National Programme for Control of Blindness

Manual on Early Diagnosis & Management of Glaucoma

Editors :

- Prof. H.C. Aggarwal
  Head of Glaucoma Services
  Dr. R.P. Centro, AIIMS
- Dr. Harsh Kumar
  Additional Professor of Glaucoma Services
  Dr. R.P. Centro, AIIMS

In Collaboration with the Study Group of Glaucoma under the aegies of Ministry of Health & Family Welfare.

Ophthalmology / Blindness Control Section
Directorate General of Health Services
Ministry of Health & Family Welfare
Government of India, New Delhi - 110 011.

Prepared by : Dr. Rajendra Prasad Centre For Ophthalmic Sciences
All India Institute of Medical Sciences
Ansari Nagar, New Delhi - 110029

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I. INTRODUCTION

Recently glaucoma has been identified as one of the major causes of blindness among global population. The International Agency for the Prevention of Blindness (1980) estimated that 20% of blindness in the world is caused by glaucoma. According to WHO survey (1992) in nine regions across the globe there are 104,650,000 glaucoma suspects. There are 22.5 million people with glaucoma blindness. Glaucoma accounts for 6.7% to 21% among blindness statistics of Germany, Denmark, Iceland, U.K., U.S.A. and Canada.

According to NPCB-WHO survey (1986-89) glaucoma accounts for 1:7% of total economic blindness in India. In view of very few epidemiological studies on glaucoma (different studies with different parameters for the diagnosis of glaucoma) it is difficult to suggest the eseact prevalence of glaucoma and glaucoma related blindness in this country. Moreover, most epidemiological studies in India have concentrated on detection of primary open-angle glaucoma. But in oriental races including India, Burma, China, Japan etc. the primary angle closure glaucoma is nearly as common as primary open-angle glaucoma. Secondary glaucoma, which is farless common in western countries, accounts for nearly 30% of all cases of glaucoma. We can expect that the member of glaucoma patients and patients blind from glaucoma may rise in absolute and relative terms as life expectancy is increasing in India. Blindness due to glaucoma is irreversible therefore, it is essential that glaucoma is detected and treated before loss of vision has taken place. Creating awareness in highrisk population about glaucoma as a blinding disorder in the target population though media of mass communication and other channels of information can prevent blindness due to glaucoma. In this manual an attempt has been made to provide a basic guideline for early diagnosis and management of glaucoma to ophthalmologists posted in district hospital. Those interested in a detailed study may consult the books and published articles on glaucoma.

II. CLINICAL OCULAR EXAMINATION

Proper diagnosis of glaucoma requires complete evaluation of the patient which includes history-taking, ocular examination and relevant investigations.

A. History

1. Name of patient, Age, Sex, Occupation, Address.

2. Presenting complaints:

   a. Eye involved (OD/OS)
   b. Symptoms : Pain in the eye, headache, vomiting, acute attack of blurring, congestion of the eye, halo, early onset of presbyopic symptoms – frequent change of presbyopic glasses, constricted visual field, diminution of vision, night blindness, injury, duration of each symptoms.

3. Past history:

   Systemic – Diabetes/ cardiovascular disorder/ Bronclial asthma/ thyroid disorder/ chronic use of steroid. Mustard oil/ any other.

   Ocular – Trauma, prolonged topical steroid therapy, any other disease with nature, duration, treatment including medicines, laser, any intraocular surgery, past record of IOP, duration of medical treatment.

4. Family history:

   Family history of glaucoma, diabetes.

5. Recent investigations : Relevant test reports with date.

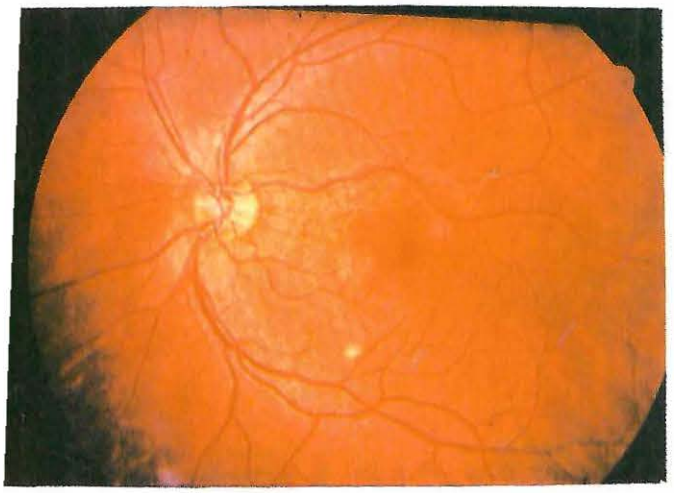
6. Current medication :

   To note the name of drugs and dosage schedule for all medications being used by the patient.

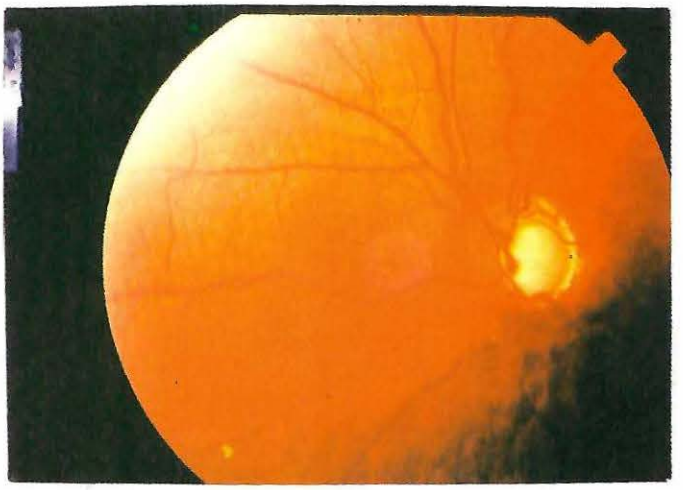
B. Ocular Examination

1. Visual acuity
   a. For distance and near without and with spectacles, if any
   b. Power of glasses for distance near.

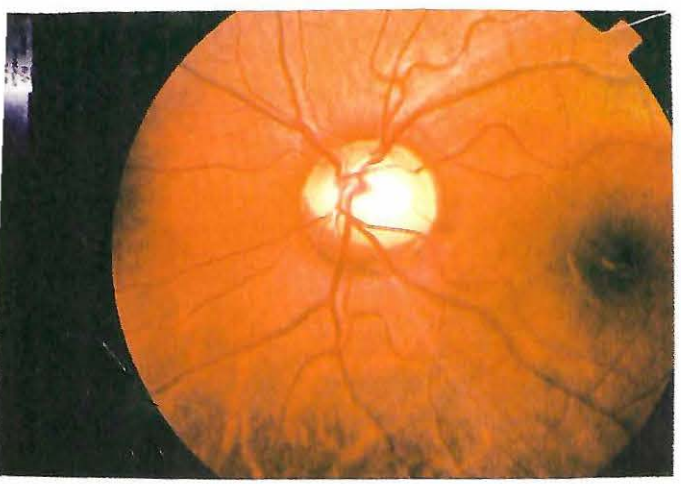
2. Refraction



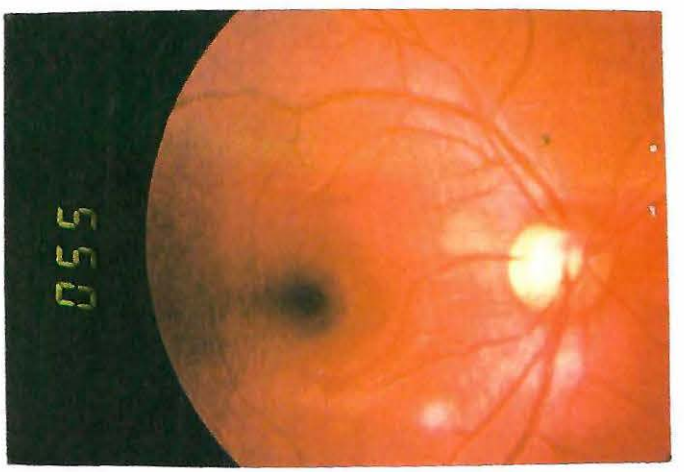
Normal Cup :Disc ratio



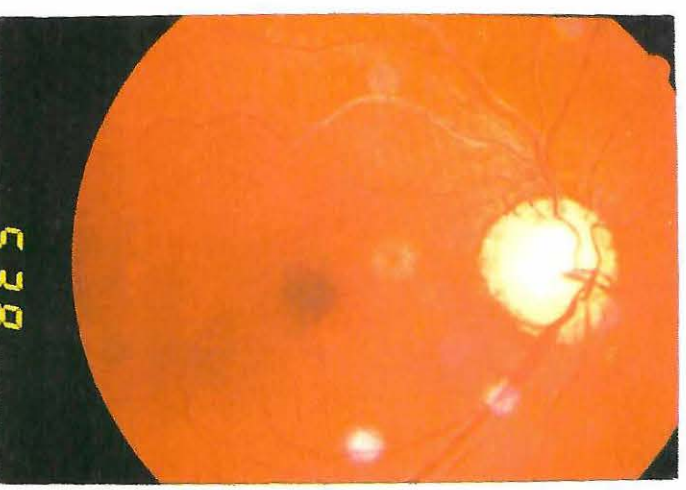
O.5:1 C:D ratio with temporal pallor



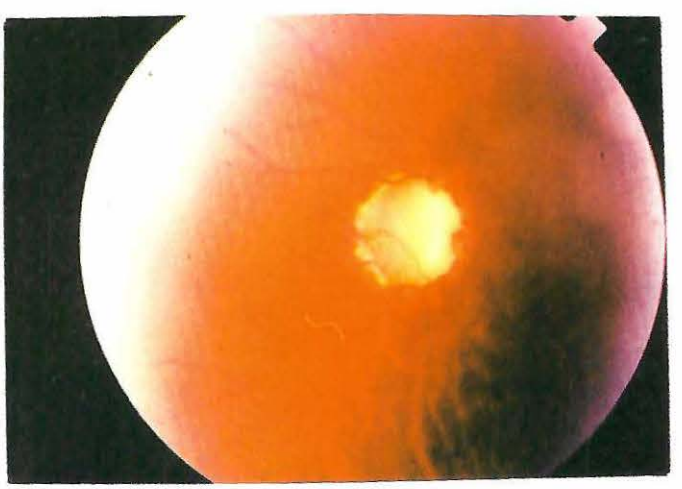
0.6:1 C:D ratio



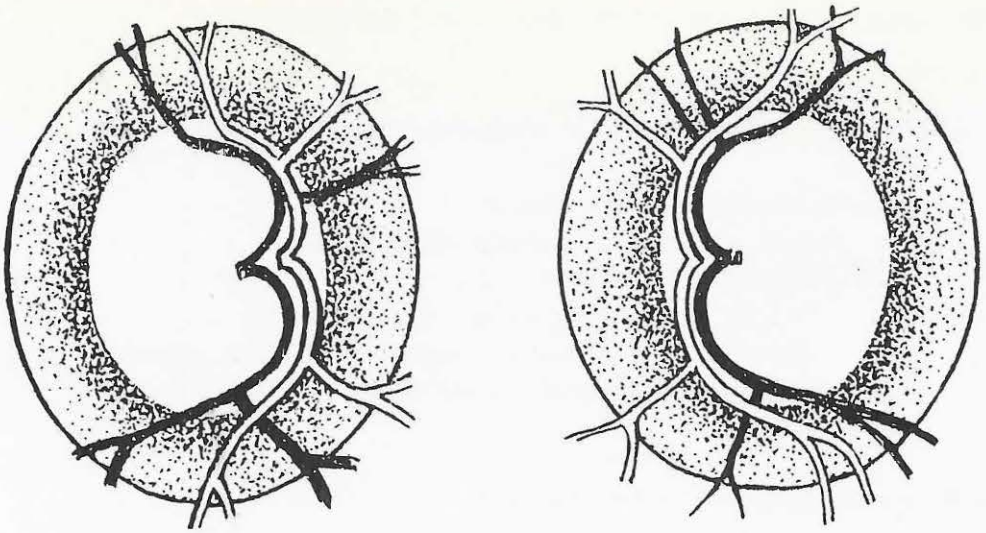
0.6:1 C:D ratio



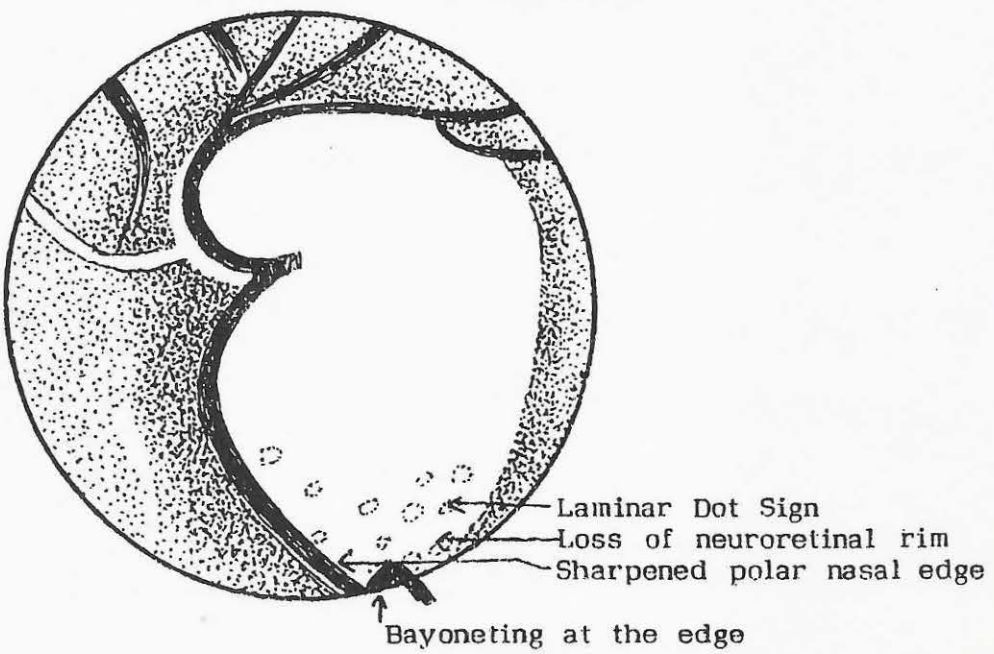
Almost total cupping



Total cupping



NORMAL PHYSIOLOGICAL CUPPING
(NORMAL NEURORETINAL RIM)



3. Examination in oblique illumination (including flash light test).

   a. Ocular adnexa
   b. Cornea – Transparency size, thickness, pigment on the back of cornea.
   c. Anterior chamber – depth, content.
   d. Iris – pattern, atrophy, new vessels, discolouration.
   e. Pupil – size, shape, reaction to light.
      To look for afferent pupillary defect (RAPD)
   f. lens – Transparency glaucoma flakens, exfoliation, pseudo-exfoliation pigment material on the anterior surface of lens, displacement.

4. Slit lamp examination : (A) Van Herick's test

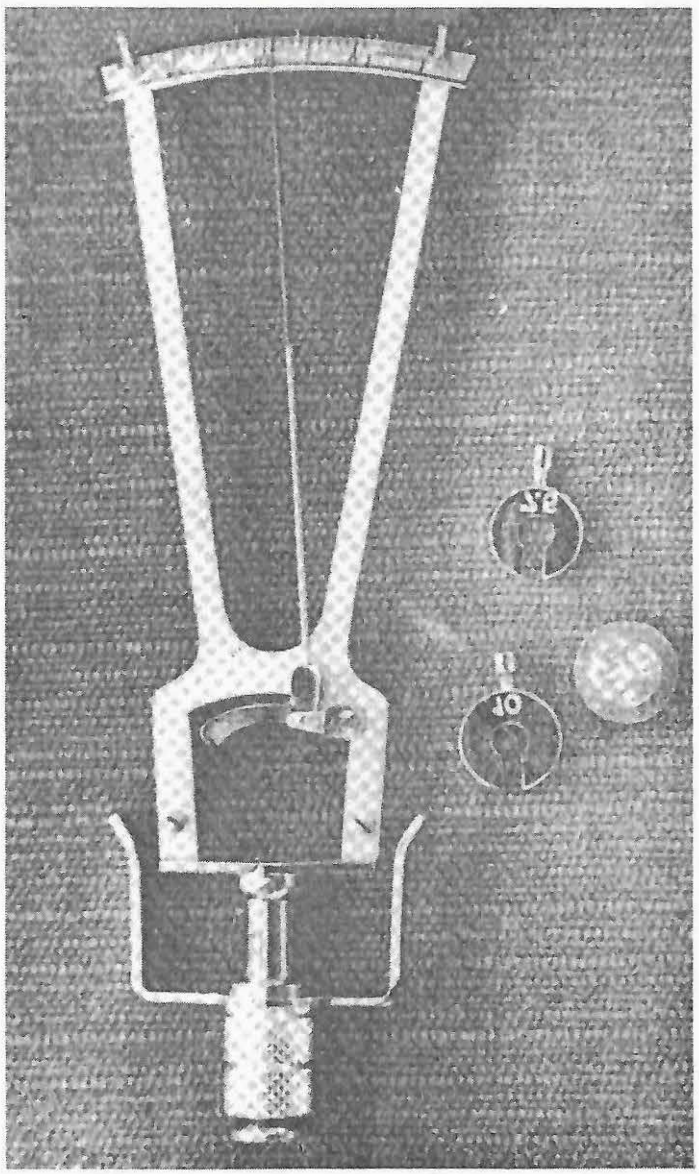
   (B) Note for corneal thickness, oedema, vascularisation, look for any evidence of iridocyclitis either healed or active.

5. Fundus:

   Disc – cup size, neural rim, notch, splinter haemorrhages, pallor nerve fibre layer, peripapillary atrophy, laminar dots, baring of circum linear vessels, over pass phenomenon, any vascular occlusion, macular area, periphery.

   Cup disc ratio

   Cup disc assymetry of more than 0.2.



SCHIOTZ TONOMETER

III. Tonometry

The intraocular pressure in normal eyes as measured with applanation tonometer ranges from 10.0 to 21 (15.5±2.6) mmHg. Clinical measurement of intraocular pressure is performed by instruments namely schiotz tonometer or Goldmann applanation tonometer.

A. Schiotz indentation tonometry:

Schiotz tonometer consists of a concave foot plate attached to a shaft enclosing a freely sliding plunger. The instrument is placed on the anaesthetised cornea of the subject in the supine position looking up at a fixation target. The cornea indented by the punger is measured as the distance from the foot plate curve to the plunger base. This is indicated by a simple lever system which moves a needle on a calibrates scale, indicating a scale reading that is converted to an intraocular pressure measurement. The scale reading should be noted as an average of the excursions of the indicator needle. Usually, the 5.5 gm weight.

Limitations of Schiotz tonometry, If the scale reading is less than 4, readings are repeated with additional weight.

- Ocular rigidity – abnormal scleral rigidity gives wrong IOP.
- Variable expulsion of intraocular blood during schiotz tonometry affects the tonometric reading.
- Abnormal corneal curvature and thickness changes the measurement of IOP.

B. Applanation tonometry:

Goldmann applanation tonometry measures IOP by subjecting the eye to a force that flattens the cornea. It is mounted on the end of a lever that is hinged on the slit-lamp. A biprism, which contects the cornea to creates two semicircles. The edges of corneal contect is made apparent by the instillation of a small amount of fluorescein into the tear film while viewing in a cabalt blue light. By manually rotating the dial calibrated in mm Hg, the force is adjusted by changing the length of a spring within the device. The prisms are calibrated so that the inner margins of the semicircles touch when 3.06 mm of the cornea is applanated.

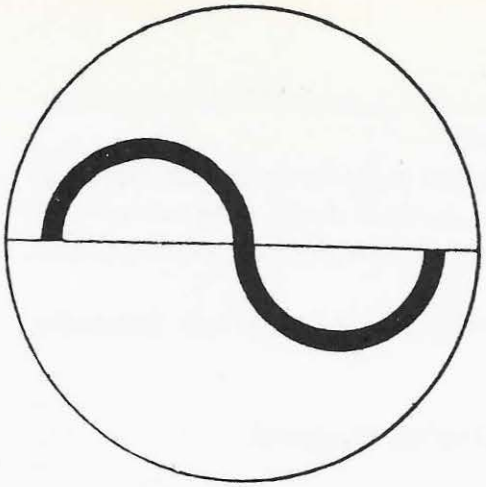


Fig.1 The inner border of upper semi-circle touches the border of lower semi-circle. To increase the pressure more.

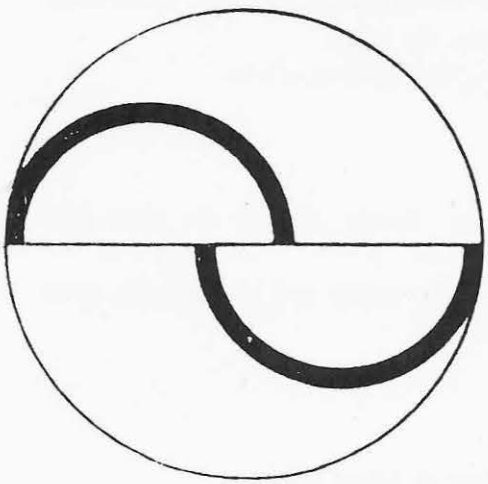


Fig.2 Two borders of the semi-circle have become to far apart because the pressure has been increased too much.

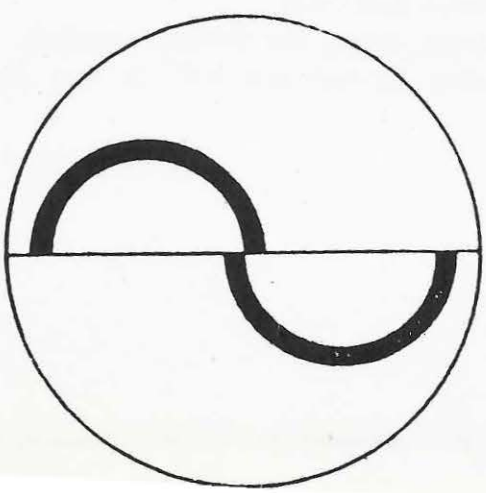


Fig.3 The inner border of the upper semi-circle touches the inner border of lower semi-circle. This is the correct-position to record IOP.

Preparation of the patient:

* Topical anaesthesia both eyes with 1 drop 4% / 2% xylocaine two times at 2 minutes interval.
* Fluorescein paper strip in touched in the lower conjunctival sac. for few seconds to colour the lacrimal fluid. Alternatively 2% fluorescein solution is introduced with a sterile glass rod into the conjunctival sac.
* Patients is asked to put his chin on the chin rest. Excessive fluorescein is wipe off.

Preparation of slit lamp and the applanation tonometer:

* Make sure that the eye-pieces are correctly focussed.
* Bring the blue filter into the beam of slit lamp and open the slit diaphragm completely.
* Angle between illumination and microscope should be 60^{o}.
* Turn the transformer switch on to provide optimum illumination to the prism. The tonometer is inserted in its base into horizontal guide plate on the slit lamp.
* Set the measuring drum at the scale reading of one.

Instruction to the patient:

* Patients head should be placed firmly against the chin and forehead rest.
* Instruct the patient to look straight ahead and to keep his eyes wideopen during examination.

Measurements:

* Before measurements the patient in asked to blink.
* Slit lamp is moved forward and measuring prism is brought into contact in the centre of cornea.
* The flattened area is seen as two semi circles of equal size in the middle of field of view.
* The pressure in the eye is increased by turning the measuring drum on the tonometer until the inner border of the two fluorescein rings just touch each other.
* Now read the measuring drum, the pressure applied. By multiplying this reading by ten the IOP in mm Hg is determined.

Sources of Error:

* Too wide or too narrow fluorescein ring.
* When the too much pressure is applied on the cornea or patient retracts slightly.
* When the semicricles are not in the middle of the field of view.
* When the inner border of fluorescein ring do not touch each other.
* When gross astigmatism (> 3 diopters) is present to measure correct IOP in high astigmatism, measurements are made in a direction 43° to the meridian of the lowest power.

Important: It is emphasised that random tonometry is not always adequate as peaks of IOP vary during 24 hours in a day. A diurnal valuation of IOP should be recorded for diagnostic and therapeutic purposes.

CHECKING THE TONOMETER

Schiotz Tonometer: Before recording IOP Schiotz tonometer should be placed on a test block, provided within the instrument box, to check the zero error. It is a good practice to compare the IOP recordings periodically with Goldmann applanation tonometry recording of IOP. This eliminates the chances of instrumental error. Schiotz tonometer can be sent to tonometer standardisation laboratories for the repair of faulty tonometers.

Goldmann Applanation Tonometer: The standardisation of Goldmann tonometer should be done periodically to check for the instrumental error. It may be done as following.

1a. Checking at zero gram. The measuring drum is brought into zero position. By slightly pushing the pressure arm (with the prism in position) it should move from one stop to the other and remain there.

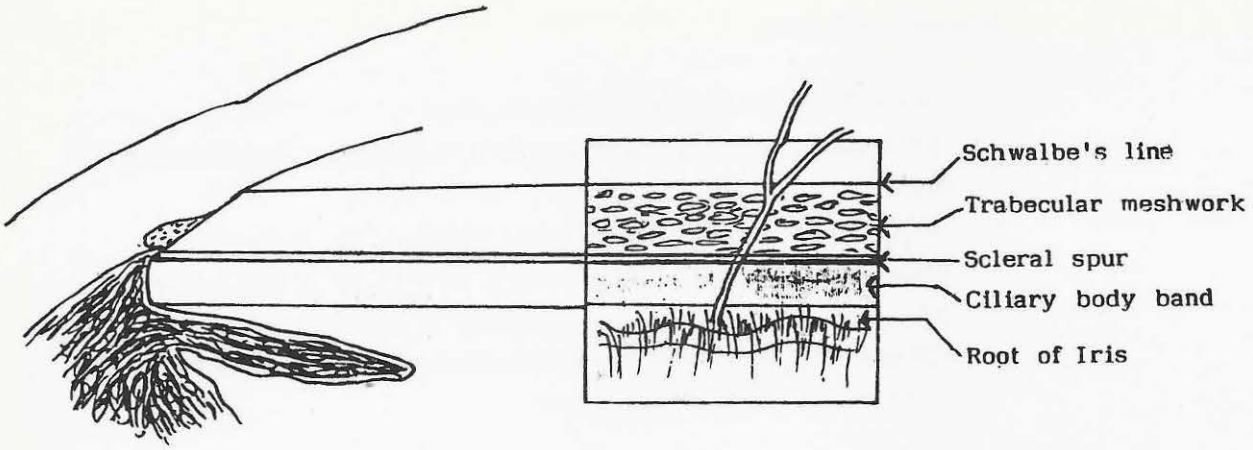
1b. A further check at zero gram should be made as follows.

Set the measuring drum at -0.1 gram. Hold the pressure arm between the 2 stops. On releasing, the arm should move towards the stop on the side of the examiner. The same procedures should be followed at + 0.1 gram when the arm should move towards the patient's side.

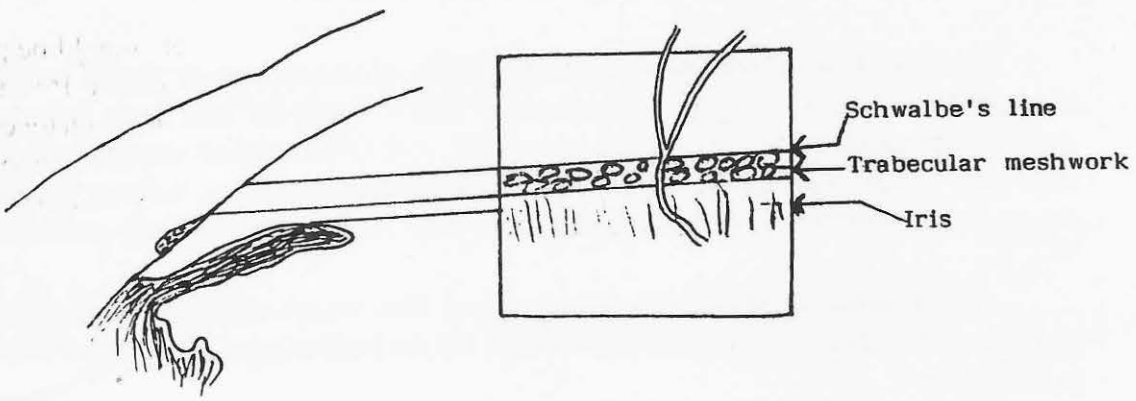
2. For checking at 2 gram the control weight is used. One of the 2 gram marks on the weight is set precisely on the index mark of the holder. Holder and weight are then fitted over the axis of the tonometer so that the longer part of the weight points towards the examiner, figure 14. The pressure arm should move from between the 2 stops at 2.1 gram respectively at 1.9 gram.

3. In the same manner the tonometer should be checked at 6 gram. The corresponding checking points are 5.9 gram and 6.1 gram.

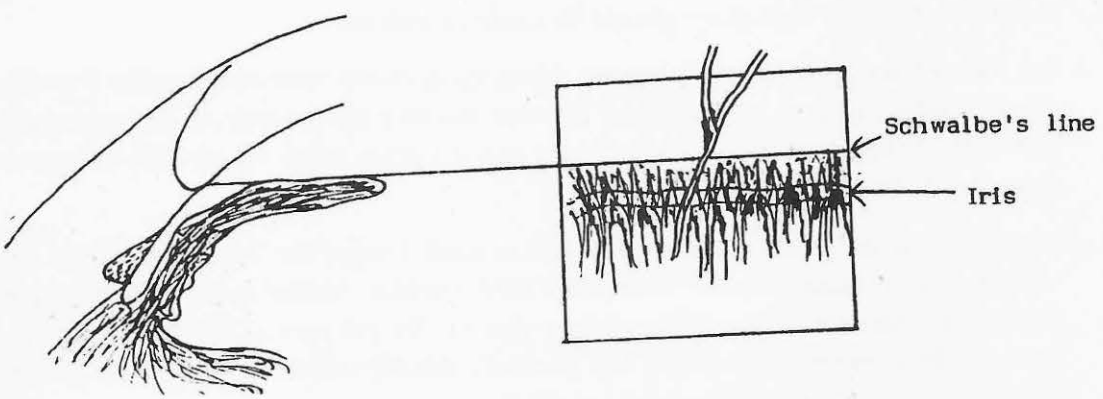
OPEN ANGLE



POTENTIALLY OCCLUDABLE ANGLE



CLOSED ANGLE



IV. GONIOSCOPY

Gonioscopy is very important to distinguish primary OAG from PACG. It also helps to detect the cause of secondary glaucoma. Gonioscopy also helps to plan the surgery. The most commonly used contact lens to visualize the structures of anterior chamber angle is Goldmann single mirror gonioscope in conjunction with a slit lamp. It weights 4.2 g. A mirror forming a 62° angle with the front surface, and a height of 17 mm. The width and shape of the anterior chamber angle are only recognised by means of the narrow slit beam of the slit lamp. As the slit can be turned, rotated and inclined the examination of the shape of whole angle can be done.

Methodolgy:

* Topical anaesthesia can be achieved with 2% xyclocaine one drops instilled in the eyes 2 times at 2 minutes interval. (or one drop of proparacaine)
* Patient is asked to put his head on the chin rest.
* The patient is asked to look up and the examiner draws the lower lid down & away from eye ball. If necessary the upper lid can be lifted by means of the thumb of the other hand.
* The gonioscope, moistended with 2% methyl cellulose, is put on the conjunctiva with the patient now looking straight ahead is slid on the cornea.
* The illumination of anterior chamber angle is achieved by a narrow slit beam through the contact lens mirror.
* When examining the vertical segment of the angle (between II-I 0' clock and 5-7 0' clock) the angle between the illumination arm and microscope is set at 10°
* The horizontal segment of the eye (between 2-4 o' clock and 8-10 o' clock) can be seen with the horizontal slit with angle of inclination in central position.
* For the examination of the upper segments, the mirror of the contact lens is placed below, and for lower segment the mirror is placed above i.e. always on the opposite side.
* Care should be taken not to press the contact lens against the cornea to avoid artifical opening of a closed/narrow angle and disturbing folds in the cornea. For better visualisation of a narrow angle, the patient is asked to look towards the area being examined.

Compression gonioscopy:

By applying pressure to the cornea with the base of gonioscope the aqueous humours in the anterior chamber is displaced into the angle, opening it wider. This technique is important to distinguish oppositional closure from organic closure (with PAS) of the angle. This method is also known as indentation gonioscopy (Forbes 1996).

Manipulative gonioscopy:

While examination the lower quadrant of the angle with Goldmann lens, the patient is requested to loop up, the gonioscopic lens is slided towards the lower quadrant of the angle, then a pressure is exerted with the edge of the gonioscope against the periphery of cornea to force aqueous from upper part to the lower angle. This leads to widening of the angle in the lower part. By rotating the gonio lens 360° circumference of the angle can be seen. This method is used to estimate the extent of peripheral anterior synechiae that could not be seen before manipulation.

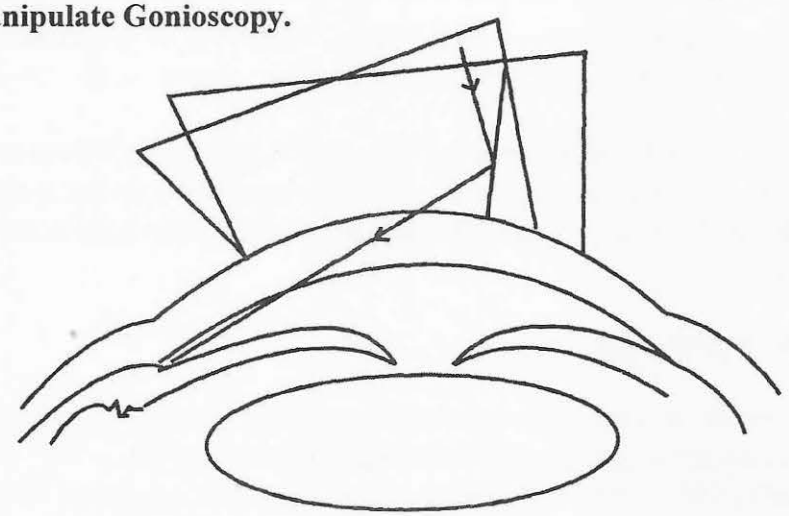
CONTRAINDICATIONS FOR GONIOSCOPY:

* Gonioscopy is contraindicated in presence of fungal, bacterial, viral and other infections of eye unless sterility of the gonioscope is assured for subsequent use

STERILIZATION AND CARE OF THE GOLDMANN APPLANATION PRISM AND GONIOSCOPE AND SCHIOTZ TONOMETER.

As soon as the applanation prism or the gonioscope has been used, it should be thoroughly rinsed in clean water to remove salts, mucous, fluorescein or methyl cellulose. To sterilize the prism/lens wash it mild soap and water, dry with tissue and store in the dry case. Gluteraldehyde (2% solution) 10 minutes exposure will effectively disinfect. Rinse with sterile water and store it in case. Sterilization with ethylene oxide gas, with aeration, temperature not to exceed 120° F has been recommended. Do not boil, autoclave or use alcohol or peroxide on the prism or lens, as this will damage the lens/prism. The use of 1: 1000 merthiolate solution in which the applanation prism is dipped for 10 minutes is also popular as a sterilization method.

B. Gonioscopic mirror moved towards the angle allowing the light to reach the angle Manipulate Gonioscopy.



Similarly Eye can also be moved towards the mirror with similar results

V. PERIMETRY

Visual field examination is very important in detecting glaucoma and following the course of disease. In glaucoma the visual field changes first appear in the central 30 degree field followed by peripheral visual field as an extension of central visual field defect. The characterstic changes are nerve fibre bundle defects. A large number of instruments are available to chart the visual field defect in patients of glaucoma. These instruments are tangent screen, Goldmann perimeter, automated perimeters. Each equipment has advantages and disadvantages. Any of these instruments can be used depending upon the availability.

When properly performed tangent screen technique is capable of eliciting 90% of visual field defects either wholly or in part within 30 degrees of fixation and partly peripheral visual field defect extending inword to within the 30-degree radius. Most of the advocates of tangent screen perimetry have designed their own instruments but most commonly used tangent screen is 2 meters square, fixed on a wall. The screen is marked by stitching to indicate the meridians and degrees from fixation with dull black thread on a soft finish black felt cloth. The meridians are marked at 30-degree intervals and the circles at 5,10,15 and 20 degrees for two meter distance. Two blind spots are indicated on each side of fixation, one for 2 meter distance and other for one meter distance.

- Fixation target varies from 1-100 mm depending on the visual acuity. Adequate illumination of tangent screen should be considered on 7 foot Candles of light on the center and all other areas of screen. This can be achieved with two spot lights directed from above and placed slightly on one side.

Examination with Tangent screen

* Patient is seated at a distance of 2 meters on a chair.
* Patient wears the spectacle with correction for distant vision (Biofocals are not used).
* After carefully explaining the procedure the examination is started for one eye at a time. The other side eye is covered with on ocluder.
* First the blind spot is charted. A 10 mm test object is chosen to be shown in the peripheral field of vision and will completely disappear within the blind spot area as the target is moved towards the center. The target size of 10 mm is chosen to familiarize the patient with the procedure and the isopter (10/2000) passes out the blind spot.
* After the blind spot has been located, it is carefully oulined for any extension. For this purpose a change to a 1,2,3 mm test object is desirable, depending upon central visual acuity and mental alternates of the patient.
* With small stimuli it is possible to detect early nerve fibre bundle scotoma.
* It is important that the test object is moved slowly, steadily, and without vibration towards the fixation target.

* At regular intervals the target should be made to disappear by flipping the wand. If the patients is alert, he will detect this loss of stimulus immediately and will report so. If he does not report the disappearance of the target his attention is called to the fact that stimulus is no longer visible.
* The scotoma is marked with a black pin.
* It is convenient to start field charting by exploring 45 degree meridians and if it is normal then vertical and horizontal meridians are explored.
* If during examination an area of defect is noted, it should be explored for size, shape and density. This is done by moving the test object from the blind to the seeing areas, at right angles to the border of the defect. The density, uniformity, the sharpness of the border can be tested by changing the size of target.
* When the answers of the patient are conflicting and confusing it is possible that either two small target has been chosen or he is fatigued. The test should be suspended or postponed.
* Although it is possible for a trained technician to carryout visual field charting but it is preferably done by an ophthalmologist who can assess the patients attitude, responses and reproducibility of the findings during visual field assessment.

AUTOMATED PERIMETRY

In recent years manual perimetry has been replaced by computerised automated perimetry because of its several advantages such as uniformity of procedure, comparability of results, standardization of test conditions, efficiency and optimization of the examination, increased reproductibility and improvement in display and storage of results.

The most commonly used autometed perimeters are Octopus and Humphrey perimeters. These perimeter differ in their design but the performance is equally good. The exact technique of perimetry is beyond the scope of this manual. The interpretation of test results involves consideration of patient data, test conditions, determination of reliability parameters, interpretation of grey scale print out, total deviation plot, pattern deviation plot, global indices and glaucoma hemifield test. For the analysis of successive visual fields, particularly for patients on long term medical therapy, analysis of over view print out, box plat histogram, regression analysis gives an idea of progression of visual field defect or a stable visual field. The readers are advised to consult a book on automated perimetry to acquire detailed knowledge of automated perimetry.

VI. PROVOCATIVE TESTS

The provocative tests are generally carried out in individuals in whom the diagnosis of glaucoma is doubted on history and or clinical examination.

A. TESTS FOR PRIMARY OPEN-ANGLE GLAUCOMA

1. Water Drinking Test (WDT):

* Patient is kept fasting for 8 hours (preferably over night).
* Baseline IOP is recorded just before WDT .
* Patient is asked to drink one litre (15-20 ml/kg body weight) of water in about 4 -5 minutes.
* IOP is measured at every 15 minutes interval until it stops further rising.
* An increase of more than 8 mm Hg indicates glaucoma, an increase of 6-8 mm Hg is suspicious of glaucoma while in increase of <6 mm Hg is normal.
* It is advisable to run a diurnal variation of IOP and the WDT is done 1/2 hour before the maximum level of IOP on diurnal curve. The test should be performed by the same person with the same instrument.

B. TESTS FOR PRIMARY ANGLE CLOSURE GLAUCOMA:

Before the test is performed tonometry and gonioscopy is necessary. A large number of tests have been described but the most commonly performed tests are as under.

1. Dark room-prone provocative test:

The patient is requested to lie prone for one hour in a dark room (without going to sleep) after taking the initial IOP and gonioscopy. At the end of one hour the IOP recorded again in dim light. A rise of over 10 mm Hg is considered as positive. A rise of 8-10 mm Hg is a suspect and less than 8 mm Hg is normal. The repeat gonioscopy at the end of the test in dim light shows further narrowing of angle in a positive test.

2. Mydriatic Test:

The mydriatic test consists of dilating the pupil, preferably one eye at a time, so that the peripheral bunching of iris crowds the angle of anterior chamber leading to elevation of IOP by impairing the outflow of aqueous humour from anterior chamber into the trabecular meshwork.

Methodology:

* IOP is measured before instillation of mydriatic.
* Pupil is dilated with 2% Homatropine drops instillation in the conjunctival sac. of the eye to be tested.

* IOP is measured at every 15 minutes for two hours or earlier if a positive test is achieved.
* IOP rise by 10 mm Hg during pupillary dilation indicates positive test.
* At the end of the test the pupil is constricted with a miotic drops (2% pilocarpone or 0.25% escerine drops).
* Gonioscopy before and after the positive test indicates narrowing of anterior chamber angle. It also eliminates a false positive test.

Caution :

At the end of the test the pupil must be constricted before the patient is sent back home because sometimes an acute attack of angle-closure glaucoma is precipitated during constriction of pupil when the effect of mydriatic passes away after few hours. The chances of acute attack of glaucoma is maximum in mid-dilated position of pupil. At this point of time the arc of contect of iris with the lens is maximum with relative pupillary block.

CLINICAL FORMS OF GLAUCOMA

Primary Open angle Glaucoma: It is defined as chronic optic neuropathy characterised by elevated intraocular pressure and glaucomatous optic disc cupping with or without visual field defect.

Ocular Hypertension: Ocular hypertension is defined as a condition characterised by intraocular pressure more than 21 mm Hg on two consecutive occasions without disc changes and visual field defect (and wide open angle).

Normal Tension Glaucoma / Low Tension Glaucoma: It is characterised by glaucomatous optic disc cupping and visual field changes with intraocular pressure less than 21 mm Hg.

Primary Angle Closure Glaucoma: It is defined as a condition characterised by history of coloured haloes and circumcorneal congestion in which the angle of anterior chamber may be closed either functionally or with peripheral anterior Syniechae.

GLAUCOMA SCREENING

I. Population For Glaucoma Screening :

Glaucoma screening should be done in all subjects having any one or more of the following risk factors associated with glaucoma.

A. Systemic Risk Factor:

* Age more than 40 years.
* Family history of glaucoma.
* Diabetes mellitus.
* Thyroid dysfunction.

B. Ocular Risk Factor:

* Myopia
* Hypermetropia with shallow anterior chamber.
* Central venous occlusion.
* Pseudoexfoliation / true exfoliation.
* Longterm corticosteroid therapy.

II. Parameters For Glaucoma Screening :

* Flash light test for peripheral anterior chamber depth.
* Fundus examination with direct ophthalmoscope.
* Tonometry.
* Gonioscopy.

III. Management of Glaucoma Suspects:

All glaucoma suspects detected by screening programme should be subjected to a detailed history taking, clinical examination, provocative tests and visual field examination.

LIST OF EQUIPMENT TO BE PROVIDED AT DISTRICT LEVEL

S.No.	Name of Equipment	Cost
1.	Slitlamp (with provision for attachment of a Goldmann applanation tonometer)	35,000/-
2.	Gonioscope (Goldmann Single Mirror)	12,000/-
3.	Goldmann applanation tonometer	35,000/-
4.	Schiotz tonometer	2,000/-
5.	Bjerrums screen	2,000/-
6.	Surgical Instruments	10,000/-
7.	YAG Laser	10,00,000/-
8.	Automated Perimeter	4,50,000/-
9.	Hand held Perkins tonometer	25,000/-

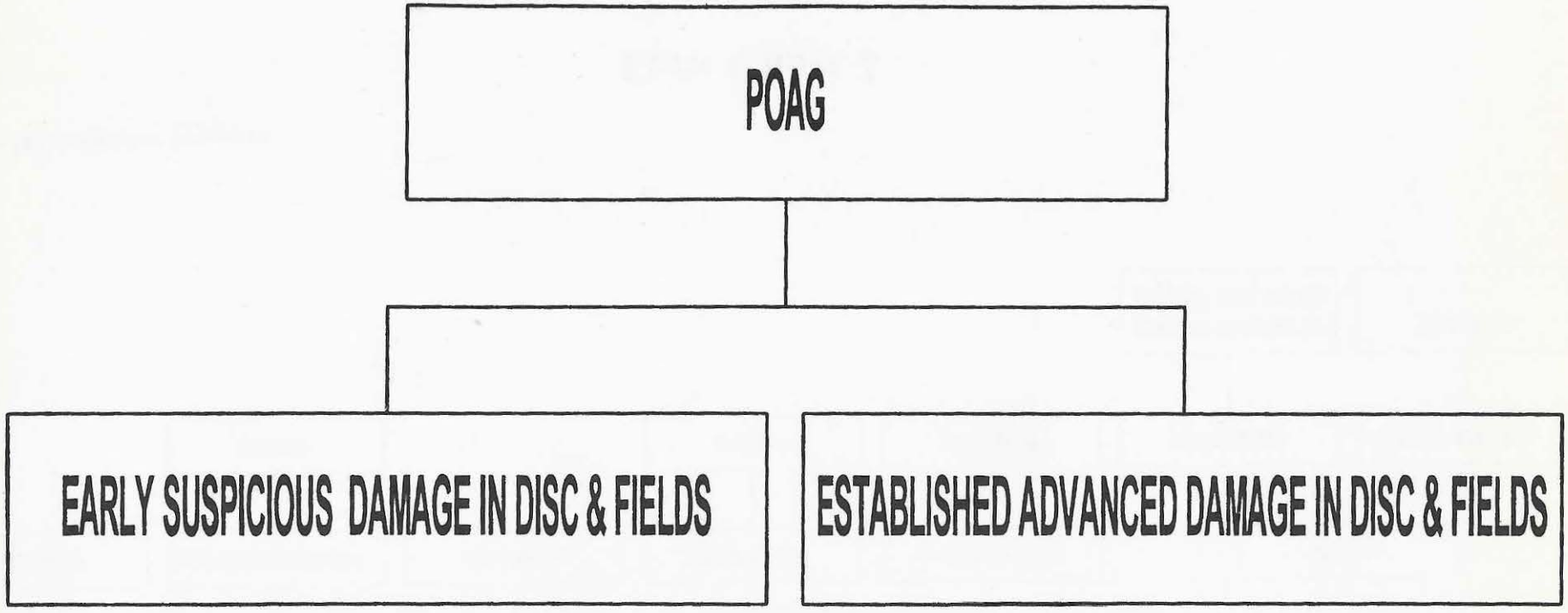
VII. MEDICAL TREATMENT

Principles of medical therapy in chronic open-angle glaucoma

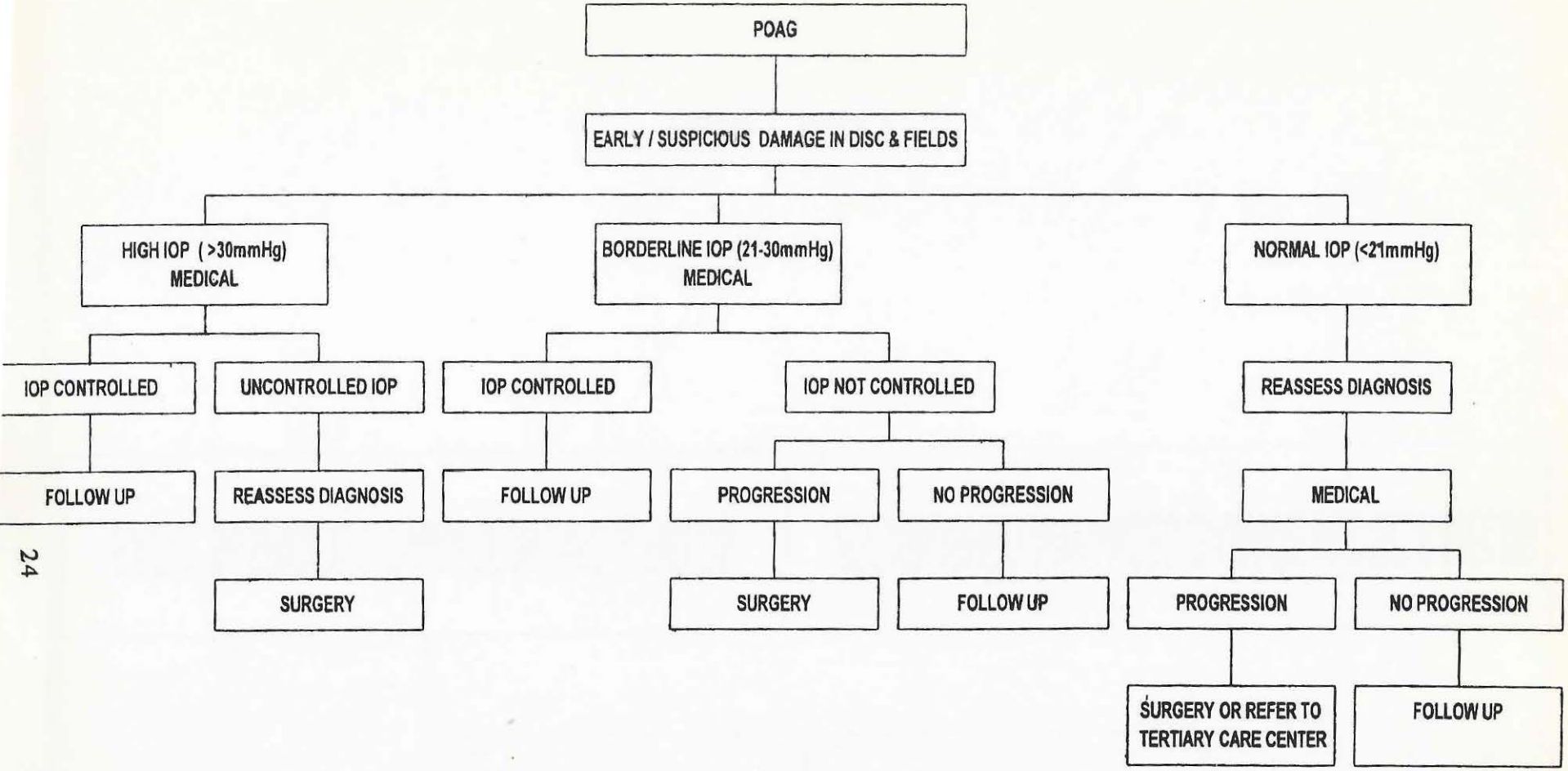
- Glaucoma may be defined as an optic neuropathy characterized by specific findings of optic nerve head & visual field damage caused by a number of different diseases. Chronic OAG is a diagnosis of exclusion.
- Raised IOP is the most important risk factor for the development of glaucomatous damage, but is still a risk factor & not a disease per se.
- The goal of therapy is to prevent functional visual loss for the remainder of patient's life time.
- This goal should preferably be achieved with minimal number and strength of medications necessary .

INDICATIONS OF TREATMENT

- Evidence of visual field defects.
- IOP of more than 30 mm Hg.
- Ophthalmoscopic evidence of optic nerve damage.
- High IOP with difficulty in assessment of disc damage as in high myopes, eyes with small or anamolous discs & eye with large physiological cup.
- As a general rule, the greater the existing damage to optic nerve head & visual field, the lower the IOP should be to prevent further visual loss.
- Patients with advanced field defect require a more aggressive approach in achieving low IOP.
- Ideally, initial treatment should be started in one eye only so that fellow eye can act as a control.
- The first drug chosen (usually B blockers) should be used at its lowest concentration & as infrequently as possible.
- While starting any medication keep following in mind:-
- For cardiac patients and with pulmonary problems. Avoid B blockers, if necessary give betoxolol. (Selective & Blocker)
- Avoid pilocarpine (a) in young patients where it induces spasm of accomodation and myopia. (b) in patients with central opacities of cornea, lens (posterior subcapsular cataract). (c) Eye with inflammation. (d) Spherophakia (may induce acute block). (e) Malignant glaucoma.
- Avoid Alpha 2 agonists :
  (a) Those with recent ocular surgery.
  (b) Those with pre existent inflammation.
- Avoid Epinephrine & Dipivefrin.
  —In hypertensive
  —Those with cardiac problems.

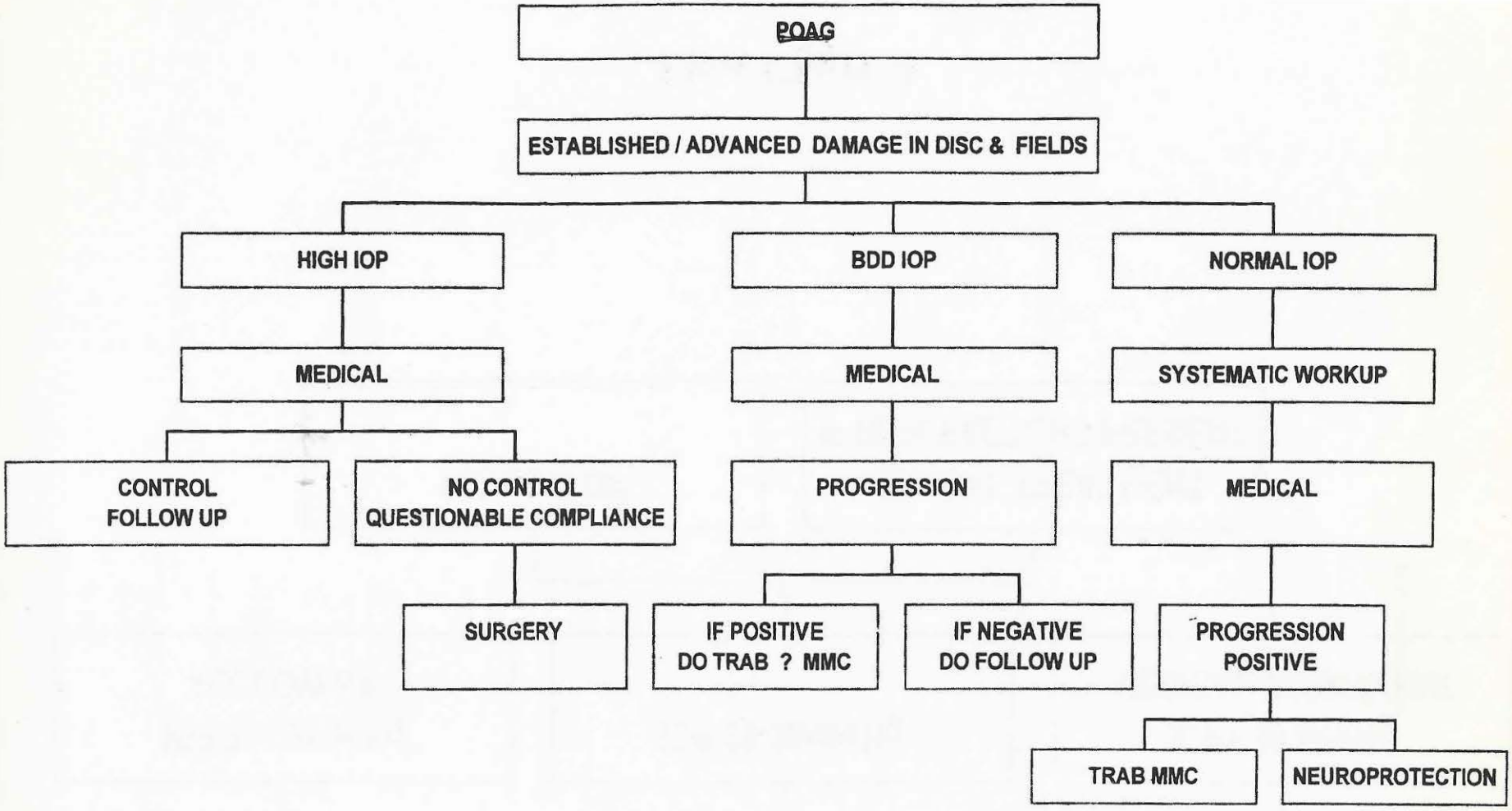

POAG
EARLY SUSPICIOUS DAMAGE IN DISC & FIELDS
ESTABLISHED ADVANCED DAMAGE IN DISC & FIELDS

Flow Chart 1



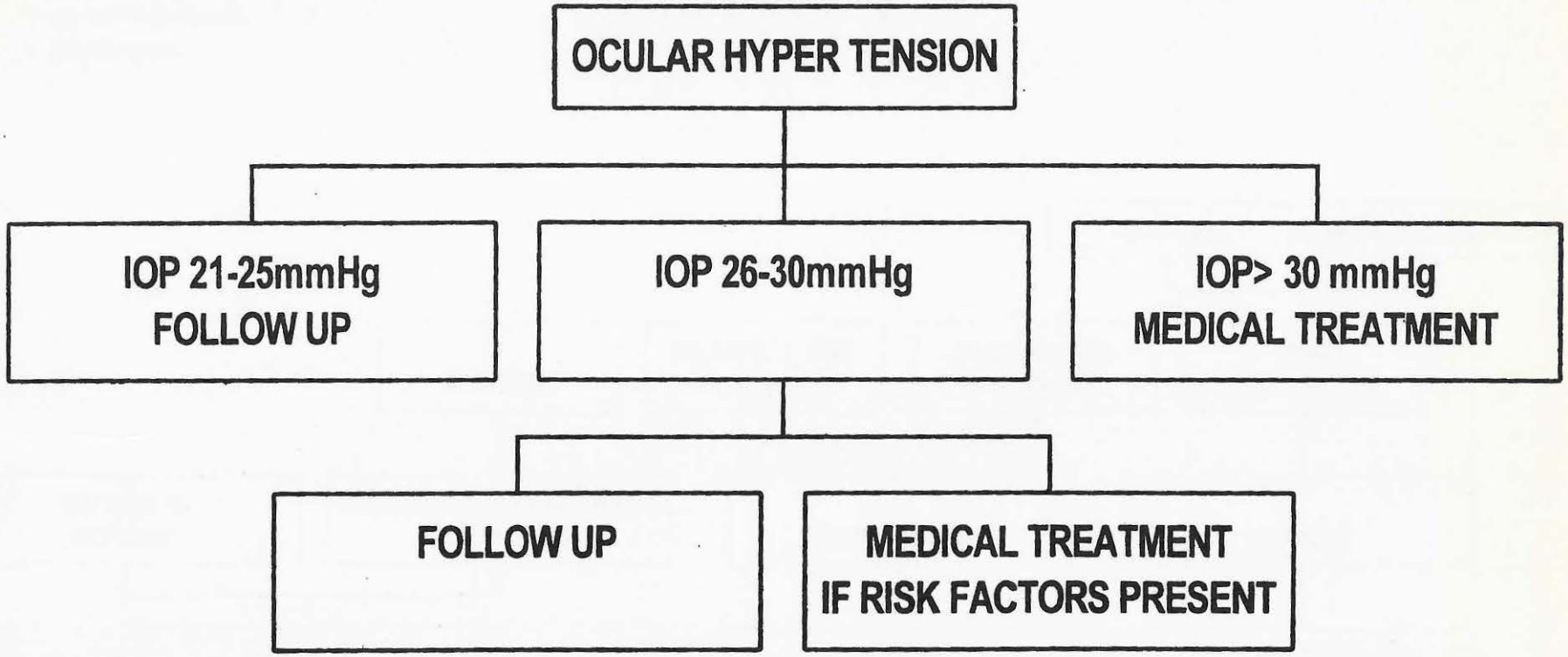
IOP – Intra Ocular Pressure

Flow Chart 2



BDD - Borderline
Trab - Trabeculectomy
MMC - Mitomycin application during surgery

Flow Chart 3


OCULAR HYPER TENSION
IOP 21-25mmHg
FOLLOW UP
IOP 26-30mmHg
IOP> 30 mmHg
MEDICAL TREATMENT
FOLLOW UP
MEDICAL TREATMENT
IF RISK FACTORS PRESENT

Flow Chart 4

Try to start treatment with drug like Timolol and Pilocarpine to begin with. Use Brimonidine (Alphagan) only if above problem precludes the use of these two drugs. Use latanoprost in low tension glaucomas. It decreases the IOP by increasing uveo scleral outflow. The only limiting factor in its being a first line drug is its high price.

* First follow-up is done after 2 weeks & patient assessed for the drug response & any side effect. A fall of > 3 mm Hg of pressure is considered siginficant. The treatment for the fellow eye can be started at that time.

* The subsequent follow-up are done after 1month & there after 4 months interval.

* The long standing stability of visual field & optic nerve head appearance determines the safe level of IOP.

* When the control is good and the appearance of optic disc stable, twice yearly perimetery is recommended.

* If IOP is not controlled satisfactorily or field loss is progressive any of the following option can be tried :-

a. Increasing strength of the drug or increasing its frequency.
b. Withdrawing intial drug and substituting with another.
c. Adding another drug – Adrenergic agonist like dipivefrin is added to a B-Blocker if a small additional pressure reduction is requried; miotics are preferred if a large reduction in IOP is warranted.

* Argon laser trabeculoplasty - a method of loweing IOP by application of discrete laser burns to trabeculum is indicated when:-

  - IOP is not controlled despite maximal tolerated therapy.
  - Patient with poor compliance or intolerable side effects.

* Filtration surgery i.e. trabeculectomy is done in medically unresponsive cases or in patients with poor compliance, intolerable side effects and advanced glaucomatous damage.

* Cyclodestructive procedure i.e.cyclocryo/ photoocoagulation are generally used as a last resort after other surgical measures have failed.

- Nasolacrimal duct occlusion or gentle closure of the eye lids should be done after each drop instillation.
- A gap of five or more minutes is recommended when using multiple drug therapy.

The detailed flow chart for understanding primary open angle glaucoma (POAG) is depicted in Flow Charts (FL 1 to 3.) Similar strategy for managing ocular hypertension is depicted in F.L.4.

Classification of antiglaucoma drugs.

	Drug	Concentration eye drops	Dose regimen / day
A.	**Adrenergic Antagonists. (B Blockers)**		
	(Non Selective)		
	* Timolol	025.0.5%	BDS
	* Levobunolol	0.5%	-do-
	(Selective)		
	* Betoxolol	0.5%	-do-
B.	**Adrenergic Agonists**		
	Non-selective Alpha & B agonists		
	* Epinepherine	0.25-2%	BDS
	* Dipivefrin	0.1%	-do-
C.	**Cholinergics**		
	* Pil ocarpine	2 to 4%	TOS or QID
D.	**Prostaglandin analogues**		
	* Latanoprost	0.005%	OD
E.	**Carbonic Ahydrase Inhibitors**		
	* Acetazolamide (oral)	250mg tab	2-4 times / day
	* Dorzolamide (Topical)	2%	TDS
F.	**Hyperosmotic agents- oral**		
	* Glycerol	1 to 1.5 grn/kg	
	* I so sorbide	-do-	
	Intravenous		
	* Mannitol	1 to 1.5 grn/kg (20% solution)	
G.	**Ca++ Channel Blockers**		
	* oral Nifedipine		
	* Verapamil		
	* Nicardipine		

Mechanism of Action

A. B Adrenergic Antagonists (e.g. Timolol / Levobunolol)

- Reduced aqueous production (B_1 & B_2 antagonist)

Betoxolol
B_1 selective - has lesser pulmonary side effects.

B. Adrenergic Agonists

(a) Epinephrine / Dipivefrin

- increases aqueous outflow

(a) Alpha 2 Agonist (Apraclonidine / Brimonidine)

- Primarily by decreasing Aqueous production.

C.

- **Cholinergic drug** (Pilocarpine)
- Increased facility of outflow
- moisis - Breaks pupillary block

D. Prostaglandin Analogues (latanoprost)

- increasing uveoscleral outflow

E. Carbonic anhydrase Inhibitors

- decreases aqueous production.

F. Hyperosmotic agents

- Reduces vitreous volume
- Additional IOP lowering through Central nervous system.
- Mediated by hypothalmus optic nerve-axis

Major side effects of antiglaucoma drugs

1. B-Blockers

Local - Blurred Vision

- Red eye
- SPK
- Dry eye
- Corneal anaesthesia
- Uveitis etc

Systemic * Pulmonary - Broncho spasm
- Dyspnoea.

Cardiac => Brady cardia
Hypotension
Arrhythmias

* CNS => Amnesia
Depression
Confusion
Headache

* GIT => Diarrhoea
Nausea

* Dermatologic => Alopecia
Nail pigmentation
Urticaria

* Metabolic => Delayed recovery from hypoglycemia
↑ Triglycerides
↓ HDL

* Genitourinary => ↓ Libido
Impotence

2. Cholinergics

Ocular * Miosis -Impairment of night vision
- ↓ vision in axial lens opacities
- Generalised Constriction of fields
- Spasm of Accommodation, Headache, Browache, Induced myopia

* Redness, watering
* Retinal detachment

Systemic = * Abdominal pain / diarrhoea
* Breathlessness

- Marked salivation & perspiration

3(a) Adrenergic Agonists

local side effects

- Stinging
- Rebound Conjuctival Injection
- Allergic pupillary conjunctivitis
- NLD obstruction
- Pigmented Conjuctival Deposits
- Mydriasis
- CME

Systemic

- Palpitation / Myocardial infraction
- Nervousness
- Faintness
- Tremors
- Skin Blanching

Dipivefrin causes fewer local & systemic side effects & thus can be prescribed in patients intolerant of adrenaline.

3(b) Brimonidine

Side effects:

Local

- FB sensation/itching
- Redness of the eye
- Blurring of vision
- Increased width of palpeberal aperture
- Conjunctival congestion
- Papillae
- SPK

Systemic

- Dryness of the mouth
- Drowsiness

3. Prostaglandin analogue

Local

- burning & stinging
- Foreign Body sensation
- Conjuctival hyperemia
- Blurred vision
- Iridial pigmentation
- Hypertrichosis

- Hyperpigmentation of eye lashes & adjacent face

Systemic - Headache
- Facial rash
- Musculoskeletal pain
- G.I disturbances

4. **Carbonic anhydrase Inhibitors**
systemic
- Metallic taste
- Tingling sensation
- Malaise symptom Complex
- GI symptoms – diarrhoea, abdominal Cramps & nausea
- ↑ urinary stones
- Stevens - Johnson syndrome
- Bone Marrow suppression

Topical CAI

- Burning & Stinging
- Allergic Conjuctivitis
- SPK
- Corneal decompensation

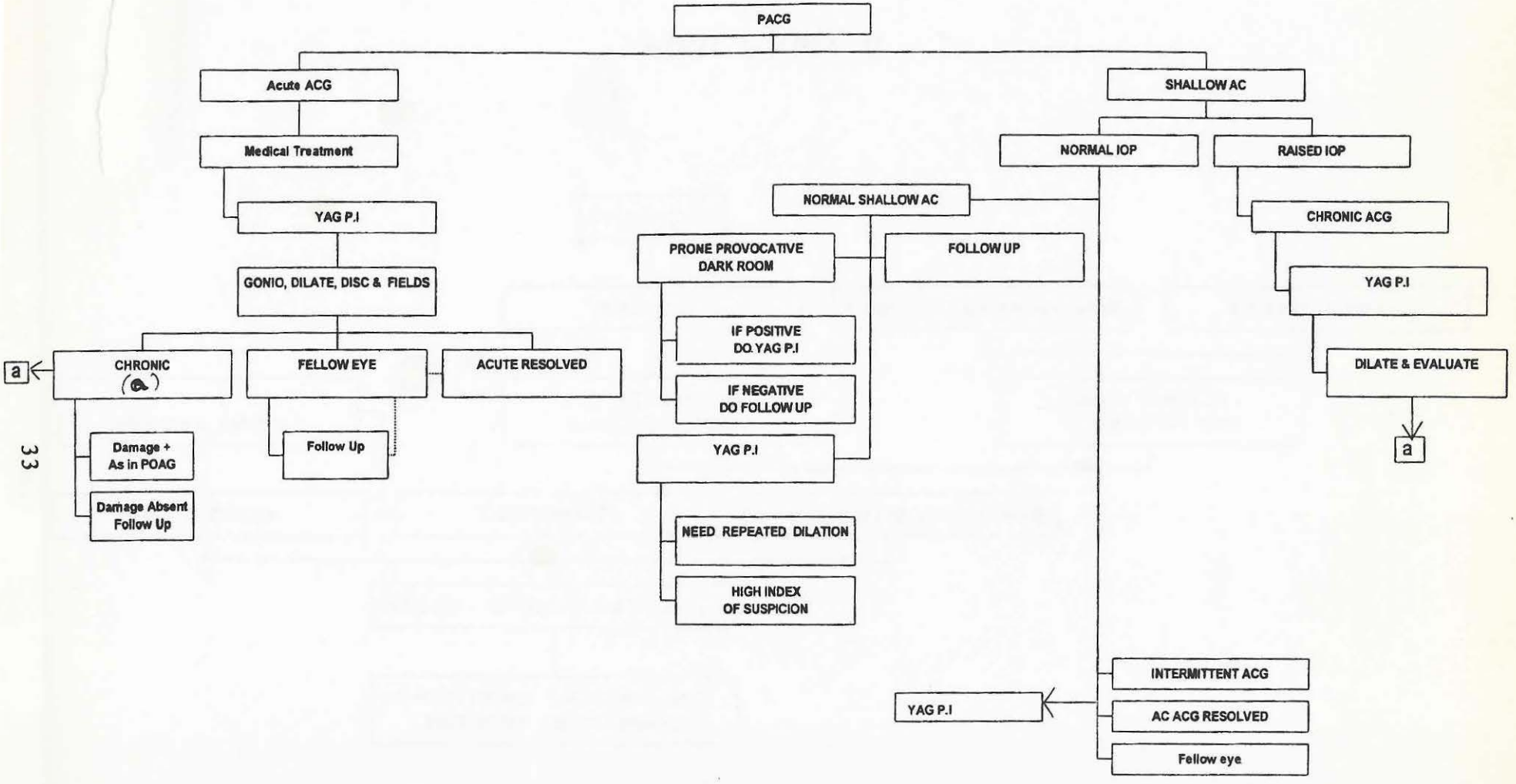
5. **Hyperosmotic agents**

- Nausea
- Vomiting
- Dehydration
- Thrombophlebitis
- Cardiac over load
- Hyperglycemia– (glycerol)
- Lethargy
- Seizeure
- Coma

Patient should be carefully assessed for hepatic, renal & cardiac disease.

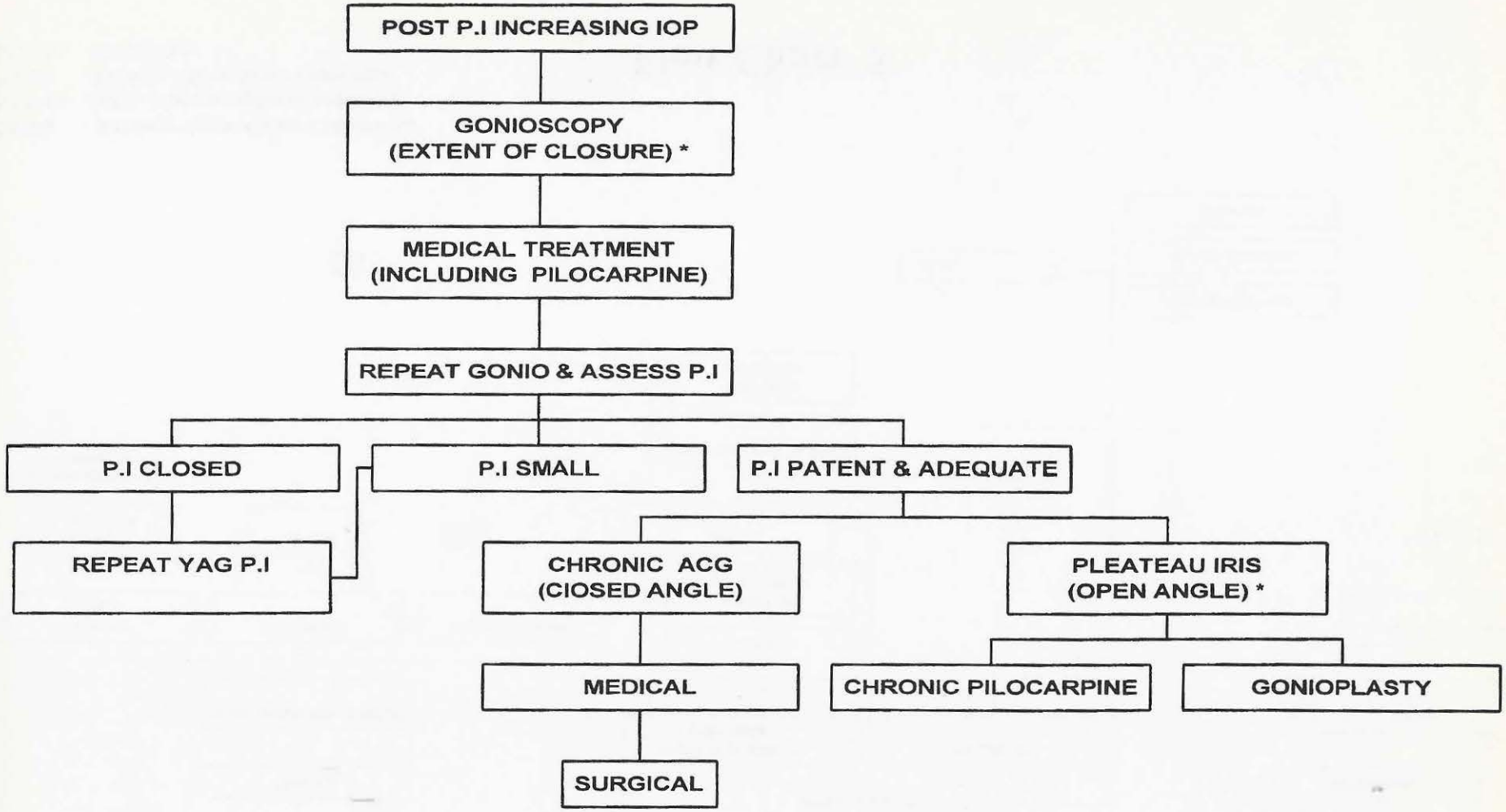
Principles of Management of Angle closure glaucoma (ACG)
The goals of treatment in ACG are :

1. To eliminate pupillary block and other causes of angle closure.
2. To re-open the filtration angle



PAGG - Primary Angle Closure Glaucoma
YAG PI - YAG Laser peripheral iridotomy
POAG - Primary Open Angle Glaucoma
GONIO - Gonioscopy

Flow Chart 5


POST P.I INCREASING IOP
GONIOSCOPY
(EXTENT OF CLOSURE) *
MEDICAL TREATMENT
(INCLUDING PILOCARPINE)
REPEAT GONIO & ASSESS P.I
P.I CLOSED
P.I SMALL
P.I PATENT & ADEQUATE
REPEAT YAG P.I
CHRONIC ACG
(CIOSED ANGLE)
PLEATEAU IRIS
(OPEN ANGLE) *
MEDICAL
CHRONIC PILOCARPINE
GONIOPLASTY
SURGICAL

Flow Chart 6

3. To prevent further damage to the optic nerve by loweing IOP.

- Iridotomy / Iridectomy is the defenitive Rx.
- Medical Rx is however necessary before Iridotomy to lower IOP and after Iridotomy if necessary to control it.
- Filteration surgery is necessary if these measures are insufficient

Mx of Acute ACG : (Refer to Flow chart 5 & 6)

Acute ACG is a medical emergency and should be managed aggresively.

The Rx is aimed at reducing IOP rapidly and opening the angle.

* A careful history of symptom relative to intermittant angle closure attacks in the fellow-eye and type of activity preceeding the attack should be taken.

* Examination of the affected and fellow eye with attention to central and peripheral A/C depth and shape of the iris is noted.

* Indentation of the central part of the cornea with zeiss gonioscopic lens, cotton tip and muscle hook may open the angle temporarily there by decreasing the IOP.

* Shining bright light of opthalmoscope may cause enough miosis to abort an acute attack.

* Systemic Acetazolamide is the first line of Rx.

* I/V administration is useful when patient is having nausea and vomiting.

* Oral isosorbide or hyperosmotic agents may also be given.

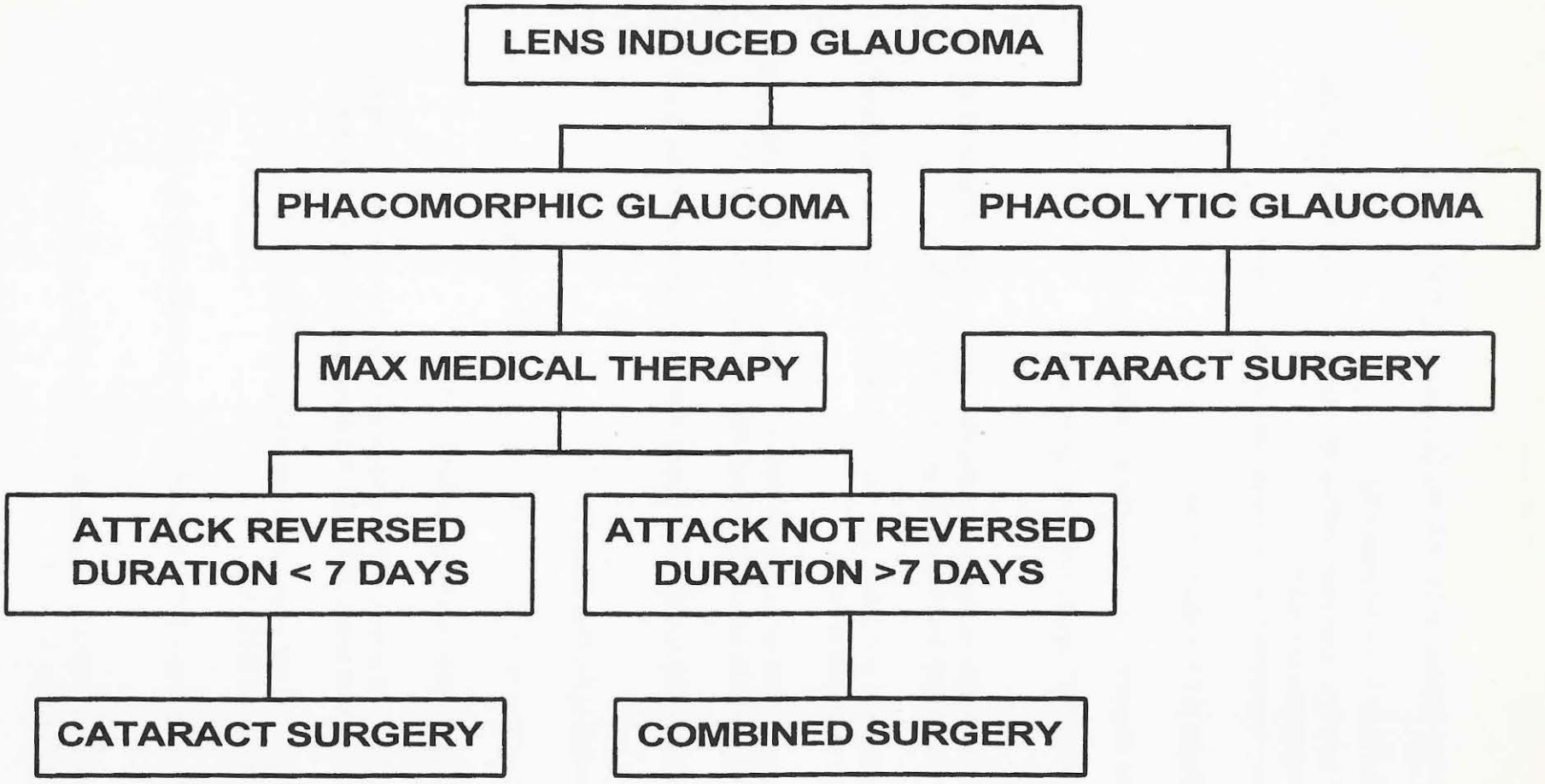
* B-blockers have an additive action with Acetazolamide but have more prolonged action. They have role in later stages of Rx and in maintaining IOP before iridotomy.

* Miotics like pilocarpine are not useful when the IOP is > 60 mm of Hg because of ischaemia & paralysis of iris sphincter.

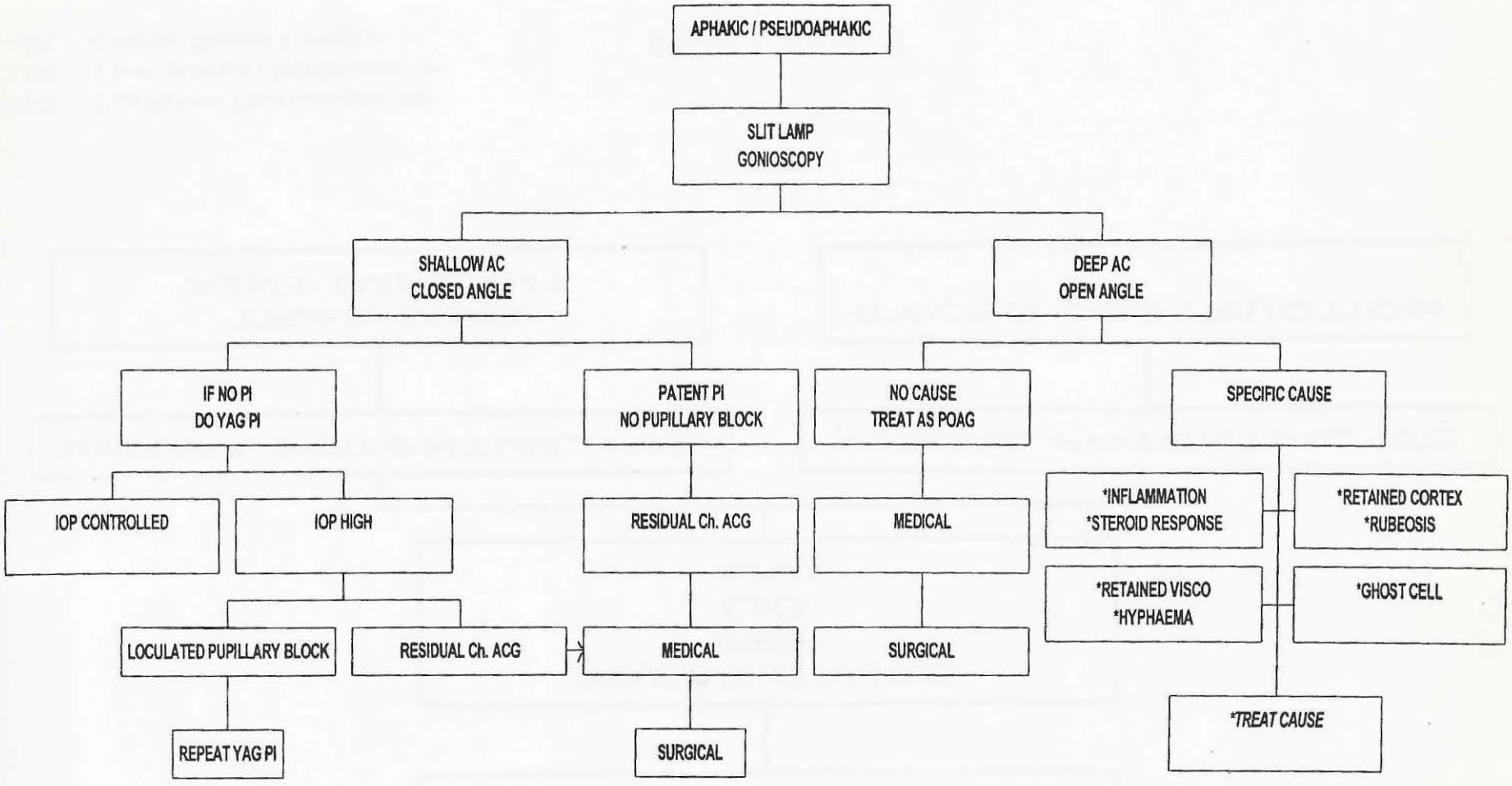
- Pilocarpine topically started once IOP is reduced i.e. 30-40 minutes after the systemic treatment.

* Presently we favour use of 2% Pilocarpine initilled twice 15 minute apart and 4 times a day after IOP reduced below 30 mm Hg.

* The Patient should lie supine to permit the lens to fall backwards.

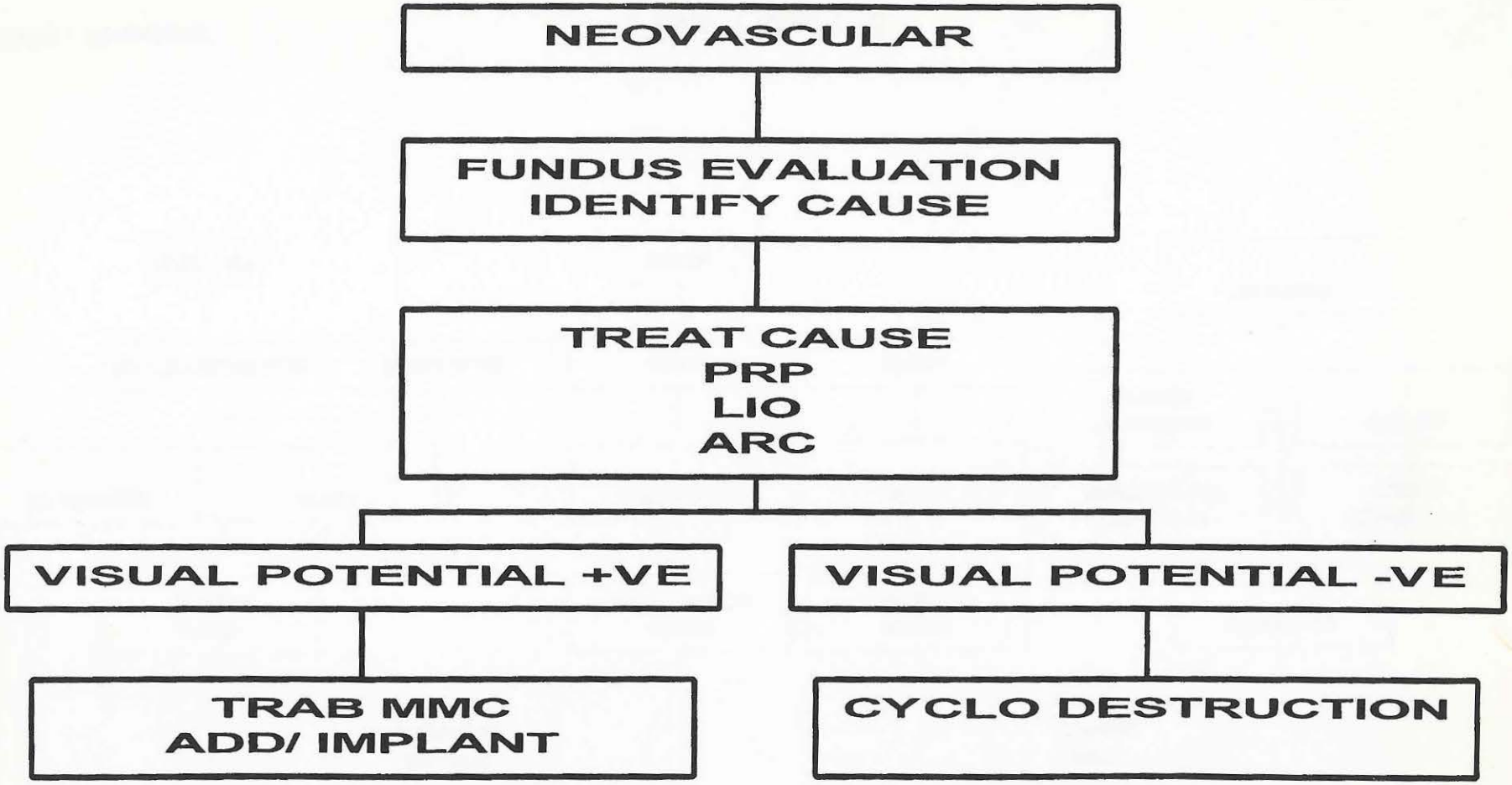

LENS INDUCED GLAUCOMA
PHACOMORPHIC GLAUCOMA
PHACOLYTIC GLAUCOMA
MAX MEDICAL THERAPY
CATARACT SURGERY
ATTACK REVERSED
DURATION < 7 DAYS
ATTACK NOT REVERSED
DURATION >7 DAYS
CATARACT SURGERY
COMBINED SURGERY

Flow Chart 7



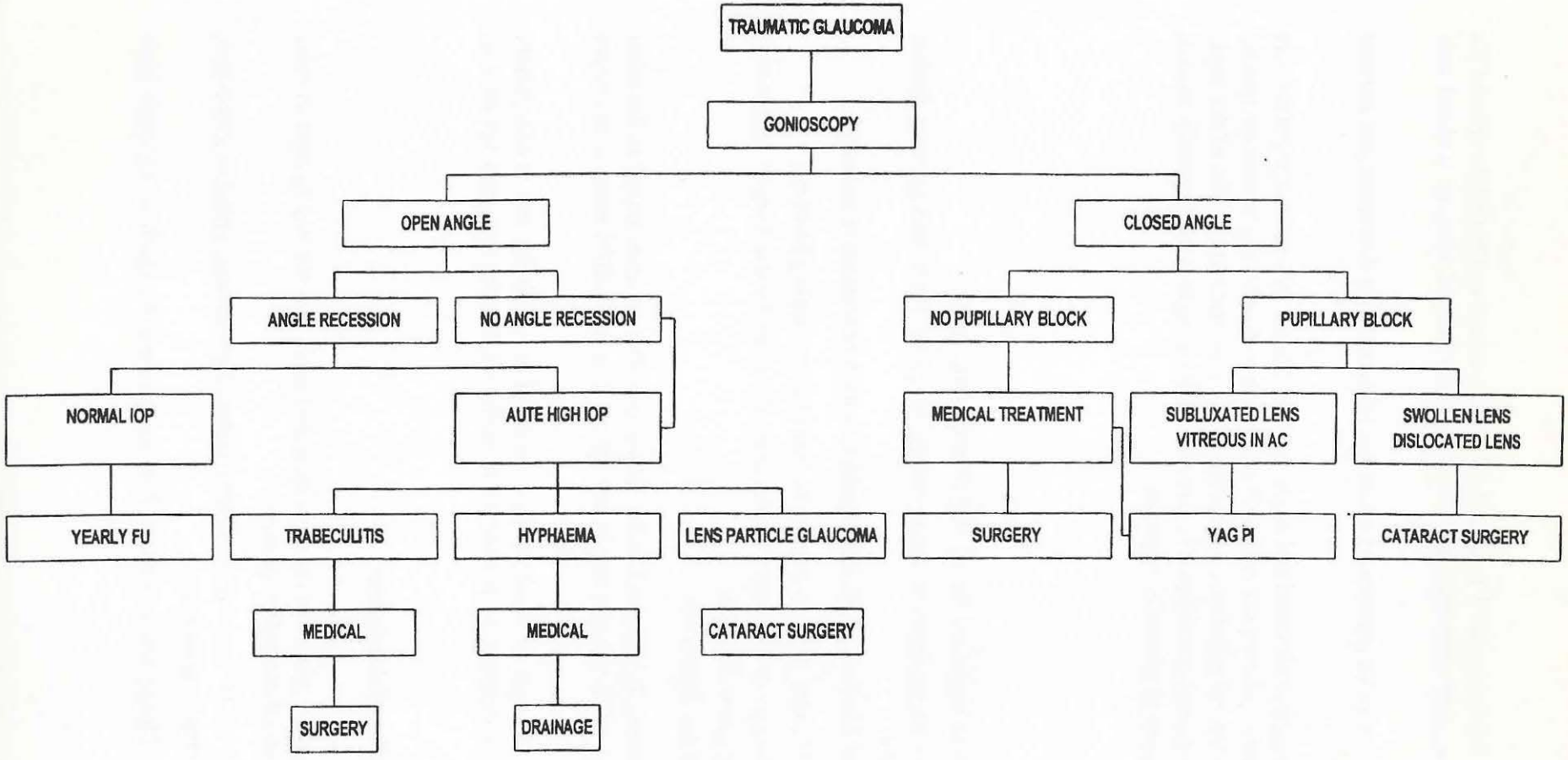
VISCO : Viscoelastic

Flow Chart 8



PRP - Pan Retinal Photocoagulation
LIO - Laser Indirect Ophthalmoscope
ARC - Anterior Retinal Cryopexy

Flow Chart 9



FU – Follow up

Flow Chart 10

* Reasses ocular findings after 1 hour and if IOP is reduced and the angle opened Rx the patient medically with topical pilocarpine and steroid with or without oral acetazolamide.
* Laser iridotomy may be performed when the inflammation decreases and corneal edema subsides.
* If IOP is unchanged or elevated and angle remains closed lens related angle closure is suspected, further pilocarpine with held and attack broken by argon laser peripheral iridoplasty. Peripheral iridotomy is sucessful only if no more than 50% of the angle is closed by peripheral synechiae. If more than 180' of angle is permanently closed, a filtration Surgery is generally required.

Chronic ACG

* Laser iridotomy is indicated for all stages of chronic ACG.
* Iridotomy opens those areas of angle not involved by PAS. and prevent further synechial closure.
* If Iridotomy and Medical Rx is inadequate filtration procedure is indicated.
* Medical Rx of chronic ACG is similar to that of open angle glaucoma.
* Repeated gonioscopy is necessary for deciding the need for the Surgery depending upon the gonioscopic changes.
* Management of the fellow eye.

A prophylactic Iridectomy is indicated in the fellow eye after an acute attack in the other eye as the chances of ACG developing in the fellow eye is 70-80% even with proper medical treatment.

Absolute PACG is end stage of acute congestive ACG in which the eye is completely blind and usually cyclodestructive procedure is indicated to alleviate pain because of raised IOP.

Treatment of Secondary Glaucomas

Management of secondary glaucoma is a complicated topic and we would deal in brief with the common types of secondary glaucoma.

The flow charts 7,8,9 & 10 deal with the lens induced glaucoma, aphakic glaucoma, Neovascular and Traumatic glaucoma.

Malignant glaucoma: Please see section on Post operative care, shallow AC with high tension.

VIIIa. INSTRUMENTATION & MICROSURGERY

Microscopes

Have revolutionized the surgical proceedings of glaucoma including its investigative modalities.

Advantage of microscope are:

- Precision Surgery.
- Minimal tissue trauma.
- Fewer surgical complications.
- Better surgical results.
- Greater professional satisfaction.

Places where microscope are invaluable in glaucoma surgery are:

- Identifying the schlemm's canal.
- Performing controlled lamellar dissection of the scleral flap.
- Precision removal of block of tissue.
- Fine closure of conjunctival wound.

Microscopes however have a problem such as:

- Expensive
- Narrow field of vision
- Narrow depth of focus & loss of points of reference
- Relatively static surgery
- Can cause photopic macular problems
- Need for a good assistant/good instruments

Parts of a Microscope:

- Binocular tube with eye pieces
- A microscope body with a variable lens system and an objective lens
- Co-axial illumination system (optional)/ beam splitter for viewing / recording (optional)
- UV block / cold light / neutral density filter

- X-Y and zoom along with foot pedal controls

How to choose a microscope:

(a) Choose according to your surgical requirement / experience.
(b) Must have adequate field of vision (if 4x or 6x must have 35 to 50 mm).
(c) Intensity of light should be good.
(d) Working space that is distance between microscope & patient's eye should be 150 to 200mm.

Qualities of Good Microsurgical Instruments

- Length less than 10cm
- Minimal closing pressure to avoid tremors.
- Working parts not to open more than 10mm.
- Metal must be dulled to avoid glare
- Preferably made of Titanium, which is light durable.
- Avoid needle holder with catch/ the holder should have a round body handle to rotate easily. The working part should have a gentle curve at 30degrees to enable it to be held like a pen.
- Tying forceps should be toothed with a tying platform which is curved to prevent blurring under microscope.

Cleaning of Microsurgical Instruments:

- Handled by senior sisters.
- Use fine brush / avoid metal Scrubber, abrasive.
- Blood and debris adhered to working part removed by washing before it clots.
- Do not use saline to wash / use distilled water.
- Use ultrasonic cleaners (use cavitation to clean instruments).
- Instruments should never be thrown together but hung separately otherwise they loose their cutting edge.

Sterilization

- Ethylene Oxide (ETO) steritistion is most popular, ETO and Freon are used in a ratio of 12:88 . Instruments packed in 300 gauge polyethylene bags. Use ATI indicators to ensure adequate sterilization has taken place usually 6 hours exposure required.

- *Activated Saturated Dialdehyde solution (cidex 2%);* instrument placed separately on a mat dipped in this solution. It takes 3 hours for total sterilization, after this rinse with BSS.

Dry Heat

- Temp of 150 heat for 1 ½ hours
- Instrument wrapped in brown paper bags kept in racks (Do not use autoclaving – steam for such instruments)

Storage of microsurgical Instruments

- Always in trays with rubber pads
- Always separate from each other / not touching each other

VIII b. LASER MICROSURGERY IN GLAUCOMA

Laser form a very Important modality for treatment of Glaucoma's

Modalities

1. YAG Laser Peripheral Iridotomy
   - (A) Angle Closure Glaucoma (ACG)
     - → Acute attack
     - → Subacute attack
     - → chronic ACG
     - → fellow eye
   - (B) Mixed glaucoma (ACG + OAG)
   - (C) Secondary glaucoma's like
     - Uveitis with seclusio pupillae
     - Silicone oil induced glaucoma

2. Argon laser trabeculoplasty(ALT) – OAG

3. Argon laser Iridoplasty
   - (a) Plateu iris syndrome
   - (B) Opening of peripheral angle in narrow entry OAG to facilitate ALT

4. Reopening of closed bleb - failed trabecelectomies (YAG laser)

5. Transcutaneous Diode cyclophoto cogulation
   - For recalcitrant glaucoma like Aphakic / neovascular (where cyclocryo required)

<u>Nd-YAG Laser peripheral iridotomy</u>

Procedure

Pre op:
- Control IOP by giving topical and systemic medication
- Start patient on pilocarpine 2% TDS for 2-3 days before YAG PI . Also before starting PI instill Pilocorpine 2% three times to stretch out the iris .
- Give oral diamox 1 hour before in case of chronic ACG and those with pre operative IOP on higher side.

YAG PI -

- Take consent and explain procedure
  Instill Paracaine 1 drop or Xylocanie 4%
- Seat patient comfortably
- Tie headband
- Use Abrams kind of gonioscopic lens (with +55 D button). To focus laser better/ keep eye immobile / reach peripheral areas / get magnification / select a thin area / crypt in iris / superotemporalr or nasal quadrant away from the interpalpebral aperture
- Set to Q Switched
  5 mj energy./13 degree cone angle / no posterior focal shift
- Try and complete PI in 1-2 shots by hitting at same spot
  PI complete when
- Sudden deepening of A/C
- Sudden gush of acqeous & pigment
- Can see retroillumination (by itself not confirmatory of full PI)

Complications :

- **Microhaemmorhge** invariably occurs but self stopping / if continues – put pressure on eye by gonioscope
- **Pigment release:** settle by itself
- **Elevated IOP :**
  highest post laser IOP occurs within 1-4 hours though elevation can last upto 24 hours. Control by giving extra antiglaucoma medication

Post PI care :

1. Give topical steroids for 2-3 days in OD dose.
2. Continue pilocarpine for a week to keep iris stretched.
3. Continue antiglaucoma medication as being used previously at least for a week taper gradually.

ALT :

Lowers IOP in OAG by 4-6 mm Hg
useful for - Delaying surgery in patient controlled on maximal medication.

- Psedoexfoliation

Practically used very little now in Indian eyes as the response is not good.

Procedure

- Topical anesthetic
- Use 1 mirror/3 mirror gonioscope / Ritch lens
- Argon laser 0.1 Sec 1watt 50 micron spot size
- Hit anterior trabecular meshwork 180'degrees to get a blanched spot.

Post op

- Topical steroids/antiglaucoma medication

Argon Laser Iridoplasty

setting : 200-500 micron spot size
0.2- 0.4 W power
0.1-0.2 sec time

Argon laser shots foccused on peripheral Iris to retract the iris to deepen the angle and break synichiae.

Use Gonioscope & do 180-360 degrees in peripheral Iris.

IX. Pre operative Preparation of Glaucoma Surgery

A. All one eyed patients must undergo a culture from conjunctival sac 2 days prior to surgery. This must be free of growth to proceed.

B. Explain to patient/take consent.

- Vision might drop after trabeculectomy
- Patient may develop cataract
- If fields are very compromised/ may have blindness.

C. **Stopping Pilocarpine** pre operatively

- Increase permeability of blood Acquous barrier worsens inflamation, more chances of posterior synichiae
- Chronic use causes irreversible miosis .
- Causes shallow anterior chamber with regular use.

Duration of action 6 – 12 hrs.

wash off effect – 3 weeks.

Best to stop Pilocarpine as soon as surgery planned/shift to other drugs (Timolol/Acetazolamide)

D. Acetazolamide in morning of surgery to patients where IOP in range of 20's.

E. **Intravenous mannitol**.

- Useful to operate in eye with controlled IOP .
- Avoid expulsive hemorrhage.
- Prevent sudden decompression and snuff out syndrome
- Decreases chances of complication like hyphema, flat chambers.
- Permits working with a deep chamber hence minimizes injury to lens & cornea.

Before giving mannitol check - Pt not cardiac patient (poor cardiac output) or compromised renal function.

Retrobulbar anaesthesia

Blocks 2ml of anaesthetic mixture used. Can go upto 3-3.5 ml. 1 ½ inch – 23 Gauge needle used.

Traditionally - Position of globe looking upward and nasal as Inferior Oblique & Inferior Rectus muscle are placed out of reach of the needle.

- Now many prefer primary gaze.

Peribulbar anesthesia

- Term periconal preferable
- Local anaesthetic is deposited within the orbit but does not enter within the geometric confines of the cone of rectus muscle

Bloombergs method - 7-10 ml (lignocaine or 6 ml Ligno+ 4 ml Bupivacaine) 2.5 cm, 25/27 gauge needle (with 1500 units in 30 ml bottle of hyalase [Hyaluronidase] necessary for increasing the spread of the drug through the orbital tissues & penetrations into intraconal region / directed towards the orbit inferotemporally, and is deliberately directed towards orbital floor to a depth of 2 cm. A single 8-10 ml injection, Other people would give two blocks of 3-5 ml each in sup.nasal & infero temporal quadrant as these areas are relatively avascular.

Inf. temp site *Actual method of giving block*

Patient looks straight ahead.
enter the inferior lid at junction of lateral 1/3rd and medial 2/3rd just above orbital rim.
Needle goes straight posterior 1 ml is injected immediately posterior to orbicularis oculii muscle.
The needle is then advanced just anterior to the equator of the globe, along the inferior orbit. The needle rather than passing under the globe and into the cone is angled slightly laterally and less superiorly than a RB injection. 1 ml of anaesthetic is deposited just anterior to the equator of the globe.
The needle advanced past the globe, just past the equator in slightly superior medial direction and 2 ml of anaesthetic mixture injected.

Supero nasal site

Lid entered in upper lid fold between the supraorbital notch and trochlea.
1 ml of anaesthetic Solution injected immediately posteriorly to orbicularis occuli
Needle advanced essentially parallel with roof of the orbit staying away from the globe . After this 2nd injection needle is directed posteriorly behind the globe Outside the muscle cone. Finally needle is advanced in direction of S0F and 1 m of solution is injected just past the equator.

Superpinky/ Massage

After retro/ Peribulbar put a superpinky (A rubber ball tied with elastic bandage). On the said eye to help reduce vitreous volume and produce hypotony. Pressure of 30 mm Hg should be applied for 5-10 min . However if the eye is compromised due to uncontrolled elevated IOP, avoid pinky or give it only intermittently.

Alternately one can give message by hand

A thumb rule is to keep one hand on the eyeball and press with other hand till your nails blanch. This would exert around 30 mm Hg pressure which we want to apply.

GENERAL ANESTHESIA

- Usually causes reduction of IOP
- Exception are - Trichlorethylene and Ketamine
- Carefull in estimating IOP in infants and children in GA
- High dose chloral hydrate solution (100 mg/Kg for first 10 Kg and then 50 mg/Kg) did not alter IOP significantly in children < 6 years of age.
- Open globe in GA- Depolarising agents like Succinylcholine and Suxamethonium cause transient rise in IOP due to EOM contraction and intraocular vasodilation.
- Pretreatment with non depolarising muscle relaxant is of no value so pretreat with - Diazepam/Fazadinium/Atracurium
- Trachael intubation may also cause IOP rise.
- Elevated pCO2 also increased IOP.

Decreased pCO2 or increased O2 reduced IOP due to decreased episcleral venous pressure.

SPECULUM

Check that the eye speculum used during surgery is not causing excess pressure on the globe.

X. SURGICAL TREATMENT OF GLAUCOMA

INCISIONAL IRIDECTOMY

INDICATIONS : Is used only when laser iridotomy is not available in the following Conditions.

1. Fellow eye of Chronic ACG and Acute ACG (angle closure glaucoma)
2. Subacute ACG.
3. ACG suspect when follow up is poor.
4. After control of IOP in acute ACG.
5. Pupillary block glaucoma due to other causes.

TECHNIQUE:

- Under local (peribulbar) anesthesia.
- A fornix Based conjunctival flap is made.
- 3-4 mm incision is made at limbus.
- If iris prolapses it is lifted with iris forceps & it is incised with iris scissors held parallel to the limbus.
- After the incision iris is reposited back, by gentle stroking action across the cornea
- In closing the wound a single suture is placed.
- Sub conjunctival gentamcin and decadron are injected

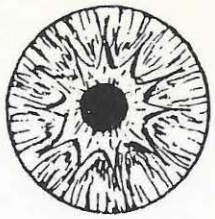
PRVENTION & MANAGEMENT OF COMPLICATIONS

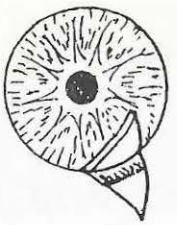
HEMORRHAGE: If it occurs it can be stopped by placing an air bubble in the A/C.

INCOMPLETE IRIDECTOMY: Can be prevented by ensuring the presence of Pigment endothelium and by noting transillumination through the iridectomy.

POST OP ELEVATED IOP: If A/C is flat malignant glaucoma should be suspected or it can be due to an incomplete irdectomy.

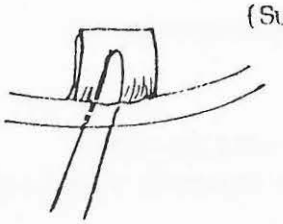
STEPS OF TRABECULECTOMY



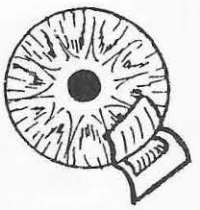


Conjunctival incision

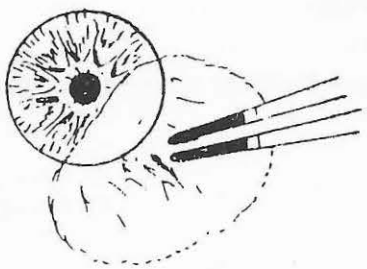
(Superior nasal/temporal)



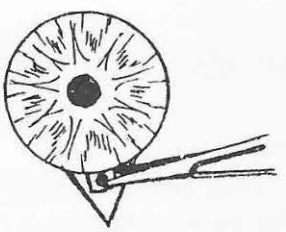
Limbus based flap



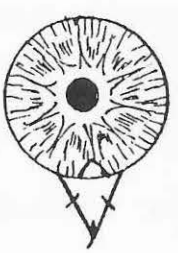
The block of tissue to be excised



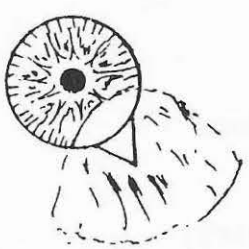
Wet field cautery on sclera



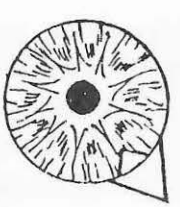
Peripheral Iridectomy done

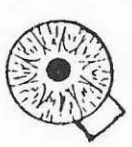


Scleral flap closure 3 sutures



Triangular scleral flap





Rectangular scleral flap

Conjunctiva sutured

Flow Chart 8

VISCO : Viscoelastic

Cataract Can occur due to injuring to lens

Endophthalmites treat in the standard manner

FILTRATION SURGERY

OBJECTIVE: To maintain useful vision and to avoid further glaucomatous Damage by lowering IOP.

INDICATION: Medical / Laser therapy is insufficient to control the rate of deterioration of visual function in glaucoma especially in cases of

- Rapid deterioration of optic nerve.
- Advanced stage of optic nerve damage.
- Advanced stage of visual field loss.
- Increase in IOP above a level known to cause optic nerve damage.

FULL THICKNESS FILTRATION SURGERY

- Iridenclesis (1907) -
- Limbal Trephination (1909) -
- Posterior sclerectomy (1924) -
- Thermal sclerostomy (1962) -

Advantages over trabeculectomy:

- These procedures have a greater long term success
- Initial IOP is lower than with trabeculectomy.

Disadvantages: Immediate and late complication of hypotony.

GUARDED FILTRATION SURGERY (TRABECULECTOMY)

Technique:

Preparation of a conjunctival flap.

The flap is generally limbus based.
The flap is made slightly nasal to 12-o clock to prevent scarring for later Cataract surgery, gentle handling of conjunctiva is essential to prevent Buttonholing especially in older people where conjuctiva is thin.

Making the superficial scleral flap:
As the assistant holds the conjunctival flap , bleeders on sclera are cauterized. A 5x5mm partial thickness (½ thickness of sclera) scleral flap is made or a triangular flap with a 5mm base is made untill 1mm bluish grey zone is exposed..
The A/C is entered with a knife. This radial incision should start in the clear cornea and extend until the blue white transition zone. A 1 x 4-mm block of tissue is excised. The incised block is lifted first from the corneal side and incisions are extended towards the posterior side till a pigmented line signifying the meshwork and schlemms canal are seen. This area must be included in the block excised. Iridectomy is done under the scleral flap.
The flap is closed with 10-0, Monofilament nylon interrupted sutures.
Other use additional sutures for tighter closure. Adjustable sutures are being used to titrate conjunctival flap closure and filtration preoperatively.

Conjuctiva is closed using 8-0 (Absorbable) vicryl suture with a running suture that provides tightest closure. Subconjunctival Gentamicin and decadron are given at the end:
Antibiotic eye drops, topical mydriatic and cycloplegic with topical steroids are given for 3-4 weeks.

COMPLICATIONS OF STANDARD TRABECULECTOMY

INTRA OPERATIVE:

1) Conjunctival button holing.
2) Scleral flap complications.
3) Descemets detachment.
4) Hyphema.
5) Lens injury.
6) Vitreous loss.

EARLY POST OPERATIVE COMPLICATIONS

1. Deep A/C with elevated IOP.
2. Shallow A/C with elevated IOP.
3. Shallow A/C with low IOP.
4. Hyphema.
5. Loss of Vision.
6. Uveitis.

LATE POST OPERATIVE COMPLICATIONS

1. Filtration failure.
2. Cataract.
3. Late bleb leak.

4. Bleb related infections

MODIFICATION OF TRABECULECTOMY TO INCREASE SUCCESS RATE

1. Use of antimitotic agents.
2. Releasable suture techniques.
3. Seton (implant) valve surgery.

PROCEDURES PERFORMED DURING SURGERY

1. Removal of Tenon's capsule .
2. Decrease thickness of superficial scleral flap.
3. Use of only 2 sutures in closing the superficial scleral flap.

SURGICAL MANAGEMENT IN CASES OF GLAUCOMA AND CATARACT

EVALUATION OF PATIENT:

- Extent of cataract.
- IOP.
- Cup Disc Ratio.
- Visual fields.
- Treatment taken for glaucoma.

INDICATIONS FOR CATARAT EXTRACTION ALONE

1. IOP well controlled or till 24 mm Hg on medication.
2. visual field and disc damage mild – moderate.

INDICATIONS FOR FILTERING SURGERY ALONE

1. Borderline control of IOP with advanced disc and field damage.
2. Uncontrolled IOP (despite maximum tolerable medical therapy).

INDICATIONS FOR COMBINED SURGERY

1. Borderline or uncontrolled IOP in a debilitated patient with cataract.
2. Cataract patient with poor compliance to medical therapy.
3. Two surgeries not feasible.

Technique: for glaucoma surgery with extracapsular cataract extraction and IOL implantation.

- Under local anaesthesia.
  - Superior Rectus is bridled.
  - Fornix based flap is preferred as it allows A/C visualization.
  - Superficial scleral flap as in trabeculectomy.
  - At the limbus A/C entry is made.
  - A/C is filled with viscoelastic/ Air and capsulotomy done.
  - A groove at the limbus for cataract extraction is made and corneoscleral scissors used to complete the incision.
  - Nucleus is delivered and lens matter aspirated IOL is placed.
  - IOL is placed.
  - Trabeculectomy is done under the partial thickness scleral flap and peripheral iridectomy made.
  - The incision is sutured with 10-0 monofilament nylon sutures.
  - Cut edge of the conjunctiva is sutured to the peripheral edge of conjunctiva).
  - Subconjunctival gentamicin with decadron is given.

CYCLOCRYO THERAPY

INDICATIONS: Intractable glaucomas with poor visual prognosis and refractory to alternative treatments eg.

1. Neovascular glaucoma.
2. Aphakic glaucoma.
3. Post traumatic glaucoma.
4. Previous failed filtration surgery.
5. Secondary glaucoma's.
6. Congenital glaucoma's.
7. Post penetrating keratoplasty glaucoma.

Procedure: - Under local anesthesia (retrobulbar or peribulbar) and topical Anesthesia.
  - Eyelids are separated with lid speculum.
  - Cryoprobe (2.5mm) tip at – 80 degree C is applied 2-2.5 mm from the limbus.
  - It is applied for 50 second with firm pressure on sclera, thereby delivering the iceball faster to ciliary processes. A 10 sec thawing is allowed.
  - 3-4 spots are given per quadrant and depending on severity of glaucoma 90, 180 & 270 degrees therapy is given in a gaurded fashion.
  - Younger patients require a larger number of conjunctiva applications than do older individuals to achieve satisfactory pressure reduction.

Freezing technique: Rapid freeze and slow thawing produces maximum destruction, with probe being lifted gently to prevent injury to conjunctiva / Tenons.

Post op Management:

1. Topical steroids, antibiotic and cycloplegic ointment to be used.
2. Systemic non-steroid anti-inflammatory drugs to relieve pain.
3. Antiglaucoma medication to be continued 3-5 days postoperative.

Complications: Uveitis
Pain
Hyphema
Ocular hypotony / phthisis bulbi.

XI. POST OPERATIVE CARE

Post glaucoma surgery care is crucial.
Makes all difference between a long term/short term success or complete failure.

Care after Trabeculectomy:

Routine Care:
Check that there is no conjunctival congestion or discharge; watch for reaction, exudation in anterior chamber or vitreous to rule out endophthalmitis.

Special Care

(a) Conjanctvial bleb : ideally thin /anemic and diffuse ;
(b) if bleb not well formed / IOP is high with deep anterior chamber
- Do ocular massage by telling patient to look down and press the lower lid on cornea so that acquous leaks out and forms the bleb. This massage to be continued Twice daily till bleb formed nicely.

(c) Conjuntival sutures / conjuctival gape: rule out any gape or tear in conjunctiva.
(d) **Anterior chamber depth** :
(1) **Deep**: If A/C is deep on first few post op days and IOP is high, do regular message as detailed above along with topical steroids

(2)**Shallow A/C**

2(a) *With low tension*:
R/o (i) Wound leak - Conj tear/gape – do seidles test (put fluorescein in conjunctiva see any leak by pressing on cornea.
- Requires pad & Bandage / operative repair.
(ii) Overfilteration: Bleb will be very large, No leaking area found/give pressure bandage : Roll a small ball of cotton, place on upper lid which covers the area of bleb, put another eye pad on top and close for 12 hours. Do not let patient sleep as this puts the pressure in center of cornea as eye rolls up in sleep.

(b) Dilate pupil by homatropine 2% (HA).
(c) Keep pupil mobile by instilling pilocarpine 2% and dilating with HA 2%.
(d) Tell patient to drink lot of water so aqueous keeps forming.
(e) If A/C remains shallow for over one week and shows no sign of recovery – may have to reform A/C by injecting visilon / Air from separate corneal stab wound.
Better to leave a viscoelastic in such situation as it stays longer and better chances for A/C reformation.

(iii) *Choroidal Detachment* :

- Give topical steroids / Atropine ointment.
- If no benefit do suprachoroidal drainage by making a scleral incision in inferior quadrants and draining the suprachoroidal fluid. Along with this A/C has to be deepened with viscoelastic / Air / Balanced salt solution (BSS).
  All A/C reformation should be done only when despite conservative management there is either corneal decompensation or elevation of IOP due to peripheral synichae formation.

2 (b) **Shallow A/C – high tension**

- Consider Malignant glaucoma
- Start Atropine eye ointment. I/V mannitol oral diamox & glycerol
- Atropine to continue even when attack is broken.

If Medical Management fails:
Laser: In Aphakes YAG laser can rupture vitreous phase & cure this condition

Surgery

(a) Posterior sclerotomy with air injection
(b) Lens extraction
(c) Cyclocryo
(d) Vitrectomy if eye is aphakic

Other post operative problems:

1. *Uveitis* : They have excess reaction
   Treat with steroids & mydriatics.

2. *Hyphema*: Pt sleeps in head elevated position

Late Care:

Even after long time has elapsed glaucoma patients need special care for watching below mentioned complications.

(a) Late Rise of IOP / regular recording of IOP is must. Bleb scarring/fibrosis may elevate IOP.
- Manage medically (Timolol/pilocarpine/Brimonidine/Latanoprost).
- Try bleb rivision/ Repeat filtering surgery.

(b) Late bleb rupture
- Surgical repair by taking conjunctival tissue from posterior to the flap.

(c) Cataract may occur after trabeculectomy:
Manage surgically

(d) Endophthalmitis : If bleb is too thin must watch carefully for late rupture & Infection.

In Routine Post op trabeculectomy

- Give Topical steroid antibiotic drops QID
- Keep pupil mobile preferably by short acting mydriatic like tropicamide.
- Keep IOP check/give antiglaucoma drugs if need be.

Field Examination

Post operative field examination is a must since some patients might loose fields after surgery. Also regular field examination may tell whether the glaucomatous process has actually been controlled despite normal tensions.

Refraction:
May be altered and should be recheked 6 weeks after surgery.

Diurnal Control
It is better to repeat diurnal variation of IOP after surgical wound has stabilized.
Thus 3 months post operative a diurnal IOP will reflect the control gained.

XII. SUGGESTED READING

1. The Glaucomas Clinical Science - 3 Volume
Second Edition.
Eds., Robert Ritch, M. Bruce Shields & Theodore Krupin
Published by: Mosby Year Book, 1996

2. Glaucoma Surgery,
Eds., John V. Thomas,
Ass. Editor C. Davis Belcher III, Richard J. Simmons
Mosby Year Book , 1992

3. Becker – Shaffer's
Diagnosis and Therapy of the Glaucomas
Eds., H.Dunbar Hoskins Jr. & Michael Kass
Sixth Edition
The C.V. Mosby Company– 1989

4. Clinical Atlas of Glaucoma
E. Michael Van Buskirk
W.B. Saunders Company, 1986

5. Text Book of Ophthalmology
Eds : Steven M. Podos & Mycon yanoff.
Volume – 7 Glaucoma
Ass. Editor: Paul L. Kaufmann
Thomas W. Mittag
Mosby 1994

6. Glaucoma Vol. I & II
Eds.Cairns. J.
Grune & Stratton ,1986

7. Complications of Glaucoma Therapy
Eds. Mark B. Sherwood & George L. Spaeth.
Indian Edition
Jaypee Brothers- 1991

8. Stereo Atlas of Glaucoma
Eds., David G. Campbell.& Peter A. Net land
Mosby, 1998

9. Colour Atlas of Glaucoma
Eds. M. Bruce Shields
Williams & Wilkins , 1998.

10. Diseases of the lens and vitreous glaucoma and hypotomy
Duke Elder and Jay B.
Henry Kimpton, London 1969

11. Glaucoma
Eds. Chandler PA and Grant WM
Lea & Febiger, Philadelphia, 1979

12. Glaucoma,
Eds. Chandler and Grant's, 3rd Ed.
Lea & Febiger,
Philadelphia, 1986