it is something that has to be done immediately in the face of rising backlog of cataract blindness.

- R.D. Thulasiraj

Introduction

This appendix provides guidelines and strategies for achieving high quality, large volume cataract surgery with efficient and cost-effective utilisation of resources within the operation theatre(OT).

After outlining operation theatre staffing, physical dimensions of the OT, and necessary material resources, this appendix discusses the efficient use of OT resources, sterilisation procedures in a high quality setting, and types of cataract surgery suitable for large volume. This concludes with a summary of strategies for greater productivity in the operation theatre.

NB: Theinformation in this appendix should be viewed as a practical guide, to be used in addition to knowledge gained from surgical training and standard textbooks. The Aravind model illustrated here has achieved the goals of high quality and efficiency in decreasing the backlog of cataract blindness. See Management Principles and Practices Module for more information. However, the guidelines and strategies can and should be modified to optimise the different situations of other eye care institutions.

The operation theatre team

(See Paramedical Contributions Module for more information)

The responsibility for creating a 'surgery-friendly' environment that enables a surgeon to function at his/her best belongs to operation theatre personnel. Successful large volume surgery is possible only with a cohesive team whose members have a strong sense of commitment, dedication and singleness of purpose.

The paramedical staff should have received adequate training and should be knowledgeable about the functioning of the operation theatre. Junior ophthalmic assistants can undergo training on the job as well, under direct supervision.

The number and distribution of staff should be such that every person has a definite role to play in the process of cataract surgery. Well-defined responsibilities will facilitate high quality work, even when the whole process is repeated numerous times per day in assembly-line fashion. It is the system of standardisation of processes and surgical techniques that creates the teamwork. Division of work, job allocation, and maximum utilisation of available resources all serve to enhance the surgeon's productivity.

For example, at Aravind, a senior surgeon operates on two side-by-side tables with a scrub nurse at each table. While the surgeon operates on one table assisted by one scrub nurse, the other scrub nurse drapes and prepares the second patient up to the bridle suture. Once the surgery is over, the assistant gives the subconjunctival injection and bandages the patient, while the surgeon, after scrubbing his/her gloves with disinfecting spirit, moves on to the other table , where the next patient is ready to be operated on. Thus a single surgeon with a single microscope almost doubles his/her output in such a setting. Typically, an experienced surgeon can perform around six to eight ECCE and eight to ten manual sutureless cataract surgeries in an hour.

1. Surgeon

The surgeon must be a qualified medical doctor who has undergone or is undergoing training in ophthalmology. (In some countries, highly

trained ophthalmic technicians or traditional healers perform cataract surgery.) The surgeon also needs to monitor all other tasks performed in the OT and will sometimes be required to solve problems as they arise.

Even though OT tasks are specialised, at Aravind they are delegated to adequately trained paramedical staff. Building this concept of 'smarter working' by allocating routine work to para-medical staff significantly increases the volume of work an ophthalmologist can do.

- Dr. G. Natchiar

2. Assistant/Scrub nurse

The assistant in surgery must be a trained ophthalmic paramedic (Aravind model) or a surgeon in training. The scrub nurse

- Helps maintain sterile conditions throughout the surgery.
- Carries out procedures like draping, setting the microscope, placing the lid speculum, and placing the bridle sutures
- Assists the surgeon during surgery by providing appropriate instruments and material, helping in the use of instruments, maintaining a dry field to prevent accumulation of fluid, anticipating and identifying complications in a timely manner, keeping sutures and clamps ready for emergency, and providing the required instruments
- Checks whether the surgical tray is properly arranged and ensures that all the requirements of the surgeon are met
- Tracks and disposes the sharps

The surgeon and the assistant are sterile and therefore are restricted to tasks that maintain their sterile condition. It is therefore necessary to have additional OT staff in a large volume setting. But in a smaller set-up, the surgeon and assistant can complete other preliminary work earlier.

3. Running (Circulating) nurse

The running nurse ensures that all nonsurgical aspects of the operation theatre function smoothly. This allows the surgeon and scrub nurses to concentrate on surgery. The running nurse

- Helps in sterile preparation of the surgical team.
- Assists the operating team by providing additional equipment and material (IOL, fresh set of instruments, drugs) for every case, and by making external adjustments of the microscope, cautery, vitrectomy machine and cryo machine.
- Helps in placing patients on the table after ensuring they are prepared for surgery, and subsequently helps them off the table.
- Arranges for an uninterrupted flow of patients for surgery
- Provides details from the case sheet, maintains records for the OT, writes postopertive notes
- Acts as a messenger from the OT
- Proactively anticipates requirements during emergencies and makes necessary arrangements, such as a quickly supply of instruments

4. Sterilisation nurse

A large volume cataract surgery programme needs someone to provide continuous sterilisation services. The sterilisation nurse

- Hands sterilised instruments to the scrub nurse
- Sterilises instruments between surgeries and checks them for faults
- Carries out gross cleaning and sterilising of instruments at the end of the surgical day

5. OT supervisor/Coordinator

The OT supervisor is a qualified nurse in charge of the functioning of the operating theatre, overseeing all its activities and all the paramedical staff. The supervisor

- Plans the surgical day, assigns surgeons and paramedical staff to their postings, and arranges patient movement and OT assignment
- Manages all OT resources
- Communicates and co-ordinates between all members of the theatre team and with hospital authorities.
- Maintain quality assurance and infection control

6. Theatre assistant /Runner/Orderly

A large volume programme cannot maintain high quality without a staff member dedicated to the cleanliness and good functioning of the operation theatre. The orderly

- Cleans the theatre and its fixtures
- Shifts equipment
- Does minor electrical and mechanical repairs
- Moves patients in and out of the theatre

7. Equipment technician

Operation theatres functioning at a large volume rate use a lot of equipment, electrical and otherwise. This requires the presence of a full-time qualified technician to take care of problems as they arise.

A large eye care institution will benefit from an in-house instruments and equipment maintenance division. At Aravind, the Instruments and Maintenance Division ensures that all instruments and equipment are maintained in good working condition. Routine maintenance includes checking different parts of each instrument to ensure proper functioning and rectify any deficiencies, however minor. This will ensure longer life. For example: operating microscope maintenance involves frequently cleaning the optics, checking controls and moving surfaces. This ensures optimum illumination and proper functioning of the controls.

Instruments and equipment maintenance is about constant care, periodic maintenance and immediate repair, when necessary. An instrument repaired is an instrument gained.

- Prof. V. Srinivasan

There is considerable overlap in responsiblities of the above personnel and a convenient combination can be designed and utilised according to the patient load and set-up of different institutions.

Suggested staffing of operating theatre(s) for large volume

	1 surgeon 2 tables	2 surgeons 4 tables
Assistants/ Scrub nurses	2	4
Running Nurse	1	2
Sterilisation Nurse	1	1
Theatre Assistant/Orderly	1	1

Location and layout of operation theatre for large volume

(See Architectural Design Module for more information)

Location of OT for optimal usage

The following factors are vital in a large volume setting: the rate of surgical output, an efficient running nurse, and the ready availability of sterilised sets of instruments.

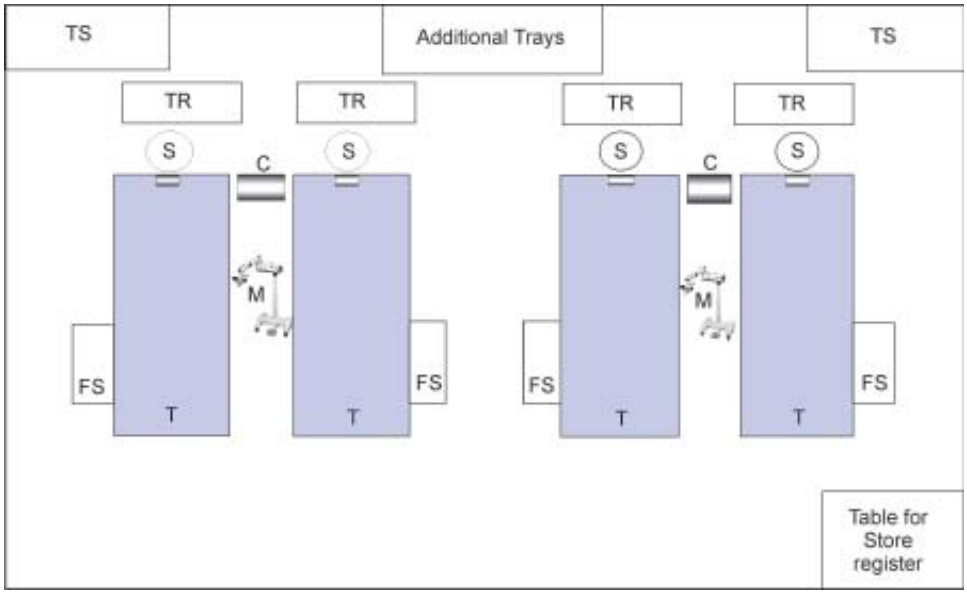
- Dr. G. Natchiar

- Away from areas exposed to crowds, noise and dust
- Easily ventilated
- Easy access to wards, but sealed off from public areas
- Restricted entry only beyond a room where all outer clothes and footwear are removed
- Easy access to sterilisation equipment

Requirements of the OT

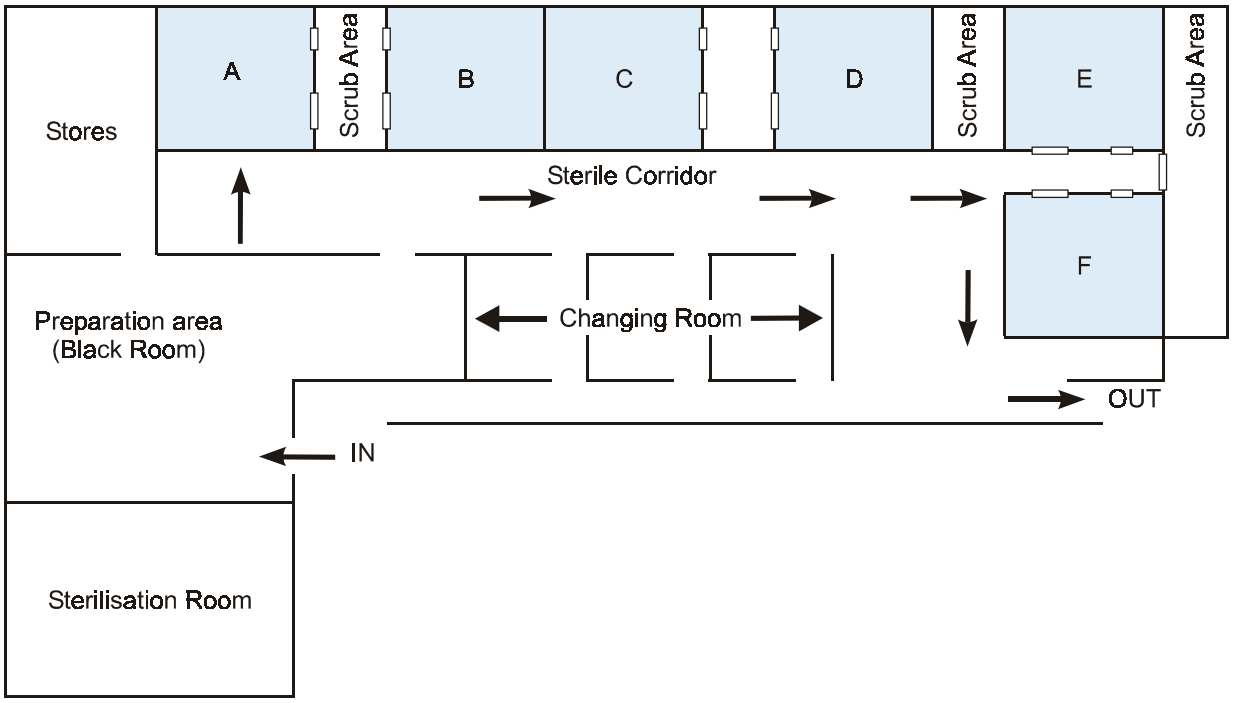
- Adequate number of power points, at appropriate locations
- Backup power supply, appropriate for microscope and other equipment
- Adequate air conditioning to maintain a controlled environment
- Proper lighting
- Wall clock
- Smooth surfaces that lend themselves to easy maintenance and cleaning (to help maintain sterile conditions by acting as a deterrent to dust collection)

Layout of the OT



TS - Tables for sterilising sharp instruments
TR - Tray
M - Microscope
FS - Foot stool
T- Operating Table
S - Surgeons stool
C - Cautery

Location of operation theatres in a large volume set-up



Current reports of endophthalmitis in the USA suggest an incidence of 0.072% to 0.17%. This implies about 1500 cases of postoperative endophthalmitis occur annually in the USA despite using one table per OT, doing a complete scrub for each case, and cleaning the theatre between cases.

- from ICO, 1997-107

OT equipment , furnishings and microsurgical instruments

Linen

- Caps and masks
- Sterile gowns
- Theatre dress for patients (optional)
- Sheets to drape over patients

Furniture

- 2 or 3 tables, dimension 6'6' x 3'x 3', with head rest at surgeon's end
- Stool - adjustable elevation and cushion with back support
- Footstool - to help patient mount the table
- Instrument trolleys (stainless steel top is preferable) of adequate area
- IV drip stand, with variable height adjustment

Equipment

- Microscope, with the following features
  - Coaxial illumination
  - Good optics
  - Adjustable intensity of illumination
  - Range of magnification
  - Focus controls

  - Eye piece adjustment
  - Interpupillary distance adjustment
  - Adequate position adjustment
  - Sterile grips and knobs
- Bipolar cautery machine, if possible
- Automated vitrectomy machine, if possible
- Cryo machine (optional, rarely used now)
- Steriliser (flash autoclave)
- Adaptors and extension wires

Microsurgical instruments

Simple, safe and effective cataract surgery is possible with a minimum set of essential instruments. I use only six instruments: one forceps (with fine teeth and tying platform), one pair of corneal scissors, one pair of corneal scissors, one fine straight non-locking needle holder, a speculum, a reverse Simcoe cannula attached to a disposable syringe, and a blade breaker.

- Dr. Marty Spencer, Ophthalmologist

- Eyelid speculum / barraquer lid speculum
  - Linen strips 2" x 1"
  - Gauze pads 2'' x 2'' x 1/2''
- Fine toothed forceps
- Heavy toothed forceps / muscle holding forceps
- Curved round bodied needle
- 5-0 silk/cotton bridle suture
- Mosquito clamp (anchor for bridle suture)
- Spring scissors (Westcott)
- 5ml syringes
- 22 gauge disposable needle with 120º bend
- 2ml syringe for viscoelastic
- 26 gauge needle bent/cystitome
- Bard Parker blade breaker and razor blades/Castraviejo blade breaker
- Corneal scissors
- McPhersons forceps (capsule holding)
- Vectis/lens loop
- Lens spoon/squint hook (nucleus delivery)
- Simcoe irrigation aspiration canula and handle
- Lens holding forceps
- Microhook (Sinsky/Fenzl)
- Needle holder
- Silk (8-0) nylon (10-0) sutures
- Nontoothed forceps (tying)
- Vannas scissors
- Straight scissors (optional)
- Iris repositor, iris scissors, iris forceps (optional)
- Artery clamp/Kalt needle holder
- Blunt 22 gauge needles
- 8-0 silk sutures

Other materials

- Eye shield
- Intraocular lens
- Adhesive tape
- Alcohol (hand wash between cases)
- Dish for povidone-iodine ½ strength (for sterilisation between cases)
- Cotton tipped buds/triangular cellular sponges
- Mannitol 20%
- Ringer lactate/balanced salt solution/viscoelastics
- 1/1000 Adrenalin
- IV set
- Emergency drug tray

Technology in health care does not have to be expensive to be effective. Commercial ophthalmic equipment and expendable supplies are often scarce or unavailable in developing countries. Monetary resources are limited and the demand for quality services is high. Appropriate technology or intermediate technology in ophthalmology, local manufacture of inexpensive but effective supplies, and application of simple yet practical ideas all extend basic eye care services where resources are frequently very limited.

-Dr. Larry Schwab, Ophthalmologist

Use it up; wear it out. Make it do. Or do without.

- Traditional saying of nineteenth century German immigrants to America

Efficient use of resources

Ensuring an adequate supply of resources is vital in high quality, large volume cataract surgery programme. A large volume of clinical work is made possible when diagnostic and surgical equipment and microsurgical instruments are available in the required quantity and at the required time. Buying high quality instruments, maintaining a high uptime of equipment through good spare parts planning, and providing continual maintenance help in achieving high quality.

Forethought and planning while ordering instruments is an effective cost containment strategy. It is advisable to avoid unnecessary stocking of instruments that are not used frequently. "Relocating" instruments is another effective practice in keeping costs low. This is a commonsense approach to devising alternative uses for surgical instruments. For example, forceps with a broken tooth can be smoothened and used as an instrument that does not require a tooth, like a tying forceps.

At Aravind, surgical instruments are divided into three categories: A (frequently used instruments), B (less frequently used), and C (rarely used). The A category consists of instruments such as corneal scissors, forceps, blades, and needle holders. These are frequently used and liable to lose their sharpness, which affects the quality of surgery. Blunting also results if they are accidentally dropped or thrown together with other instruments. Attention to quality is emphasised by replacing all instruments immediately after the situation warrants. A reserve stock of an appropirate number of sets facilitates immediate replacement. Reserve stocks of A category instruments are higher than the other two categories.

The practice of using reusable consumables as opposed to disposables is an effective cost containment strategy. In the developed world, disposable consumables after a cataract surgery (gowns, drapes, trolley sheets) end up filling two bags. In contrast, using reusable counsumables is feasible in a deve oping countries because of the ready availability of human resources, which makes inventory checks possible.

At Aravind, except for sutures, surgical blades and gloves, all other items are reusable. Viscoelastics are used over a number of cases. One viscoelastic loaded in two syringes is used for two patients instead of disposing it after just a single use. This practice has been found to contribute directly to cost effective utilisation of resources, making large volume cataract surgery more likely to be sustainable.

The art of caring for the injured and the diseased is as old as the human race itself. In India, history suggests that in remote antiquity, this country enjoyed a civilisation in which medical sciences were extraordinarily well developed. This legacy is attributed to Sushruta, the father of Indian surgery [and originator of the cataract operation], who flourished in approximately 800 BC.

Sushruta excelled in his handling of minute surgical details regarding preopertive and postoperative care, diet, techniques, indications, contraindications and complications. His attention to detail extended to describing the appropriate appearance of surgeons– clean, short nails and outfitted in white.

He recommended shaving the affected area before an operation, as presence of hair was considered responsible for making the wound septic. It was also under his orders that operating rooms were fumigated with mustant, neem and other agents, probably representing one of the earliest descriptions of antiseptic measures.

- Venita Jay, M.D.

Sterilisation

Sterilisation is the process by which all pathogenic and nonpathogenic microorganisms, including spores are killed.

Two parameters must be considered for all types of sterilisation: product associated, and process associated.

1. Product-associated considerations
   - Bioburden - degree of contamination
   - Bioresistance - heat or moisture sensitivity and product stability
   - Bioshielding - characteristics of packaging materials
   - Density - factors affecting penetration
2. Process-associated considerations
   - Temperature
   - Time
   - Purity of agent and air
   - Penetration
   - Capacity of steriliser

Instrument cleaning

Special attention to be given to cleaning surgical instruments prior to sterilisation. Surgical instruments vary in configuration from plane surfaces, which respond to most types of cleaning, to complicated devices that contain box locks, serrations, blind holes, and interstices. An ultrasonic cleaner can be used for cleaning the instruments that the washer steriliser does not adequately clean during terminal sterilisation.

Instruments should be completely immersed in cleaning solution. The tank should be filled to a level one inch above the top of the instruments tray. Suitable detergent, as specified by the manufacturer, is added. Temperature of the water should be 80 to 110^{o} F to enhance effectiveness of the detergent. The instrument tray should be designed to maximise transmission of ultrasonic energy.

After cleaning instruments should be thoroughly rinsed and dried. Glassware, rubber goods and thermoplastics also can be cleaned by this method.

Packing of instruments for sterilisation

Instruments should be arranged in trays to prevent damage. Heavy instruments should be kept in the bottom tray. All detachable parts must be disassembled, syringes separated , caps, plugs, stylets removed, etc. Lubricated instruments must be cleaned thoroughly because steam or gas cannot penetrate through the lubrication.

Rubber sheets should not be folded or kinked, as steam cannot penetrate or displace the air from the fold or kink. The rubber sheet should be wrapped in a linen. Rubber articles should not be kept with metal instruments to prevent damage to the rubber items.

A margin must be created along the edges of all sealed packages. Do not use any penetrating objects like pin, staples, paper clips etc. when packaging. This will damage the package and contaminate the contents. Ensure that the packaging is loose and that there is space between items, as this is very important for easy circulation and penetration of the steam or gas. Ward or OT number, name of the item, date of sterilisation and expiry should be noted on each package.

Methods of sterilisation

There are several effective and convenient methods of sterilisation, both physical and chemical.

- Physical sterilisation
  - Steam under pressure (autoclaving)
  - Hot air (dry heat)
  - Boiling
  - Ultraviolet irridiation (not discussed here)
- Chemical sterilisation
  - Ethylene oxide gas
  - Glutaraldehyde

1. Steam sterilisation

• Instruments	15 pounds pressure	250°F / 121°C	30 min
• Linen	15 pounds pressure	250°F / 121°C	20 min
• Rubber items	15 pounds pressure	250°F / 121°C	20 min
• Solutions	15 pounds pressure	250°F / 121°C	20 min

Autoclave (steam under pressure)

With the following standards, this procedure is biocidal.

- 30 lbs of pressure
  With 121° C - 15-30 min
  With 132° C - 1-2 min
  With 138° C - 1-2 min
- Use distilled mineral-free water
- Disassemble instruments before sterilisation
- Instrument tips to be protected with plastic sleeves
- Heating and cooling should be done gradually to prevent condensation of water

2.. Hot air (by heat)

340°F(171°C) 1 hr
320°F(160°C) 2 hrs

3. Boiling

This method cannot be depended upon to kill spores. Spore will withstand water boiling at 100°C (212°F) for many hours of continuous exposure.

- 10 to 15 minutes boiling after the water reaches the boiling point

4. Gas sterilisation

Ethylene oxide gas is used to sterilise items that are hot or moisture sensitive. Ethiline oxide is a chemical agent that kills microorganisms, including spores, by interfering with the normal metabolism of protein and reproductive processes, resulting in the death of cells.

Ethylene oxide sterilisation is dependent upon ethylene oxide concentration, temperature, humidity and exposure time. Gas is supplied in a high pressure metal cylinder. The mixture contains 10 to 12% ethylene oxide. Ethylene oxide gas is highly inflammble and explosive in air, so it is diluted with an inert gas such a fluorinated hydrocarbon or carbon dioxide for use in most sterilisers. The only method for controlling ethylene oxide concentration is to operate the steriliser according to manufacturer's instructions.

Advantages of ethylene oxide gas include

- It is an effective substitute agent for most items that cannot be sterilised by heat
- Items which might erode due to moisture and heat can be sterilised by ethylene oxide
- It completely permeates all porous materials
- Glass ampules can be sterilised by ethylene oxide (but glass vials with rubber stoppers must not be put in the steriliser as the gas will penetrate the rubber and might react with the drugs in solution and cause a potentiality harmful chemical reaction)
- It leaves no film on items

There have been instances of severe corneal damage from the use of cannulae sterilised in glutaraldehyde and not adequately flushed.

- Dr. Marty Spencer

5. Glutaraldehyde (for sharp instruments)

Glutaraldehyde 2% (Cidex) is biocidal, destroying pathogenic bacteria and fungi in 10 minutes and spores in three hours. It is noncorrosive and therefore is used for sharp instruments.

- 3 to 10 hours complete immersion
- Instruments must be rinsed thoroughly in distilled water before use

Cleaning procedures in the OT

Microorganisms are normal contaminants of walls, floors, and other surfaces that are associated with transmission of infection to patients or personnel. The operation theatere must be cleaned daily, after the surgical schedule is complete, and more thoroughly on a weekly basis.

Daily cleaning involves

- First, the floor is swept
- Equipment such as electrosurgical units should be checked and cleaned
- Walls are cleaned

- Cabinets and doors are cleaned, especially around handles or push plates where contamination is more likely
- Walls around scrub sink need special attention
- Transportation carts and their wheels are cleaned with specific attention
- After use, equipments are disassembled, cleaned and dried before storage

Preventing infection is more cost effective than curing it. Infection control practices are stringent at L.V. Prasad Eye Institute because we have determined that it costs us 4-6 times more to keep infected patients in our hospital than to be extremely careful in all our infection control practices.

- M.B. Raveendran

Weekly cleaning involves

- Cleaning the air conditioner filter (remove the filter from the AC, dust it away from the OT, dip it in antiseptic solution, dry it under sunlight before putting it back in the AC)
- Cleaning ceilings and wall mounted fixtures
- Scrubbing the floor of the OT periodically to remove accumulated deposits
- Regular cleaning of all types of sterilisers as recommended by the manufacturers.
- Washing of walls and floor of the OT with detergent and mopping with antiseptic lotion (the dilution of the antiseptic according to the manufacturer)
- Tables, articles and fixtures are wiped first and the floor is always mopped last

A clean mop is used to clean the floors. One bucket is filled with warm water and another bucket with antiseptic (eg. Dettol - 1:40 dilution) in water. The mop is first dipped in dettol, wrung out, and a portion of the floor is mopped. The mop is then rinsed in the water, wrung out, dipped in the dettol again, and wrung out to continue mopping the floor in the same manner.

Proper and thorough cleaning and sterilisation must always be considered a vital part of a high quality, large volume, financially sustainable cataract surgery programme. Without high quality, large volume is impossible (since patients will not come for surgery). Without large volume, cost effectiveness is not possible. Quality must always be the number one concern of an eye care institution.

Preparation for surgery

Before the patient is taken inside the OT, the running nurse must ensure

- The retrobulbar and facial blocks are effective
- The pupil is well dilated
- The eye is adequately soft
- The lid and surrounding areas have been cleaned with iodine
- The patient's head is covered by a cap or towel
- The patient's feet are clean (to avoid tracking dirt particles into the OT)
- Theatre gown has been provided to the patient (optional)

Then the patient is walked or wheeled into the operating theatre

- Patient's head must be positioned in line with the top edge of the operating table (a thin pillow or circular head support can be used to give the head about 10º of elevation)
- The patient is covered with a clean sheet / drape up to the chin
- A chest guard (metal hoop that keeps the sheet/drape off the patient's face and chest) allows easy breathing and limits the patient's inadvertent movements (optional)

The surgeon and the scrub nurse/surgical assistant must

- Wear face masks and caps
- Wash their hands and arms once with soap, then scrub twice with chlorhexidine / half strength povidone-iodine scrub lasting five minutes, then rinse thoroughly with boiled or autoclaved water
- Wear sterile operating gowns, well-covered at the back
- Wear sterile gloves and wash off the powder with sterile water

Cleaning and draping is then done by the running nurse, who must

- Once again clean the operative area from midline to ear, brow to angle of the mouth with 10% povidone iodine or chlorhexidine, starting from the lids and working to the periphery
- Paint the eyelid margins with cotton soaked in iodoprep solution.
- Instill a drop of half strength povidone-iodine into the conjunctival sac (if chlorhexidine enters the conjuctival sac, it can cause corneal epithelial damage – if this happens, irrigate the eye profusely with normal saline)
- Thoroughly rinse the eyelids and fornices with sterile water (this can be done before the patient enters the OT, or the surgeon/scrub nurse can do it before drapping)
- Drape the patient's head and trunk with sterile towels in such manner that only the eye to be operated is exposed.

NB: Keep a small disposable plastic drape with adhesive undersurface over this, exposing only the palpebral fissure.

At Aravind, complicated surgeries are operated by senior surgeons, so complicated and simple cases must be streamed. Complicated patients are differentiated by means of special stickers on their case sheets. This strategy allows the more experienced surgeons to tackle the problem cases without any interruptions in the flow of the patients.

Types of cataract surgery

At Aravind, ICCE has been replaced since 1990 by ECCE/PC-IOL, due to positive peer pressure and increased patients demands for this procedure.

- Dr. N.V. Prajna

The primary objective of cataract surgery in developing countries should b e to restore vision to the largest number of patients possible, in the shortest possible time, making the best possible use of resources, at a cost the community can afford.

Although ECCE with PC-IOL is the treatment of choice in the developed world, there are large portions of South east Asia, East Asia, the Middle East, and Africa where ICCE with aphakic glasses is still the most commonly performed procedure. ICCE continues to be the single most common cataract surgery performed, accounting for 75 percent of cataract surgery in the developing world. However, a recent survey by the All India Ophthalmological Society revealed that ECCE/PC-IOL is becoming relatively common, partly in

response to increasing awareness and demand by patients in India.

Worldwide there are many cataract surgery techniques. The commonly used procedures are:

1. Manual extracapsular cataract extraction (ECCE), with or without posterior chamber intraocular lens (IOL) insertion
2. Intracapsular cataract extraction (ICCE), with or without anterior chamber IOL
3. Manual sutureless surgery
4. Phacoemulsification, with sutures or without sutures (with or without small incision and foldable IOL)

The surgical technique chosen by an eye care institution should be acceptable, accessible, affordable and scientifically sound. The choice will depend on the personal perference of the surgeon, determined by his/her training and experience.

The locally optimal procedure will be chosen because it is acceptable, accessible, affordable and scientifically sound.

- Dr. G. Natchiar

The choice of "**locally optimal procedure**" will depend on several factors

- Resources and infrastructure of the institution
- Surgical volume
- Patient desires
- Financial resources
- Training of the surgeon

The process of providing cataract surgery must be intelligent and evolving, in the short term as well as over the long term. For this reason, surgical techniques have changed over the years, from predominantly ICCE to ECCE, then to ECCE with PC-IOL, and now to what promises to be an excellent option, the manual sutureless technique.

1. Manual extracapsular cataract extraction (ECCE), with or without posterior chamber intraocular lens (IOL) insertion

Initially, a popular misconception among traditional ophthalmologists was that the surgical output in ECCE-IOL would be rather low. However, the Aravind experience has shown that training enables a surgeon to up his/her output from two ICCEs per hour to eight ECCE-IOLs per hour.

- Dr. G. Natchiar

The Aravind-SightSavers IOL microsurgery training programme is part of Aravind's efforts to enable ophthalmologists to make a smooth transition from ICCE to ECCE-IOL. The eight-week programme, instituted in 1993, has trained over 600 ophthalmologists. Trainees perform two to three cataract surgeries every day for six days a week, at first under supervision, and then independently.
In 1994, the Fred Hollows Foundation of Australia produced "Standard Operating Procedure Manual for Extracapsular Cataract Extraction with Posterior Chamber Lens Insertion," a 35-page step-by-step illustrated manual.

2. Intracapsular cataract extraction (ICCE), with or without anterior chamber IOL

Situations still arise when a safe and efficient ICCE needs to be performed.

- Subluxated cataract
- Severe phacodonesis where proper support for PC-IOL is remote
- Lens dislocated into anterior chamber
- Uveitis requiring removal of all lens material
- In pseudoexfoliation of lens capsule and in small, rigid pupil

In terms of training or retraining surgeons, in our experience the learning curve is the same for microsurgery and hand-held instruments. In other words, there is no difference between a surgeon who has done 1000 ICCE and one who has done only ten cases.

- Dr. G. Natchiar

Formerly at Aravind when ICCE was being practiced, a surgeon could perform eight to ten intracapsular cataract extractions per hour, thanks to proper infrastructure and utilization of OT personnel. Thus it was possible for four surgeons to perform 200 ICCEs without IOL insertion within five hours, with the help of 15 support staff.

3. Manual sutureless surgery

It now seems evident that increasing numbers of cataract patients will demand relief from aphakia. But implants will never be advisable in every case, for some eyes have other defects that preclude all but the simplest surgery.

- Harold Ridley

The technique of manual nucleus removal by irrigation vectis in manual cataract surgery is about 100 years old. The modified approach uses a scleral tunnel to enter the anterior chamber. In addition to the advantages of phacoemulsification, manual sutureless surgery is inexpensive and nondependent on expensive machines.

In 1992, Aravind introduced manual sutureless surgery with suitable modifications in a large volume, high quality, low cost setting. Today this technique accounts for 80 percent of cataract surgeries performed at Aravind's Free Hospital. At a surgical camp conducted by Aravind Eye Hospital in February 1999, one of the surgeons performed manual sutureless surgeries at the rate of 8-10 surgeries per hour. Operating for eight hours a day for three days, this surgeon had only one case of posterior capsule rupture.

With its multiple advantages, the manual sutureless technique has the potential to emerge as the cataract surgery of choice in the developing world. But technological leaps in sophisticated instrumentation can never gain precedence over surgical skills. Manual sutureless cataract surgery demands a high level of surgical skills that one must acquire through diligent practice.

- Dr. G. Natchiar

The advantages of manual sutureless surgery are many

- Easy to learn
- Comparable results to phacoemulsification (early visual rehabilitation, less postoperative astigmatism and patient comfort)
- Convenient follow-up schedule
- High quality cataract surgery

The advantages of manual sutureless over phacoemulsificatin include

- Short learning curve
- Simple microsurgical instrument
- Cost effective for both the patient and the institution
- Wide range of indications
- Less investment of resources and less dependence on instrumentation

In order to perform manual sutureless surgery, the ophthalmologist must train in and be able to do

- Scleral tunnel construction
- Capsulorrhexis
- Prolapse of nucleus into anterior chamber
- Delivery of the nucleus

4. Phacoemulsification, with sutures or without sutures (with or without small incision and foldable IOL)

Even as we cannot afford to slip behind the times and the latest developments, neither can we allow ourselves to immediately let go of tried and tested methods in the face of newer techniques. Even as we explore the possibility of viable alternatives, we must take care to foster those already existing. The fact remains that if we give up the old techniques now–techniques that are in place and working successfully–an incredible number of people will remain blind for life.

- Dr. G. Natchiar

This exciting innovation in cataract surgery was introduced by Kelman, an American ophthalmologist, in 1967. However, it took over 20 years for the technique and instrumentation to reach a level of sophistication that makes it a safe and acceptable form of cataract surgery.

Phacoemulsification permits the removal of the cataract through a 3mm incision. It thus eliminates some of the complications of wound healing related to large-incision cataract surgery and shortens the recovery period. The procedure involves fragmenting the cataract, which allows aspiration.

Phacoemulsification is an expensive, machine-dependent procedure with complex techniques requiring mastery of skills. More surgeons today are converting to phacoemulsification because of its obvious advantages. However, it requires a substantial initial investment in terms of finance, time and training, and it is important that cases be selected judiciously.

Medical teachers must be aware of the seductive effects of modern technology on young graduates. It has to be perceived that the future of medicine no doubt will involve more and more technology. However, it should be ensured during the training period that technology be curbed by common sense and tempered by humanity. Future doctors should believe that whatever technological empires are built, the most important person in the hospital will still be the patient.

- B. Ray Chaudhuri

The results of phacoemulsification and manual sutureless cataract surgery are quite comparable, except for the apprehension about more endothelial cell loss in the latter. However, both phacoemulsification and manual sutureless cataract surgery cause an endothelial cell loss lower than the extracapsular extraction group, because of improved surgical technique and more experienced surgeons.

These results were confirmed in a study at Aravind Eye Hospitals where the endothelial sutureless group. The reasons for lower cell loss in the study may be due to strict inclusion criteria and good experience of the surgeons.

There was no statistically significant difference between the two groups regarding the endothelial cell loss was 4.54% in the phacoemulsification group and 6.19% in the manual sutureless group. The reasons for lower cell loss in the study may be due to strict inclusion criteria and good experience of the surgeons.

There was no statistically significant difference between the two groups regarding the endothelial cell loss postoperatively at second month follow up.

Since the study has revealed that postoperative cell loss and visual results with manual sutureless cataract surgery has the added advantages of smoother transition during the learning period and applicability in all types of cataract. More importantly, the inexpensive instruments and cost effectiveness of the procedure will definitely make it a more feasible choice in developing countries.

It must be stressed, however, that the surgeon should have mastered the manual sutureless technique and should be prudent in converting to extracapsular extraction if necessary.

Strategies for greater productivity in a large volume setting

The most important aspect of large volume, high quality surgery is creating a system of procedures that works in an uninterrupted manner; much like a conveyor belt system. It is this support system that enables a surgeon at Aravind to perform large volume surgery. The same surgeon might not be as productive in a situation that does not provide this kind of support.

- Dr. G. Natchiar

This appendix has outlined numerous strategies that serve to enhace the eye surgeon's productivity

- "Surgery-friendly" environment in the operation theatre
- Cohesive OT team with a strong sense of commitment and dedication
- Carefully considered number and distribution of staff, with well-defined responsibilities, division of work, and job allocation
- Balanced timing of operation theatre sessions in a week or on a given day to reflect surgical load and accommodate other commitments of the personnel

For example, at Aravind Eye Hospitals, postings to the operation theatre reflect a balance of surgery, outpatient and other attendant professional obligations of the doctor.

- Assembly-line or conveyor-belt flow of patients
- At least two operating tables in each OT (sometimes a third table is used by residents/trainees)
- Rapid turnover time in the OT, with two scrub nurses and an operating microscope that swings to both tables

What is the secret of treating hundreds of patients per day? Speed up, set targets, and meet the demand.

-Dr. N.V. Prajna

- Standardisation of processes and surgical techniques
- Maximum utilization of available human and material resources
- Six to eight instrument sets per surgeon with rapid sterilization between surgeries
- Smallest possible number of instruments per set
- Careful attention given to high quality, cleanliness and sterilization techniques
- Adopt a locally optimal surgical procedure, train in it, perfect it, standardize it, and use it consistently.

Appendix 4

Postoperative Management

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Because diagnostic, therapeutic, and practice recommendations may have changed since the publication of this series, because such recommendations cannot be considered absolute or universal in their application, and because the publication process contains the potential for error, Aravind Eye Hospitals and Seva Foundation strongly advise that the recommendations in this series of clinical submodules be verified, prior to use, and be considered in light of a particular patient's clinical condition and history. The reader is urged to review the package information data of the manufacturers of the medications and devices mentioned. Drug therapy is constantly changing. Consequently, it is the responsibility of the health care professional to seek additional and confirmatory information; to evaluate its appropriateness as it relates to the actual clinical situation; and to consider new developments. Because it is beyond the scope of this series to include all indications, contraindications, side effects, and alternative agents for each drug or treatment, and because standards for usage change, it is advisable to keep abreast of revised recommendations. Caution is especially urged when using new or infrequently used drugs. It is the responsibility of the physician to determine applicable federal status of each drug or device he or she wishes to use, and to use them with appropriate patient consent in compliance with applicable law. The ultimate arbiter of any diagnostic or therapeutic decision remains the individual physician's judgement.

Introduction

Over the past 15 years, improvements in cataract surgery have greatly changed the postoperative management of the cataract patient. The following developments are responsible for earlier visual rehabilitation following cataract surgery, and must now be considered in postoperative care:

- A widespread switch from general anaesthetic to local anaesthetic, which is uncomplicated and effective, less expensive because fewer drugs are used and fewer staff are needed, which leads to fewer complications, and which allows the surgeon to communicate with the patient during surgery
- Better antibiotics and steroids
- Improved wound closure techniques, including sutureless wound closure
- IOL implants, which lead to earlier visual rehabilitation with earlier resumption of normal activities.

From the patient's perspective, the period of postoperative care normally spans the interval from the conclusion of surgery until the goal of surgery is achieved by provision of stable improved vision. In the absence of complications, this usually occurs by two to three months after the surgery and coincides with the prescription of final refractive correction.

This appendix covers all aspects of postoperative management of cataract surgery in a large volume setting, including discussions of postoperative medications, length of stay, postoperative instructions to patients, discharge, follow-up care, and possible postoperative complications to watch for.

Postoperative medications

An aspect of postoperative care at Aravind Eye Hospital that has an impact on large volume cataract surgery is the standardisation of postoperative medications: antibiotics, steroids and topical medications. Since 80 percent of cataract patients have no systemic complications, standardisation of postoperative medications expedites the whole process. At Aravind, the practice of identifying patients with ocular and systemic complications by means of a special sticker on the case sheet or a special colour of shield covering the eye has been found to be particularly effective for a large volume setting.

Postoperative care at the conclusion of the surgical procedure

- At this point, subconjuctival antibiotic gentamycin 20 mg + decadron is routinely administered (cefazolin 100 mg, if the patient is allergic to gentamicin).
- A drop of an antibiotic-steroid preparation is instilled in the eye.
- If no lens has been implanated, a cycloplegic mydriatic preparation is also instilled.
- The eye is patched with a sterile cotton pad and a shield.

Following surgery

- The patient should be examined with slit lamp in the postoperative period. Both the examining doctor and the assistant should scrub before the examination.

- Analgesics, usually paracetamol or acetaminophen (a single tablet) are given one hour after surgery.
- If pain is severe, higher doses of analgesic tablets are used.
- Sedative, usually diazepam (5 mg), 1 tablet at night following surgery (optional).
- Ocular hypotensive agents based on the surgeon's judgement.
- Other medications for systemic disease, if any, are continued.

Topical medications

- Topical antibiotics either 0.3% gentamycin or 0.3% ciprofloxacin 3 times daily, begun four to six hours after surgery.
- Antibiotic-steroid combination , one drop four times daily, for ECCE with or without IOL implantation. (The dosage schedule of topical steroids is tapered off over a period of six weeks.)
- Cycloplegic-mydriatics (only with significant inflammation), rarely needed with PC-IOL implanation.
- Only in cases of ICCE, antibiotics and steriods are applied twice daily for three to four days.
- In eyes with dacryocystitis, 0.5% chloramphenical drops are used preoperatively and postoperatively.

There is no agreement over the regimen used in preoperative, intraoperative or postoperative antibiotic prophylaxis in cataract surgery.

Systemic administration of most antibiotic agents achieves concentrations in the aqueous and vitreous humour that are subtherapeutic.

- Dr. M. Srinivasan, Aravind Eye Hospital

Antibiotics

Indiscriminate use of systemic antibiotics is now considered likely to breed strains of antibiotic-resistant bacteria. In developed countries, no oral or systemic antibiotics are administered as a routine. If the posterior capsule is ruptured intraoperatively, some doctors advise oral ciprofloxacin or ofloxacin.

Systemic medications

Patients resume their routine medications as ordered on admission. The ward nurses and coordinators must contact the inhouse physician or duty medical officer if medical emergencies arise.

- Cardiac patients are advised to continue medicines prescribed by their physician.
- Hypertensive patients have their blood pressure recorded daily and a chart is maintained. Antihypertensives are continued as prescribed by their physician.
- If hypertension is newly diagnosed on admission, the inhouse physician decides about the dosage of antihypertensive drugs, and a salt-free diet is advised.
- Previously diagnosed diabetic patients
  - for insulin dependants, standardise the dose and maintain a chart of urine sugar.
  - for non-insulin dependants, continue oral anti-diabetic drugs, and maintain a chart of urine sugar.

- If diabetes is newly diagnosed on admission, the inhouse physician will evaluate the case, advise a diabetic diet and make it available inhouse.
- Asthmatic patients are advised to continue with their prescribed medications, either bronchodilators or steroids. In rare instances, one may come across status asthmaticus, which may need transfer to ICU care.

Postoperative stay

Postoperative orders for cataract with or without IOL

- The patient is taken to the recovery room until he/she is stable and then to his/her room.
- The patient's vital signs are recorded as a routine practice.
- The patient lies on the back on the unoperated side. He/she is permitted to use the toilet and sit while eating.
- The patient progresses to the diet as ordered on admission.

The length of postoperative stay is usually determined by the surgical procedure used.

ICCE or ECCE

The patient is usually discharged third postoperative day if his/her condition is satisfactory. If not, the patient stays further untill complications are resolved.

ECCE with IOL

The patient is discharged on the second postoperative day. The stay is extended if the patient insists on staying because of some problem with travel plans or if he/she is not fit to travel (fever, weakness, eye pain, etc.). The surgeon advises the patient to stay further if serious complications are noticed.

- Sutureless surgery (phaco or manual sutureless ECCE with PC-IOL) With guaranteed compliance and follow-up, the patient can be discharged on the first postoperative day. Very rarely is the stay extended, since the sutureless wound is secure.
- Ambulatory or day care sutureless surgery

The patient is discharged a few hours after surgery.

Postoperative hospitalisation is planned in some situations:

- Presence of a medical condition might require prolonged postoperative observation by medical or nursing personnel.
- If best correctable vision in the unoperated eye is 20/200 or worse, it will be dangerous for the patient to get around.
- A patient who is mentally debilitated or diagnosed as mentally ill might require longer postoperative care in the hospital.
- If a patient is non-ambulatory or cannot exercise self-care, or if responsible care is unavailable during the immediate postoperative period, the patient will require longer postoperative care in the hospital.

Unplanned postoperative hospitalisation must be arranged when indicated by intraoperative and/or postoperative complications of an ocular(see Postoperative Complications) or medical nature. Possible medical complications requiring further hospitalisation includes:

- Cardiac instability
- Respiratory instability
- Cerebrovascular episode
- Diabetes mellitus requiring acute management
- Uncontrolled nausea or vomiting
- Acute urinary retention
- Acute psychiatric disorientation
- Other medical conditions requiring acute management or careful observation

Postoperative instructions

During the postoperative period, just before discharge, patient counsellors at Aravind Eye Hospital explain to patients their postoperative medications and details regarding follow-up. All patients are provided a pamphlet in English and the regional language that outlines the do's and don'ts following surgery. Postoperative visual acuity is checked for all patients. All patients in Aravind's Free Hospital are provided medicines free of charge.

- Dr. G. Natchiar

The surgeon has an obligation to educate that patients are educated about eyecare and given postoperative instructions.In a large volume setting, this should be done by paramedical staff or patient counsellors. Postoperative education includes:

- Signs and symptoms of possible complications
- Eye protection and hygeine
- Allowed activity
- Medication
- Required follow-up visits
- Details about access to emergency care

Postoperative Instructions for Cataract Patients
(many restrictions can be liberalised in the case of sutureless surgery)

- **Don't lift heavy weights or hold breath while lifting.**
- **Don't stoop or bend over.**
- **Don't touch the operated eye with dirty hands.**
- **Don't rub the eye.**
- **Avoid head bath for three to four weeks after surgery.**
- **Face can be cleaned with a wet cloth.**
- **Don't shave until one week after surgery.**
- **Avoid vigorous shaking of head.**
- **Avoid dusty and crowded places.**
- **Avoid cigarettes, alcohol, and snuff.**
- **There are no special diet restrictions for eye surgery, except in diabetics.**
- **In the case of prolonged cough or constipation during immediate postoperative period, cough suppressants and laxatives can be used.**
- **For other systemic problems, seek necessary medical treatment.**
- **Use previously prescribed corrective spectacles.**
- **Use dark glasses with closed side covers for outdoors.**
- **Use an eye shield (while sleeping) for the first week.**
- **Have the eye cleaned by your attender or caregiver as demonstrated by the OA or patient counsellor.**
- **Cleaning should be done twice daily.**
- **Use medication as prescribed.**

- **In the case of:**
  - **persisting pain**
  - **sudden marked redness**
  - **excessive discharge**
  - **lid swelling**
  - **sudden decrease in vision**

call your surgeon or the nearest eye hospital immediately.

Discharge

Criteria for discharge

The criteria for discharge after cataract surgery without complications include:

- Stable vital signs
- Return to preoperative mental status
- Absence of nausea
- Absence of significant pain
- Availability of attender (some patients can see with the other eye and on their own)
- Review of postoperative care with the patient and /or attender, including written postoperative instructions
- Prearranged follow-up appointment

Ocular findings and visual acuity should be recorded in the case sheet of each patient before discharge.

For quality control and improvement of a hospital's cataract surgery programme, postoperative vision (and preferably keratometric or refractive astigmatism)should be checked and recorded for each patient and tallied for each surgeon.
-Dr. Steve Miller, Seva Foundation

Discharge medications

Discharge orders for cataract operation with/without IOL

- Topical gentamicin or ciprofloxacin 0.3%
- Dexamethasone or betamethasone 0.1%
  NB: If prednisolone acetate 1% is available, it is superior to dexamethasone or betamethasone
- Topical cyclopentolate 1% or homatropine 2%, if indicated

If no lens is implanted:

- One drop of each (antibiotic and steroid) twice daily for four weeks (except cycloplegics, which are instilled once a day or once in two days).

If lens is implanted:

- Steroids, one drop in the operated eye
  Q.I.D x 2 weeks
  T.I.D x 2 weeks

B.I.D. x 2 weeks
O.D. x 2 weeks

- Antibiotics, one drop in the operated eye
  Q.I.D x 2 weeks
  T.I.D x 2 weeks
  B.I.D. x 2 weeks
  O.D. x 2 weeks
- Cycloplegics, one drop in the operated eye at night for two weeks or more as needed.

6. Follow-up Care

Patients who have undergone sutureless surgery with IOL

- Patients without signs and symptoms of possible complications should visit their ophthalmologist one day after surgery, one week after surgery if possible, and one month after surgery for the final refraction and spectacles prescription.

Patients who have undergone cataract surgery with sutures

- Patients without signs and symptoms of possible complications should visit their ophthalmologist three weeks after surgery to have the sutures cut, and six to twelve weeks after surgery for the final refraction and spectacles prescription.

Patients who have come from screening camps

- Patients who have travelled some distance from a screening camp for surgery will receive a postoperative examination before discharge, and then should be informed of the date of their appointment at the base hospital or the date of the eye hospital's follow-up camp for their follow-up examination, final refraction and spectacles prescription.
  More frequent postoperative visits might be indicated if unusual findings are noticed or complications occur. Patients who experience complications such as redness, pain, discomfort, or deterioration of vision should report to the ophthalmologist or an eye hospital immediately, without waiting for the follow-up dates.

Components of each follow-up examination:

- Visual acuity with pin hole refraction
- IOP, if warranted
- External examination
- Slit lamp examination
- Ophthalmoscopy / fundus examination
- Checking the medications

Ensuring follow-up is a major challenge of the base hospital approach in a high quality, large volume cataract surgery programme. Getting screening camp patients to come back for follow-up is very difficult. Aravind Eye Hospital has implemented a successful strategy for ensuring follow-up of free patients who were bused in from out of town screening camps for cataract surgery.
Each screening camp is now followed approximately 40 days later by a follow-up camp. An ophthalmologist attends the camp to do the follow-up examination, and final refraction is done by a trained ophthalmic assistant. Aravind's follow-up rate has reached over 95% with this strategy.

We insist on high quality care in diagnosis, surgery and all treatment, whether the patient is from a rural or an urban area, paying or free. We do try to motivate our staff to achieve excellence in their surgery and publications, and some of them are internationally known for the quality of their work...Every opportunity to keep this high quality in our work is my spiritual aspiration.

- Dr. G. Venkataswamy, Founder, Aravind Eye Hospitals

Postoperative complications

Quality assurance

Good clinical outcomes produce good visual outcomes. Postoperative compli cations will affect the patient's length of stay in hospital, the patient's visual outcome, the amount of medical staff time spent with that patient, and the patient's willingness to refer other patients. Large volume and cost effectiveness are impossible with a high number of complications.

A large volume cataract surgery programme must maintain high quality standards and low complication rates. A routine recording of factors such as visual outcome, visual improvement, intraoperative and postoperative complica tions, plus monthly analysis of the data, can help in assuring high quality.

Early postoperative complications

- Corneal oedema
- Shallow anterior chamber due to wound leak, pupillary block, or choroidal detachment
- Iris prolapse
- Postoperative uveitis
- Vitreous in anterior chamber
- Infectious endophthalmitis
- Retained lens matter
- Dislocated IOL

Postoperative complications at the first week follow-up visit

- Postoperative uveitis
- Any of the above complications

Postoperative complications at the final follow-up visit (4-12 weeks)

- Post refraction subnormal vision (Surgically induced astigmatism)
- Media opacity (PCO)
- Retinal or macular pathology
- Optic nerve abnormality

Late postoperative complications

- Decreased vision without red eye: change in refraction, posterior capsular opacification, cystoid macular oedema, or retinal detachment
- Decreased vision with red eye: loose sutures, rebound uveitis, chronic irritable eye, epithelial down growth, bullous keratopathy

Appendix 5

Paediatric Cataract

Table of Contents

Because diagnostic, therapeutic, and practice recommendations may have changed since the publication of this series, because such recommendations cannot be considered absolute or universal in their application, and because the publication process contains the potential for error, Aravind Eye Hospitals and Seva Foundation strongly advise that the recommendations in this series of clinical submodules be verified, prior to use, and be considered in light of a particular patient's clinical condition and history. The reader is urged to review the package information data of the manufacturers of the medications and devices mentioned. Drug therapy is constantly changing. Consequently, it is the responsibility of the health care professional to seek additional and confirmatory information; to evaluate its appropriateness as it relates to the actual clinical situation; and to consider new developments. Because it is beyond the scope of this series to include all indications, contraindications, side effects, and alternative agents for each drug or treatment, and because standards for usage change, it is advisable to keep abreast of revised recommendations. Caution is especially urged when using new or infrequently used drugs. It is the responsibility of the physician to determine applicable federal status of each drug or device he or she wishes to use, and to use them with appropriate patient consent in compliance with applicable law. The ultimate arbiter of any diagnostic or therapeutic decision remains the individual physician's judgement.

Introduction

Rationale

The inclusion of management of paediatric cataract in a high quality large volume, low cost cataract surgery programme represents a dichotomy of sorts. In a narrow sense of the term paediatric cataract intervention can never be part of large volume because of the special demands created by the need for specialised care in children, mandatory general anaesthesia and associated systemic problems that can't be ignored in children. At the same time, surgical intervention is a service that one must, can and should provide to this group of patients because of the large volume of adult cataract surgery being offered. And one can never afford to ignore the long term implications of timely surgical intervention in this age group.

Mankind owes the child the best it has to give... the children without exception whatsoever shall be entitled to those rights without distinction or discrimination.

- Statement from the United Nations Declaration of the Rights of the child.

For any chance of restoring or preserving their vision, it is essential that children with problems that are potentially amblyogenic such as cataract, corneal opacities, poor vision from uncorrected refractive errors be treated as soon as the abnormality is noticed.

-Dr. John Pratt-Johnson, Paediatric Ophtlamologist

In contrast to adult cataract, the management of cataract in children requires a completely different approach. The child's immature visual system, as well as the anatomical differences and psychosocial differences between adults and children, demand a different approach in surgical management and visual rehabilation. Besides, only very few children with cataracts present clinically with vision-related subjective complaints. The first sign of cataract is a white or partially white pupil noted by parents. The only similarity between the two groups is the presence of an opaque lens.

The decision to operate on a child is complex, depending on the age of the child, laterality and density and systemic problems. It is the level of visual acuity or acuity potential weighed against procedural risks that determines the need for surgery. Early intervention is necessary in order to counter the ever lurking danger of amblyopia. Studies point to the existence of a ciritical period in which the effects of visual deprivation on the visual system are marked. Cataract leads to very quick irreversible amblyopia in a child. Amblyopia can also be develop following cataract surgery due to posterior capsular opacification, anisometropia, uncorrected aphakia, or strabismus.

Objectives

1. To highlight the need for paediatric cataract surgical intervention in a large volume cataract surgery programme.
2. To outline preoperative evaluation, induction of anaesthesia, principles of surgical management, and post operative management of paediatric cataract.
3. To provide a conceptual framework for some of the issues unique to this ophthalmic subspeciality.

Staffing requirements for a paediatric cataract surgery programme

Management of paediatric cataract demands a multi-disciplinary approach involving paediatricians, paediatric anaesthesiologists and paediatric ophthalmologists. One of the essential requirements is an efficient network of referral systems involving local physicians, paediatricians and ophthalmologists. This is supplemented by creating paretal awarness, school screening and outreach programmes.

Staff for one operating table

- Paediatric ophthalmologist
- Paediatric anaesthesiologist
- Nursing staff with special training in paediatric care, including neonatology and anesthesiology
- Surgical assistant

An estimated 1.5 million children throughout the world are blind of whom 1 million live in Asia.

– World Health Organization, 1992

Evaluating a child with cataract

Etiology of congenital cataract

On a broad basis, the etiology can be classified into hereditary and nonhereditary factors. The hereditary form usually presents as isolated bilateral cataracts; in some of these cases there are other associated ocular anomalies such as microcornea, microphthalmos, coloboma, aniridia, etc. It can also manifest as one of the findings associated with one or many systemic findings as in autosomal disorders and chromosomal syndromes. The common metabolic disorders coming under this classification are galactosemia, homocystinuria, hypoparathyroidism, etc.

Cataract is the most important cause of treatable childhood blindness. There are 200,000 children blind from cataract worldwide. About 20,000 – 40,000 children with developmental bilateral cataract are born each year. Rubella is still an important cause of preventable disease in many countries. In the developing world, there is a need to improve early case detection and referral services and to establish centers with expertise in the assessment, surgical treatment and long term management of the child with cataract.

– Journal of cataract and Refractive Surgery, Vol.23, 1997, p.681

Among the nonhereditary factors, intrauterine infection like rubella is the most common one to cause bilateral nuclear cataract. It is usually associated with microcornea, glaucoma and retinopathy, with or without hearing defect and PDA (patent ductus arteriosus, a cardiac problem). The other less common infections are toxoplasmosis and herpes etc. Radiation and photocoagulation like in retinoblastoma treatment, can also induce cataract but it is usually a total cataract. Apart from prematurity, PHPV (persistant hyperplastic primary vitreous) is known t cause cataract. The most common cause for unilateral cataract in the non hereditary category is trauma.

Evaluating a child with cataract does not necessarily involve subjecting the child to a battery of expensive laboratory and biochemical investigations. Often, a careful history and detailed examination establish the diagnosis. History should specifically deal with the onset of cataract. Most parents seek medical treatment on noticing a white pupil (leukocoria). Some children may be brought to the ophthalmologist with the complaints of squinting or nystagmus. Patients with total and bilateral cataracts usually present earlier than those with unilateral or partial cataracts.

Evaluation

1. Family history

Family history is very important in children who present with bilateral congenital cataracts. Family history or presence of consanguinity will help to establish inheritance pattern. Antenatal history regarding any infection, fever or rashes should be carefully elicited.

Other family members, especially parents, may need to be examined for presence of lenticular changes if an autosomal dominant inheritance pattern is suspected.

2. Ocular examination

Begins with the assessment of visual acuity. In children, especially the preverbal age group, it is challenging to determine reliable, quantifiable, visual acuity. Preferential looking tests using Teller's cards can be done in very young children. The ability to pick up small cake decorations can also be used to assess visual acuity in toddlers. Optokinetic nystagmus or sophisticated tests like visually evoked potential can be used to assess visual potential in infants and uncooperative preschool children. School-going children usually co-operate in reading the Snellen chart or matching tests like Sheridan-Gardiner test cards or Allen's card. These can be used in slightly older children with reasonable reliability.

A detailed ocular examination using torch light and slit lamp is the next step in evaluation. Pupillary reaction is sometimes the only indication of visual acuity in cases of bilateral dense cataracts. Poor fixation or nystagmus or presence of strabismus usually indicates deep amblyopia and poor visual prognosis. Morphological pattern of the cataract and other associated features like posterior lenticonus should be looked for.

Many times the morphology of cataract indicates the etiology. For example,

- central nuclear cataract indicates an early insult
- lamellar cataract indicates late onset suggesting a good visual outcome
- invariably all children with rubella present with central nuclear cataract
- metabolic disorder can present with lamellar cataract
- hereditary or genetic cataract can present as zonular, sutural, total, polar, pulverulent, blue dot and membranous forms
- in autosomal dominant form, one of the parents may show the same or different morphological cataract
- in X-linked recessive, the female carrier may show a sutural cataract and the affected sibling may show a total cataract

The presence of frequently associated ocular anomalies like colobomas, angle dysgenesis, elongated iris processes, and persistent papillary membranes should be carefully noted. The surgeon may have to modify his/her approach during surgery if these anomalies are present. Pupils should be dilated for a detailed fundus examination and retinoscopy. Retinoscopy is usually possible in cases of partial cataract and indicates the refractive status of the eye. Whenever possible, a fundus examination should be done using an indirect ophthalmoscope. If dense cataract precludes the view, then a B-scan ultrasound should be ordered. Ultrasonography should be routinely done in all cases of unilateral cataract to rule out any posterior segment pathology. If necessary, ultrasound may be done in both eyes.

Measurement of corneal idameter should be done as microcornea is contraindication for IOL implantation. IOP should be measured in all cases of cataract with suspected glaucoma, ectopia lentis using Pulsair or even Schiotz tonometer. If the child is uncooperative, this can be deferred until surgery. A-scan axial length measurement and IOL power estimation should be done if IOL implantation is being considered.

Management of paediatric cataract poses many challenges to the ophthalmologist. The ophthalmologist is faced with the task of having to modify methods of evaluating patients who are frequently unable or unwilling to co-operate. Surgical removal of the cataract calls for techniques that counter the tendency to increased posterior capsule opacification in young eyes. Choosing a modality of refractive correction requires careful consideration of the change in refraction these eyes may undergo as they grow to maturity. Most importantly, there is all along the danger of amblyopia from visual deprivation looming large.

- Indian Journal of ophthalmology, Vol.43 (4), Dec 1995, p. 159

3. Physical examination and workup

Bilateral cataracts are more likely to be associated with systemic disorders and hence require other systemic workup. A complete physical examination by a paediatrician will help to diagnose most of the systemic problems associated with cataract. The mental and physical development of the child should be assessed as this helps in selection of appropriate modality of visual rehabilitation. It is important for the ophthalmologist to work in tandem with the paediatrician. Extensive laboratory tests are not really essential in an otherwise healthy child with cataract. Invariably, children with metabolic disorders are very sick and usually they present to a paediatrician first rather than to an ophthalmologist. Urine test for presence of reducing sugar should be done in cases of suspected galactosemia and diabetes. If maternal infection is suspected, TORCH and VDRL titers can be ordered to confirm the diagnosis. It is better to do IgM titer rather that IgG titer to avoid confusion with maternal IgG antibodies, which pass through the placenta. IgM titers in saliva is a better option to detect rubella in infants. Children who weigh less than normal, with suspicion of congenital rubella syndrome, should have their hearing checked and their cardiovascular system examined for presence of PDA, which is important to diagnose before subjecting the children to anaesthesia. In children presenting with mental retardation and ectopia lentis or cataracts, urine for homocystinuria is to be checked. Children with cerebral palsy and a history of birth asphyxia and brain damage should have a thorough neurological workup. In practice, children needing a battery of investigations are few. Chromosomal assay can be done if a high index of suspicion exists. If features consistent with specific chromosomal syndromes are present, then chromosomal analysis is justified. Amino acids in urine can be tested to rule out Lowe's syndrome.

Calcium and phosphate levels can be assessed in cases of hypoparathyroidism. Other lab tests should be done in consultation with the paediatrician.

Unilateral cataracts, on the other hand, do not require an extensive work up. However, a detailed ocular examination is mandatory. Pupils should be well dilated to verify that cataract is unilateral. A hand held slit lamp may be required to examine a very young child. Ocular features of PHPV or post lenticonus should be looked for since they are most commonly associated with unilateral cataract. Any signs of inflammation like anterior chamber reaction, posterior synechiae, or nodules on the iris should be noted. It is important to rule out retinoblastoma in children, especially if white reflex is unilateral. Ultrasound should be done in every case to detect any posterior segment pathology like underlying retinal detachment. Morphology of cataract and any subluxation

should be noted to select appropriate surgery. A few unilateral cases may be the result of intrauterine infection, so antibody titers for TORCH and VDRL tests can be done if the history is indicative of infection during pregnancy.

4. Pre-anaesthetic evaluation

Before the administration of general anaesthesia or ketamine, all children should receive a pre-anaesthetic assessment of cardiovascular and respiratory systems by the anaesthetist, to avoid any surprises on the operating table. Haemoglobin and RBC counts should be done. Children with haemoglobin values less than 8 mgs per desilitre should not be subjected to general anaesthesia. Thromboembolic complications in cases like homocystinuria should be anticipated and preparations should be made to deal with the situation in case of any eventuality.

Management of childhood cataract

Visual prognosis and the time of surgical intervention

Ophthalmologists who are used to treating patients of all ages must be acutely aware of the dangers of amblyopia when they treat young children under the age of eight years. The covering of one eye for as little as one week in an infant under the age of three can induce amblyopia.

- Dr. John Pratt-Johnson

The development of visual areas in the brain largely depends upon visual input from the eyes, especially in the first few weeks of life. Significant visual deprivation, which occurs in both monocular and binocular cataracts in early infancy, can lead to severe visual loss and amblyopia, sometimes resulting in strabismus and nystagmus, particularly in monocular cataract. Amblyopia can become irreversible in cases where the visual deprivation occurs during the critical period that is considered to be the first few months of life. Bilateral dense congenital cataracts that obscure the visual axis will cause irreversible amblyopia and sensory nystagmus unless the cataract is removed before the child is two months old. Irrespective of whether it is unilateral or bilateral, cataract should be removed and aphakic correction provided as soon as possible. Very early visual rehabilitation can result in good visual acuity and fusion with stereopsis, sometimes even in monocular cataract.

A few types of cataract like anterior polar, nuclear lamellar, and posterior lenticonus are not as amblyogenic as other types, e.g., total cataract. A child who develops cataract after six months generally has less amblyopia and a better visual prognosis than children born with cataracts. For this reason, lamellar cataract and nuclear cataracts have a relatively good prognosis even when surgery is performed after the critical period of visual development.

Bilateral cataracts with sensory nystagmus generally have a poor prognosis. In some cases, however, even late surgery can dampen the nystagmus and significantly improve visual acuity.

At Aravind, we have had the opportunity to operate on a few young adults who were admitted in blind school. These adults, blind with unoperated cataract with nystagmus, showed visual improvement up to 6/36 after cataract surgery with posterior chamber intraocular lens implanatation. The positive results have encouraged us to operate on children and young adults presenting with congenital cataract rather than labelling them blind.

- Dr. P. Vijayalakshmi

Though awareness regarding early treatment is increasing among young parents, some patients still come rather late for medical/surgical treatment for various reasons. This reticence can be attributed mostly to low socio-economic background, illiteracy among the parents, lack of awareness of treatment facilities and, above all, the inability of parents to reach the tertiary centres where the proper care is provided to these children.

- Dr. P. Vijayalakshmi, Chief, Paediatric Cataract and Strabismus Services, Aravind Eye Hospitals

In most cases of unilateral cataract, the behaviour of the child may be normal and the parents may be unaware of the problem, which leads to delay in seeking treatment. In contrast, the decreased visual acuity with bilateral dense cataracts interferes with the child's normal development, thus alerting parents to seek medical help.

Prompt surgical removal will definitely improve the behaviour of the child in general, apart from improving the visual acuity. If surgery is not done promptly, a manifest nystagmus and strabismus will occur, which generally leads to a poor visual prognosis. If nystagmus or unsteady fixation have only very recently developed in an infant with cataract, it may be reversed or improved by prompt treatment, unlike in an older child with long duration of nystagmus.

An Aravind-based study showed that 46 percent of the children presented between the age of 6and 15 years had a history of cataract since infancy. Among the reasons cited for delaying treatment, 30 percent of parents had consulted the nearby available health personnel and were advised do delay the treatment, 15 percent had been unaware of the available treatment, 20 percent could not afford the cost of treatment. The remaining reasons included no time, father was away, the child was very young.

Bilateral partial cataract

Although bilateral congenital cataracts should be extracted surgically, some of the partial cataracts may need to be managed conservatively. In some cases, bilateral partial cataract may have only a minor effect on vision, but following surgery, the child may develop postoperative problems that are more severe than the original problems. This is of relevance in cases of complicated cataracts due to some form of uveitis, traumatic cataract or cataracts associated with other ocular problems like microcornea, microphthalmos, aniridia, colobomas, and PHPV. The necessity of surgery in these cases can be decided by observing the behaviour of the child in normal circumstances. With careful observing, at frequent intervals, surgery can be postponed in the following cases: a toddler who is able to recognise family members and plays well by moving around the house without difficulty, a preschooler who is able to move with his friends without difficulty during play, and a school-going child who has no difficulty performing school work. This will provide a better option of surgical management and aphakic rehabilitation (particularly with regard to IOL implantation) ass they grow older.

In doubtful cases, conservative management in the form of dilating drops should be considered at least for some time (duration can be determined depending upon the age of child). This can be applied once a day. It is preferable to use cyclopentolate HCL 1% rather than a strong cycloplegic like atropine. The visual prognosis with bilateral cataracts correlates well with the density rather than the size of the opacity. For example, a small nucluer cataract will have poorer prognosis than a large lamellar cataract. Anything less than 3mm in size interferes with vision only to a slight extent. These children should be examined at regular periodic intervals. Although paediatric cataracts progress very gradually and sometimes not at all, it is still possible that some

cases may progress very rapidly. The parents should be given instructions to watch for the sudden appearance of white pupil, development of strabismus, or evidence of deteriorating vision. The density of the cataract can be assessed by the clarity of media during both retinoscopy and funduscopy. If the major blood vessels cannot be visualised through the central portion of the cataract, it can be considered as an indication for surgical intervention.

Bilateral unequally dense cataract

Children who present with unequally dense cataract need careful evaluation and follow-up. The denser eye should be checked for its ability to fix and converge. Visual acuity should be evaluated, if possible. Surgical removal should be considered in the eye with denser cataract. If the operated eye reveals severe stimulus deprivation amblyopia as indicated by poor visual acuity despite aphakic correction, the other eye with partial cataract needs a lot more care since that is going to be the only seeing eye. The eye with less dense opacity should be followed up at short intervals, carefully assessing for visual acuity, fixation and the independent behaviour of the child in respect to the amount of visual acuity. The delay is based mainly on the assumption that vision in the phakic eye is much better than aphakic eye vision. This assumption, however, may not be true in an older child where an intraocular lens implantation is possible and better visual acuity can definitely be achieved.

In unequally dense cataracts, the denser cataractous eye is operated first. Surgery on the second eye may then be deferred until the first eye has received its aphakic correction, or longer if the estimated visual acuity or the behaviour of the child is better with the unoperated eye rather than the operated eye. Older children with bilateral cataracts are less demanding and the interval between the two eyes can be longer, especially with an intraocular lens implantation. If there are other reasons for planning cataract removal only (no IOL implantation), the second eye can be operated on within a week.

Bilateral dense cataract

Surgery for significant bilateral dense cataracts should be carried out as quickly as possible without jeopardizing the general health of the child. An appropriate method should be selectecd and both eyes should be operated on within a week. The previously operated eye should be patched until the other eye is operated. Aphakic correction, in the form of spectacles, is advised in the immediate postoperative period before the child is discharged from the hospital. Fitting of contact lenses can be safely done at a later date.

Surgery is the easiest part of the treatment for unilateral cataract. The real hurdle is the correction of the refractive error with a contact lens, and then the almost impossible challenge of supervised patching of the good eye. Don't operate on a unilateral cataract without the facilities and capacity for rigourous follow-up.

- Dr. John Pratt-Johnson

Unilateral cataract

Invariably unilateral cataracts present to the opthalmologist very late. They remain undectected because they are partial to begin with and because vision in the other eye is usually normal. If an infant presents with unilateral cataract with apparently straight eyes, suggestive of a recent onset, immediate surgical intervention is indicated. It should be followed by immediate aphakic correction and patching to result in good visual acuity. If a child presents with strabismus and uniocular nystagmus, even with immediate intervention and prompt aphakic correction with intense patching for amblyopia, the visual prognosis is always poor. In an older child with longstanding cataract, removal is often done along with squint correction for cosmetic reasons.

Surgical management

In general, children's eyes are not only smaller, but also have a tendency for stronger inflammatory response. During surgery there is always chance of positive pressure, because of low scleral rigidity. For these reasons, a proper and well-sealed wound is necessary. Since posterior capsular opacification is present in almost all cases sometime during the postoperative period, surgical technique should include strategies for tackling this. Further to these factors, a long term commitment should be there on the part of the surgeon and parents in managing aphakia and amblyopia in these children.

Basic principles

In contrast to senile cataract, a child's cataract is soft. Hence, it can often be removed by simple irrigation and aspiration techniques. Phacoemulsification or extracapsular extraction with nucleus expression is not necessary. Intracapsular lens extraction in children is contraindicated, as removal of the intact lens causes vitreous traction (via Wieger's capsulohyaloidal ligament, which is the strong adhesion point of the posterior capsule of the lens and the anterior hyaloid face)leading to vitreous loss.

The actual surgical management of paediatric cataract has evolved considerably since schie's popularized the aspiration procedure through a small incision. Before schie's procedure, disscision and needling was in use. Both the procedures involved inadequate removal of lens matter leaving behind the posterior capsule. Instances where the posterior capsule was accidentally or intentionally injured invariably resulted in vitreous loss followed by vitreous incarceration into the wound, further leading to immediate and delayed postoperative complications. This caused considerable difficulty in postoperative management of these children. The common complications encountred were severe inflammatory response due to residual lens matter, uveitis, glaucoma and retinal detachments. Inadequate knowledge about amblyopia also left

behind many children with no aphakic correction, finally ending up with very low visual acuity.

To counter all these complications, paediatric cataract surgeons were constantly trying to evolve a better technique from the experience gained by the modern techniques of adult cataract surgeries and the experience in handling sthe vitrectomy units. The two techniques that are most widely used now are extracapsular cataract extraction and lensectomy with anterior vitrectomy. In an attempt to create a clear visual axis, either during IOL implantation or during cataract surgery preserving posterior capsule for future IOL implantation, a technique of posterior casulotomy with limited anterior vitrectomy is being used at present.

It is good to temper our enthusiasm for innovation with appropriate restraint when we consider that our patients will continue to live with the results of our efforts long beyond the end of our professional lifetimes.

- Dr. Surendra Basti, Mark J. Greenwald

Lensectomy with anterior vitrectomy

After the invention of the vitrector, which has both cutting and aspiration modes, lensectomy was mainly done by vitreoretinal surgeons. They approached the lens through the pars plicata/plana. Recently, when anterior segment surgeons started to perform lensectomies, the anterior (limbal) approach became popular because many of them were not comfortable with the posterior approach. Both the methods have their own advantages and disadvantages. The posterior approach has the advantage of working behind the iris, thus facilitating complete removal of the lens matter and, at the same time, avoiding corneal endothelial damage. It is particularly useful in cataract that is membranous, i.e., cataracts associated with uveitis, microcornea, colobomas , etc. But in neonates, the pars plana is extremely narrow and almost nonexistent, so the incision may increase the risk of creating a retinal break. The anterior approach has the advantage of allowing the preservation of the posterior capsule.

The original procedure of lensectomy involved removal of the lens matter completely without leaving any remnant, including both the capsules. The recent preference has been to use the following technique whenever possible: through a small limbal incision (3mm approximately) anterior chamber is entered. Anterior chamber is filled with viscoelastic substances. Anterior capsulotomy is done with a bent 26G needle by can-opener technique making sure not to have big tags of anterior capsule. The lens matter is now aspirated using the cutting aspirating mode of probe, maintaining the anterior chamber through the surgery.

The posterior capsulectomy is now performed with anterior vitrectomy by keeping the port down, for a desired extent. A peripheral iridectomy is done and a water-tight wound is achieved taking care to keep the ocular tension optimum. This avoids hypotony and subsequent intraocular haemorrhage.

In cases where there is a central hard cataract like rubella, or partially absorbed cataract (membranous) due to other intrauterine infections, this is

cut and removed straight away with the vitrector after needling the membrance using either a bent needle or a disscision knife. In these cases, cutting is used more than aspiration since there is no soft lens matter and posterior capsule preservation is often not possible.

ECCE

Developments such as Nd YAG laser for posterior capsule opacification and the good results of modern ECCE technique for IOL implantation in adults were responsible for paediatric cataract surgeons adopting this method. It is less invasive, simple and can be done with a Simcoe cannula, which is easily available and inexpensive. In this technique, anterior chamber is entered through a small limbal incision. Can-opener or capsulorrhexis is performed, lens matter loosened, and lens cortex aspirated by using a Simcoe cannula. The posterior capsule is left intact to be tackled at a later stage, as and when needed. Some surgeons prefer to do Nd YAG cspsulotomy on the table and some prefer to perform it at a later date. This is an ideal operation for older children where IOL is contraindicated, e.g., cataract with myopia, glaucoma,etc.

ECCE with primary posterior capsulotomy

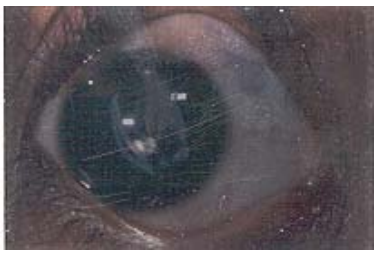
In this technique, after doing a regular ECCE, the posterior capsule is removed along with a part of the hyaloid face and the anterior vitreous at the centre. The periphery of the posterior capsule is left behind for future posterior chamber intraocular lens implantation. This leaves the infant with clear visual axis from the day of operation. In this technique, as in for ECCE, the anterior chamber is entered through a 3mm incision. Lens matter is aspirated thoroughly using either manual or automated aspiration technique. At this stage, the posterior capsule is tackled by doing central (4mm) capsulectomy combined with anterior vitrectomy by keeping the port down. Surgeons who do not have access to the vitrector can use a bent needle to incise the posterior capsule without disturbing the hyaloid face or with minimal disturbances creating a clear visual axis. However, because it can result in further opacification of the hyaloid face or with an inflammatory response, this method should be avoided unless the surgeon has no other option. At the end of surgery in all cases, a peripheral iridectomy is performed and a water tight wound is achieved.

Should the necessity arise, IOLs can be implanted in children, even below one year of age. With proper techniques of posterior capsulectomy and vitrectomy, the eyes of even the very young infants are relatively uninflamed. IOLs in very young children, especially with monocular cataracts, can free them from the use of spectacles and contact lenses, prolonged patching and amblyotherapy.

- Dr. Edward Wilson

Use of intraocular lens implantation

Most surgeons all over the world implanat IOL in children over the age of two years, because the anterior segment growth is nearly complete by this age. Most surgeons also believe that the same IOLs used in adults can be used safely in children.



IOLs are contraindicated in children with ocular abnormalities like microphthalmos, microcornea, coloboma, aniridia, etc. In traumatic and complicated cataracts, this has to be planned very carefully. The preferred lens in the developing countries continues to be PMMA single piece biconvex lenses. In Europe and America many surgeons prefer acrylic acrisol or foldable lenses.

At Aravind, we do not have experience with heparin-coated lenses, which are claimed to be less reactive in children.

Regarding. the power of the IOL all surgeons unanimously agree that there has to be some under-correction and this mostly depends upon the axial length and refractive status of the other eye. In general, after the IOL power is calculated with A-scan, reduce the power of the lens by:

+4.00 DSP between 2 and 3 years
+3.00 DSP between 3 and 5 years
+ 2.00 DSP between 5 and 6 years
+1.00 DSP up to 10 years
+0.5 DSP up to 12 years
Use the same power in patients older than 12.

General anaesthesia for cataract surgery in children

In most developing countries, particularly away from large urban centres, safe paediatric anaesthesia is unavailable from both a lack of trained anaesthetists and a lack of the necessary equipment. In these situations, ketamine anaesthesia offers the infant the only hope of getting cataracts removed by the age of two months or so. Often the only medically qualified person in the operating theatre when the ketamine is administered is the ophthalmologist. He or she should therefore learn the properties of this drug and the safest method of administering it.

- Dr. John Pratt-Johnson

Pre-anaesthetic

Children should be free from respiratory infection before they are given general anaesthesia as the pressure of the endotracheal tube can irritate respiratory mucosa and is likely to provoke bronchospasm.

Routine examination of the vital systems is done to rule out any associated congenital heart disease. Starvation of four to six hours is mandatory before they are given general anaesthesia. Premedication with sedative drugs and antisialagogues is given to sedate the patient and to dry up the respiratory secretions. Infants below six months are not given any sedative drug, or only oral promethazine is used. Injection atropine is used as antisialagogues. In older children, injection midazolam or injection pentazocine is used.

Induction of anaesthesia

Along with injection thiopentone, the musele relaxant vercuronium bromide is used to facilitate intubation and to prevent a rise in intraocular pressure.

Maintenance of anaesthesia is done by nitrous oxide-oxygen-halothane combination. Respiration is assisted until the patient breathes spontaneously, and the anaesthesia is sometimes reversed by neostigmine with atropine.

Recovery

At the end of surgery, the patient is oxygenated and observed in the recovery room. He/she is discharged from the recovery room only when consciousness is regained and vital signs are stable.

Monitoring

During anaesthesia and surgery and in the immediate recovery period, respiration and heart rate are monitored by pulse oximeter. It gives a digital reading of oxygen saturation and pulse rate.

Considerations in choice of surgical technique

ECCE with PC-IOL

Individual surgeons adopt different techniques, alerting each step of the surgery according to their convenience and the age of the child. In children, the low scleral rigidity and thin sclera predispose them to shallowing of anterior chamber and prolapse of iris through the wound. For this reason, the initial steps like anterior capsulotomy and lens aspiration are done through a 3mm limbal incision and then this is extended for another 1-2mm on either side to facilitate the IOL implantation. The wound is sutured with 10'0 monofilament nylon followed by conjunctival cautery to close the conjunctival wound.

After the success of sutureless scleral tunnel incision in adults, a few surgeons have reported good results with construction of scleral tunnel in children. After the conjunctival flap, a transverse incision is made for 4-5mm, 2 mm posterior to the limbus. Since children are more prone to injuries, the preferred site is either superior or slightly temporal as these are most protected.

Construction of scleral tunnel

A tunnel is constructed using a bevel up crescent blade as in adults. The anterior chamber is entered through the tunnel using 3.2mm keratome. During entry, anterior chamber should not be emptied suddenly. Before entering the chamber, we prefer to have side port incision made and ready for reconstruction of anterior chamber during and at the end of surgery. If one is not careful in constructing the scleral tunnel, it is not uncommon to end up with premature entry into the anterior chamber. Before implanting the IOL, the scleral wound is extended on either side for a mm or two. The wound is sutured whenever there is a failure in formation of anterior chamber or when a leak is found upon pressing the sclera at 6 o'clock position. The scleral tunnel needs to be sutured, especially in children below ten years of age. One can use an absorabable vicryl suture instead of nylon.

At Aravind, the preferred practice is to close the scleral wound with two or three interrupted sutures using 10'o monofilament nylon. Children older than 10 can go without the sutures if the wound proves to be water tight on the table. The conjunctiva is closed with the cautery. This technique may be made more difficult in caseds of secondary implant and in traumatic cataract of recent onset because of pre-existing hypotony.

Capsulotomy

The mode of anterior capsulotomy is chosen depending upon the type of cataract. In cases of dense white cataract, a can-opener capsulotomy is done, taking care not to leave large tags of the capsule. Capsulorrhexis is done in central nuclear lamellar cataract where the view is clear. Since in children the lens capsule is more elastic and tends to tear radially, it is mandatory to keep the anterior chamber deep with retainable viscoelastics during the manoeuvre. It is wise to start with a small 4mm rhexis that will automatically end up with approximately 6mm opening. The hand movement during the rhexis should be towards the centre of the lens unlike in adult cataracts. Capsulorrhexis can be done either by using a cystitome throughout until it is completed or aided by capsulorrhexis forceps. A few surgeons prefer to use a vitrector to cut the capsule by keeping the port down. Whatever method is adopted, the opening should be at least 6mm in size at the centre and without radial cuts.

Aspiration of the lens material

Once the anterior capsulotomy is accomplished, lens matter is loosened either by producing a few deeper cuts or by injecting a little saline into the bag. The lens matter is aspirated either manually, using Simcoe cannula, or by an automated irrigation aspiration device. In cases of hard and calcified lens matter that is more frequently seen in longstanding childhood cataracts, both congenitial and traumatic, the surgeon may be forced to extend the section to express the lens matter in small pieces.

Implantation of IOL

If the surgeon intends to leave the posterior capsule intact, as in older children, the section is extended on either side with keratome or crescent knife and the lens is placed in the bag. The excess of viscoelastics used during implantation is removed completely with Simcoe cannula before the wound is closed.

Posterior capsulotomy

When the posterior capsule needs surgical modification, as in young children or in older children with primary posterior capsular opacity, the posterior capsulectomy with limited vitrectomy is performed. This can be performed either before or after implanting the lens. There are different techniques available for this. One is to use forceps to do posterior capsulorrhexis combined with

vitrectomy. Another technique is to use a vitrector to cut both the capsule and a part of anterior vitreous. Third, one can use a bent needle to incise the posterior capsule at the centre followed by vitrectomy. If the vitreous is not removed properly, it leads on to a severe inflammatory response. It will always be safe to leave the posterior capsule intact on the table (if one does not have a good vitrector) and tackle the posterior capsular opacification with Nd YAG or by surgical membranectomy, which can be performed through an anterior or pars plana approach, at a later date

Alternatives:
Ophthalmologists like Dr. Edward Wilson prefer to place IOL over the intact posterior capsule and perform posterior capsulectomy and vitrectomy through a separate pars plana approach. They claim that they can more safely perform a larger posterior capsulectomy than they could with an anterior approach. Also there is no risk of leaving a vitreous strand at the wound or in the anterior chamber and the chances of secondary membrane formation are less.
Still others perform a continuous curvilinear posterior capsulorrhexis and believe in producing a posterior optic capture by pushing the lens optics behind the posterior capsule. This eliminates the hylaoid face thickening over years but it is possible that these children with no vitrectomies performed may develop secondary membrane formation at the visual axis.

Routine postoperative management

Postoperative management of the patient starts as soon as the child comes out of anaesthesia. The parents should be reassured and told about possible side effects like vomiting. For this reason, feeding is withheld for three to four hours, except in young infants who can be fed in an hour. If there is significant vomiting, parenteral antiemetics can be given.

At Aravind, the preferred practice in postoperative medication for all patients who have had only cataract surgery is to use both antibiotics and steroids in two separate forms. Drops are used in almost all children except in very young infants where the application of ointment at less frequent intervals is easy.

To start with, postoperative medication is given three to four times per day in the first two weeks followed by two to three times per day in the next two weeks. For cycloplegia, atropine 1% ointment is used once a week in almost all children and when this is contraindicated for some reason, cyclopentolate drops are used (daily or alternate days) for at least the first four weeks.

In cases of bilateral cataract in infants and neonates, the second eye is operated usually three to four days after the first surgery, provided the child is fit for anaesthesia. The patch on the first eye is kept until the second eye is operated. On the following day the child is refracted on both eyes and prescribed aphakic correction.

In cases where an IOL is implanted, inflammatory response is more exaggerated. Topical application of steroids has to be more aggressive and meticulous. Trauma, or presence of blood, viscoelastics or cortex in the anterior chamber usually precipitate the formation of fibrin membrane over the lens and iris. To

Though making the children aphakic and rehabilitating them with either contact lenses or spectacles seems much simpler and safer than implanting the lens into children's eyes with anticipation of an inflammation response, the quality of vision attained with the second mode is superior to the first. The visual rehabilitation adds to the personal and psychological well-being of children with increased social acceptance.

- Dr. P. Vijayalakshmi

combat this, we prefer to give a single of SC gentamycin (0.5cc) and IV dexamethasone on the table (does according to body weight).

From the first postoperatively day topical steroid drops are used five to six times/day. Antibiotics, preferably ciprofloxacin, (three times/day) along with cycloplegic (preferably cyclopentolate1%), are given as and when needed. The same medication is continued for three more weeks with less frequent application. The number of applications is assessed on an individual basis. Children are discharged from the hospital only on the third or fourth postoperative day.

Before the child is discharged from the hospital, appropriate glasses are prescribed. If it is a unilateral aphakia, parents are advised to ensure that the child uses glasses for a few hours each day along with patching of the normal eye. For four weeks until they are reviewed, children are advised to abstain from school and outdoor activities. The review is done after four weeks, and thereafter routinely at frequent intervals as indicated, according to the problem and age of the child. The first review examination includes refraction, fundus, ocular tension by pulse air, and ocular motility evaluation. Special emphasis is placed on getting visual acuity measured using the appropriate method to facilitate the detection of amblyopia.

Surgical intervention in paediatric cataract implies a long term commitment on the part of the parent, the child, and the ophthalmologist because of the long follow-up and periodic check-ups it entails.

-Dr. P. Vijayalakshmi

Children with amblyopia and strabismus, which is often present especially in unilateral aphakia, are followed closely with a similar regimen of occlusion therapy as in strabismic amblyopia and are surgically managed at the right time.

In cases of unilateral and bilateral aphakia where fitting of contact lenses has been deceided, it is done well after six weeks postoperative with temporary spectacle correction in the interim period.

In general, the acceptance by parents of contact lenses for aphakia in children is found to be less in developing countries because of socio-economic reasons, illiteracy among parents, time and environmental factors. The other difficulties are practical. It is not easy to insert a lens on a child's eye because of narrow palpebral fissures, frequent losses and need to change the lenses frequently, etc. But if parents accept the contact lenses, athen this is definitely a better option than spectacles for achieving a visual acuity of superior quality. Many times the infants who are fitted with contact lenses, for no reason, become intolerant to them as they grow. For the above reasons the percentage of children treated at Aravind through this mode is low.

In cases of IOL implantation, the first review is done after four weeks. The examination includes S/L biomicroscopy, visual acuity estimation and fundus evaluation. Parents are advised to continue medication in a tapered does for another two to three weeks with a change in the antibiotics and steroid combination. The second review is done after eight weeks. Ocular motility examination for binocular single vision and stereopsis is routinely done both in unilateral and bilateral implants. Residual correction along with near vision correction in spectacles is given whenever needed. Since children are prone to violent activities leading to injuries, parents are asked to restrain them from attending

school and outdoor activities at least for four weeks. Children cooperate very well when they are not bandaged for long. For this reason, they are given protective glasses in the immediate postoperative period and plastic shield for a week to cover the eye at bed time.

Operative complications

1.Global collapse

The reduced structural scleral rigidity and increased pliability in the child's eye predisposes it to scleral of global collapse during surgery. It causes bowing of the iris thus shallowing the anterior chamber. The probability of this complication is increased when a larger corneoscleral incision is made as required for the IOL insertion. Global collapse can be prevented to a large extent by using viscoelastics during surgery and a well-monitored general anaesthesia.

Use of viscoelastics
Maintaining the anterior chamber with viscoelastics throughout the surgical procedure is mandatory to prevent corneal endothelial damage, and also to make the procedure easy ands mandatory to prevent corneal endothelial damage, and also to make the procedure easy and uneventful in many ways. The viscoelastic used must have high retaining capacity so that it can withstand the positive pressure that occurs during general anaesthesia. At the end of the surgery the viscoelastics should be removed thoroughly. Retained viscoelastic may produce high intraocular tension and membrance formation in the immediate postoperative period, especially in the presence of blood.

2.Hyphaema

Several hyphaema is uncommon in an uncomplicated cataract but may lead to serious consequences if it occurs. The sites if bleeding into the anterior chamber are usually corneoscleral wound, the iridectomy site, or a vascularised anterior synechiae. Local cautery or air tamponade controls the haemorrhage most of the time. Since red blood cells are attracted to the IOL and are also sources of anterior chamber fibrosis, collection of blood must be irrigated from the anterior chamber before it forms a clot or at least prior to wound closure.

3. Iris complications

A peripheral iridectomy is done in almost all cases. Proper care is taken to wash away the iris pigments that are released during this attempt; if not done these pigments may later on get attached to the back of the lens surface. The anterior chamber depth is reduced when the child's eye is open and the IOL loops often damage the iris stroma during insertion. Iris tears, dialysis, pigment epithelial dispersion or erosion, and hyphaema may be produced by this trauma.

4.Posterior capsular rupture and vitreous loss

Accidental rupture of posterior capsule during aspiration of lens matter can well be tackled by immediately stopping the aspiration, followed by cutting of the prolapsed vitreous using very low aspiration with an automated or mechanical vitrector. It is very important to clear all the vitreous from the anterior

chamber and the wound. If the rent is small, a PC-IOL can still be implanted. But if posterior capsular support is inadequate, it is wise not to implant the IOL. This complication is more commonly encountered in children with posterior lenticonus traumatic cataract, especially in penetrating injuries. The anticipated site of rent is usually at the thinned part of the cone in cases of lenticonus, and corresponding to the site of wound of entry in cases of traumatic cataract.

5. Poor IOL placement

The IOL must be placed in the desired position at the conclusion of the operation. Sometimes 'in the bag' placement is not possible for known reasons. IOL can be placed in the sulcus, making sure that both the haptics are in the sulcus. Since children have a tendency to develop more fibrosis, this results in fusion of both the anterior and posterior capsules. This fusion of capsules may lead to decentration of the lens if one haptic is inside the bag and the other one is out.

6. Wound closure and sutural complications

In cases of limbal incision, at least three to four sutures with 10o'clock nylon are needed. To ensure a water tight wound it is better to leave a small air bubble in the anterior chamber and the conjunctiva should be closed by cauterizing the ends. In the case of scleral tunnel, water tight wound closure can be achieved by using at least one or two interrupted sutures either with 9o'clock vicryl or 10o' clock nylon, whenever needed, along with conjuctival wound cautery. These sutures are usually left intact. They are removed only when they are symptomatic and attract mucus collection or vascularisation.

Postoperative complications

Immediate

Striate keratopathy is rare in children if surgery is done meticulously. Exaggerated inflammatory response, in the form of anterior uveitis, is more common in children. In its severe form it can result in fibrin strands over the anterior surface of the lens and on the iris. In its very severe form, it may result in hypopyon with very thick membrane formation both in front and behind the IOL. Usually the mild and moderate uveitis resolves completely with adequate local and systemic corticosteroids combined with the proper local antibiotics. Atropine eye ointment helps in these cases. In some cases, especially in traumatic cataracts, despite treatment uveitis may cause posterior synechiae formation leading to a partial or total pupillary capture, especially when the lens was implanted in the sulcus. Pupillary capture, as it is, may not cause decreased visual acuity. In our experience we have observed that the inflammatory response is almost nil if the scleral tunnel is constructed and if there is no bleeding into the anterior chamber. This increased inflammatory response can also be checked to a certain extent by giving a single does of intravenous dexametha-

sone on the table according to the weight of the patient. It has been noted in the literature that heparin-surface modified lenses produce less inflammation.

Late complications (after cataract surgery and posterior capsule opacification)

Posterior capsule opacification happens in almost all cases, at sometime or other, when the posterior capsule is left intact. This could be either in the form of uniform thickening of the posterior capsule (membranous) or in the form of Elsching's pearls (soft after cataract). An opening in the posterior capsule can be created by Nd YAG laser or surgically. The time of intervention is decided depending upon the influence of the opacification on visual acuity and fundus clarity. Nd YAG laser is an ideal mode to achieve this in cooperative children who have only posterior capsule opacification (not very thick) with adequate space between the lens and the capsule. The energy used should be minimal. Nd YAG can be used at any time postoperatively, unlike in adults who have the risk of developing CME (Cystoid Macular Edema) and require a time interval for the same. A few surgeons use YAG laser even on the operating table, at the completion of IOL implantation in young children without surgical primary posterior capsulectomy. YAG capsulotomy may be difficult where the capsule is either thick or very near the posterior surface of the IOL. In such cases, YAG laser may cause pitting of the lens at its posterior surface. In cases where there is soft cataract formation or the membrane is too thick for the laser energy to create an opening, YAG laser may not be very useful. In such a situation, one has to opt for surgical membranectomy , either through the pars plana or through the limbal wound.

From our experience, we feel that the quality of vision is far better after surgical membranectomy than after YAG capsulotomy.

- Dr. P. Vijayalakshmi

Iris complications

Iridocapsular adhesions in any quadrant may produce papillary capture. Synechiae formation of the iris to the periphery of the IOL or the IOL loops may cause malpositioning of the IOL. When the malpositioned captured lens lies on the iris for a longer time it erodes the iris tissue, causing thinning of the iris at that site.

Lens precipitates are often noted at the back surface of the lens, which may be of greasy consistency and are often pigmented or grey-white in colour. These precipitates are thought to be composed of lens elements, iris pigments and inflammatory debris. Generally these do not interfere with the vision. This complication can be avoided if the lens matter is completely cleared on the table. IOL implantation should be done without dispersing the uveal pigments during the manoeuvre and taking precaution to disturb the iris tissue minimally.

Post pseudophakic membrane is the occurrence of a membrane, described by Binkhost and Gobin, that is adherent to the anterior or posterior surface of the IOL optic or its loops or lying behind the IOL, overlying or condensing the vitreous face. It is attributed to low grade uveal activities due to

enhanced inflammatory response by the presence of IOL. This can be totally avoided or minimised in cases of congenital cataract with IOL implantation if a proper technique is adopted with a carefully chosen IOL. In our experience, this complication is seen in cases of recent trauma with a lot of inflammation with either minimal or no response to medication preoperatively. To a certain extent, this can be controlled by giving IV dexamethasone single dose on the table, followed by either oral anti-inflammatory or steroidal drugs in a tapering dose. It is also observed that this inflammation response is much less or almost nil when scleral tunnel is chosen as wound of entry.

Suture-related complications

Sutural reaction can be observed as mucous collection, vascularisation at the site of loose sutures, recurrent redness, etc. Usually children are more tolerant than adult of sutural irritation. Only in such situations do the sutures need to be removed.

Postoperative astigmatism is not a frequent entity since the wound is small and fewer suturers are used. If it occurs, glasses are prescribed for correction.

Glaucoma can occur as a complication, mostly as a result of postoperative uveitis. Surgical peripheral iridectomy helps in amny cases to avoid this complication. Cystoid macular oedema, is rare entity in children. Retinal detachment can occur after resurgeries like pars plana membranectomies.

Intraocular infections like endophthalmitis are extremely rare complications in children. A complete asepsis during surgery with proper pre and postoperative hygiene and care will avoid this.

As a paediatric ophthalmologist, my greatest satisfaction is a big smile on a child's face on being able 'to see' following a successful surgery.

- Dr. P. Vijayalakshmi

Conclusion

Childhood cataract and its management sometimes seems to be an exercise in frustration and heart break due to difficult surgery, complications and often less than satisfactory visual rehabilitation. But the rewards of restoring vision to the best possible extent and giving the child a fair chance in life make all the efforts, on the part of the child, his or her parents and the surgeons, worthwhile.