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(Introduction, Materials & Methods, results, Discussion, conclusion).

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Glaucoma in Bangladesh : Problem is big, awareness may help

M. Nazrul Islam[1], Sk. M.A. Mannaf [2]

Glaucoma has long been recognized as a leading cause of irreversible blindness. but only recently has it been appreciated by WHO, IAPB and other organizations how numerically important it is worldwide. World Glaucoma Association and Glaucoma society in many countries has been formed to combat the problem.

According to WHO, Approximately 285 million people worldwide live with low vision and blindness, Of these, 39 million people are blind and 246 million have moderate or severe visual impairment. 90% of blind people live in low-income developing countries. Yet 80% of visual impairment is avoidable- i.e. readily treatable and/or preventable. Restorations of sight, and blindness prevention strategies are among the most cost-effective interventions in health care.

Glaucoma blindness affects over 7 million people, ranking only second to cataract as a cause of blindness worldwide. Being medically and surgically irremediable, visual impairment from glaucoma presents a significant challenge to those concerned with prevention of blindness, both on an international and local scale. Unless detected at an early stage the prognosis for sight will be poor.

The prevalence of glaucoma in Bangladesh: a population based survey in Dhaka division published in 2004 reveals that among people aged 35 years and older, the prevalence of definite glaucoma was 2.1%. The prevalence of definite and probable glaucoma was 3.1 % in subjects of the same age. Primary open angle glaucoma was the most common form of glaucoma, accounting for 75% of the total. Glaucoma prevalence was higher in men than women. About 98% people have not heard the name of glaucoma. But recent study results indicate that overall 13.5% patients were aware of glaucoma and 8.7% had some knowledge about glaucoma. It seems awareness has increased than that of previous study.

Despite limitation of centers with modern facility for diagnosis and surgical management, glaucoma is diagnosed mostly clinically and treated by medicines. There is adequate local production of anti glaucoma medications though costly but within affordable price. Regarding medical treatment, compliance is very poor. Most patients are reluctant to surgical procedure.

Bangladesh Glaucoma Society leading development of awareness about glaucoma among mass people, general physicians, ophthalmologists and all stakeholders. In the last 5 years awareness of glaucoma has been increased. Now, many patients ask our doctors- Do I have glaucoma?

Joint effort will help prevention of curse of blindness due to glaucoma in Bangladesh soon.

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Tripple E Trabeculectomy in developing country- a study in 50 cases

M N Islam[1]

Abstract

Aim : Efficacy of an economic and easy procedure of Trabeculectomy(Triple E trab) in both open and angle closure glaucomas

Methods : Prospective study of Fifty triple E tabeculectomy of 41 patients were done by same surgeon at BIRDEM and Advanced Eye & Glaucoma Centre, Dhaka from December 2010 to December 2011.

Results : After 12 months follow up, Forty one eyes (82%) had complete success, seven eyes (14%) had qualified success and 2 eyes(4%) needed bleb revision and retrab respectively. No vision threating complications was observed. This technique produced diffuse noncystic bleb with long-term pressure control in 43 eyes(86%)

Conclusion : Triple E trab is significantly effective to control post op IOP in low economic set up in developing countries.

Key words : Tripple E trab, easy, economic, success

Introduction :

Glaucoma is an optic neuropathy characterized by a specific pattern of optic nerve head and visual field damage caused by a number of different diseases that affect the eye. Elevated intraocular pressure (IOP) is the most important known risk factor for the development of glaucomatous damage, and its lowering remains the bulwark of our treatment.

Trabeculectomy remains the gold standard for external filtering surgery. Surgical failure is mainly owing to scarring at the level of the scleral flap or conjunctiva-Tenon-episcleral interface. The search for materials to enhance the success of filtering procedures has started with the advent of filtration procedures themselves[1,9]. Many foreign materials designed to aid drainage in glaucoma surgery e.g. Ologen collagen matrix, ExPress and Gold shunt, Valve implants[2,3,4,5,6] etc. The first implants were made of a horse hair. Silk thread, nylon, gelatine film, silicone tubes, and amniotic membrane. Scarring has been reduced with the use of antifibrotic agents primarily 5-flurouracil 5 and mitomycin-C (MMC)[6]. Side effects associated with the use of these agents include corneal and conjunctival toxicity, hypotony maculopathy, endophthalmitis, and late onset bleb leak. Implantation of collagen matrix, shunts, different valves are now practiced specially in developed countries. I have developed easy, low cost procedure of trabeculectomy for developing countries named triple E trab.

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Materials & Methods :

This is a prospective study. Fifty triple E tabeculectomy of 41 patients were done by same surgeon at BIRDEM and Advanced Eye & Glaucoma Centre, Dhaka from December 2010 to December 2011. Informed consents were obtained from patients where all details of the procedure were explained with emphasis on the intended outcome.

Patient Selection and Preparation :

Forty-one patients were enrolled for this study (Table 1). The inclusion criteria for this study were a diagnosed case of Primary Open Angle Glaucoma (POAG) or Primary Angle Closure Glaucoma (PACG) and an uncontrollable IOP despite of maximum medical treatment. The cut-off value for the IOP was 21 mm Hg. Patients who were unable to afford treatment were also allowed to enroll in this study.

All patients had a through ocular examination which involved assessment of best corrected visual acuity (BCVA), slit lamp biomicroscopy and the measurement of the IOP using a Goldmann

applanation Tonometer.

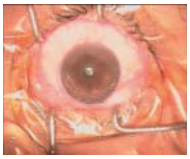
The BCVA ranged from 6/6 to CF

Table 1. Demographic Characteristics of patients No. of eyes, n== 50

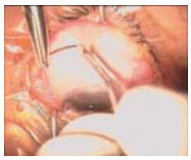
Age (Years)	
Range	10-60
Mean	41.3
< 40	5 eyes
40-50	24 eyes
51-60	11 eyes
>60	10 eyes
Male	16 (21 eyes)
Female	25 (29 eyes)
Types of Glaucoma	
POAG	32
PACG	18

Surgical Technique

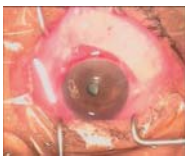
All surgeries were performed under peribulbar local anesthesia, with ocular compression was performed in all cases. The surgery was initiated by placing a 4/0 black silk superior rectus bridle suture. A moorfield forcep and a blunt Westcott scissors used to do the fornix based conjunctival flap and dissection as far back as possible was performed. Light cautery was done. A triangular sclera flap was fashioned with a number 11 blade with the base of the triangle placed in the clear cornea. A crescent knife was used to dissect the flap, and the dissection was carried forward into the clear cornea.



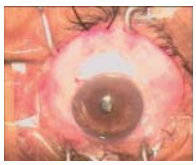
Sterile drap & betadine wash



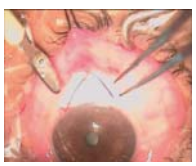
Superior Rectus Briddle Suture



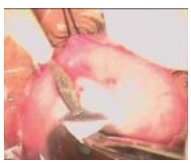
Fornix based conjunctival flap



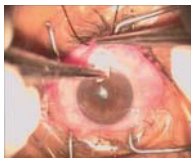
Bipolar Wetfield light cautery



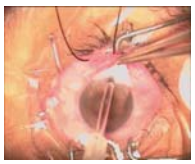
Incision-Triangular superficial sclera flap



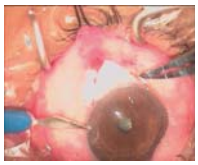
Triangular half thickness sclera flap



MMC 0.2% soaked sponge

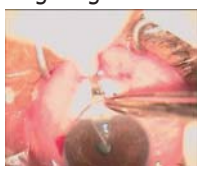


Copious irrigation with ringers lactate

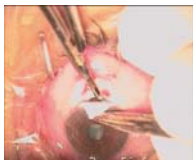


Side port paracentasis

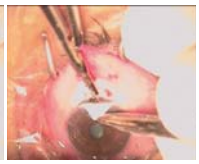
In surgeries where MMC (Kyowa Hakko Kogyo Co Ltd, Tokyo, Japan) was used, 5 sponges soaked with MMC 0.3% were applied, under the conjunctiva nasal, temporal as well as posterior to the intended filtration site, under and above the sclera flap. The sponges were left in place for 3 minutes and removed on a first in, first out order. The site of sponges was then irrigated with 50 mL of Ringers lactate from the irrigating bottle.



Entry of A/C by Keratome

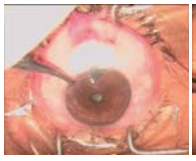


Excision of trabecular & corneal tissue by Kelly punch forcep

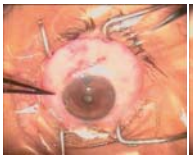


Excision completed

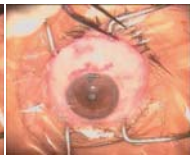
A side port paracentasis done. Then A/C was entered by a 2.8 mm keratome. A block of trabecular and corneal tissue was excised by Kelly punch forcep. 3-4 punch usually made enough dissection. A wide basal iridectomy was then performed. 10-0 nylon suture taken at the apex of the triangle to temporarily secure the scleral flap. Two sutures given at the 2 arm of the triangle. Then apex suture cut and a releaseable suture given at the apex. Water tight suturing of the conjunctiva was performed, starting with the radial relaxing incision, using 8-0 vicryl. Fluid is then given through side port to deepen A/C and also to see the patency of the bleb. Sub conjunctival Inj dexamethasone and gentamycin given at opposite side of the bleb. Antibiotic drop and atropine drop instilled.



Releaseable Suture



Water tight Suturing of conjunctiva by 8/0 vicryl



Bleb tested & trabeculectomy completed

Postoperative Care :

Routine postoperative treatment included Moxifloxacin 4 times daily, Dexamethasone 3 hourly for the first 2 days during day time, then 6 times a day till the end of the first week. By the end of the first week the doses reduced to 3-4 times/ day. for a total treatment period of 6 weeks.

The patients were seen on the first day, first week, first month, 3, 6 months and 12 months. The follow up was altered according to the clinical condition seen in each visit.

Each visit involved measurement of the BCVA, thorough slit lamp biomicroscopy, bleb morphology and applanation tonometry.

A pressure below 21 mm Hg without any antiglaucoma medication was considered a "complete" success and when it was achieved with the aid of antiglaucoma treatment termed "qualified success".

Results :

Intra Ocular Pressure Outcome of the Technique

Comparison of the preoperative and the IOP at the exit from the study revealed a significant improvement. Preoperative IOP improved from 22.35+/-6.39 to 15.21.2+/-4 mm Hg. The mean number of eye drops used preoperatively was 2.35

The Bleb Characteristics

The bleb characters such as bleb elevation, extent, and vascularity where assessed and documented for each patient throughout the follow-up period. It was observed that blebs in the group receiving MMC were apparently less vascular.

Table 2: Success & Failure in post op periods

Complete Success	41(82%)
Qualified success (needed 1-2 anti glaucoma Medication)	7 (14%)
Total success	48 (96%)
Failure (needed bleb revision, re trab)	2 (4%)

Complications :

No intraoperative complications were noted except haemorrhage in 3 eyes which was controlled in due time. Transient corneal edema, transient iridocyclitis, and shallow anterior chamber were found in 7 eyes. None of the cases suffered from wound leakage, permanent shallow A/C or endophthalmitis.

Discussion :

The goal of glaucoma filtering surgery is to reduce intraocular pressure (IOP) to a level that will prevent further glaucomatous optic nerve damage and visual field loss.

The success of surgical procedures designed to treat glaucoma depends on the prevention of excessive wound healing. The events of wound healing after filtering surgery are similar to those following injury to most other body sites. Strategies to interfere with the process of wound healing after glaucoma filtering surgery rely on several techniques including minimizing trauma to the conjunctiva and episclera, avoiding inadvertent intraocular haemorrhage, preventing iris incarceration into the wound, splinting the wound, and pharmacologically modulating the wound healing through the interference with recruitment, migration, and proliferation of fibroblasts [6, 7].

Many foreign materials designed to aid drainage in glaucoma surgery have been implanted e.g. Ologen collagen matrix, ExPress and Gold shunt, Glaucoma valves[2,3,4,5,6,] etc. All these procedures involve costs that is not affordable in the patients of developing countries.

I compared the results of trabeculectomy with the use of MMC, ologen collagen matrix, Ex Press shunt, Ahmed valve of Chen CW[9], de Jong LA[2,3] Cillino S, Di Pace F, Cillino G, Casuccio[4,] Papaconstantinou D, Georgalas I, Karmiris E, Diagourtas A, Koutsandrea C, Ladas I, Apostolopoulos M, Georgopoulos G[5] Mahroo OA, Stanbury R, Lim KS[6] showing similar outcome and complications but significantly high cost in their procedure.

The complications that I noted in this study including the transient corneal edema, transient iridocyclitis, and shallow anterior chamber are all similar or less than complications found in shunt and implant operations[5]. My results are compareable to the present standard success rates of high cost trabeculectomy operations[4,5,12].

The lack of serious complications, the good short-term success rate, the lack of additional costs triple E trabeculectomy procedures make this an appealing alternative especially in developing countries, where the patient compliance with follow up is poor, the risk of bacterial contamination is high, and cost are all important factors.

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Glaucomatocyclitic crisis - An elusive disease – our experience in management and outcomes

S M Noman[1], M A Karim[2], T Roy[3]

Background : The purpose of the current study is to describe clinical manifestations, manage-ment and its outcome of patients who were diagnosed as glaucomatocyclitic crisis at the Glaucoma department Chittagong eye infirmary and training complex, Chittagong

Method : It is a hospital based observational case series study. Study period was from 1stjuly 2009-to 30th june 2011. Unilateral ocular hypertension cases of unexplained origin referred to glaucoma clinic from outpatient department of CEITC were included in this study. Detail history taking and ocular examinations were done that included stit lamp biomicroscopy, applanation tonometry, gonioscopy, fundoscopy and visualfield analysis. Glaucomatocyclitic crisis (GCC) was diagnosed according to mentioned criteria. Management detail was recorded. Patients were followed up after one weak,[1] month,[3] months of initial visit. Examination and investigation findings were documented as much as possible.

Result : A total numers of 45 patients with GCC were included. For the better understanding the results, the total patients (N=45) were categorized into 2 age groups that are 20-49 and 50+. Percentage of patients into these groups are 51.1% (n=23) and 48.9% (n=22) respectively. In total 45 patients, 37 were male and 8 were female. 53.3% patients (n=24) presented with decreased visions, both pain and occasional redness were complaint by 15.6% patients (n=7) 13.3% patients (n=6) presented with mild discomfort. 11.1% patients (n=5) presented with recurrent red ness,8.9% patients(n=4) with occasional halos. 4.4% patients (n=2) and 2.2% patient (n=1) were presented with occasional redness and loss of vision respectively. Mean IOP of affected eyes were 30mm hg and 15mm hg before and after treatment respectively.Angles were open in all cases. At presentation 81.2% patients (n-37) presented with glaucomatous optic disc C:D ratio(0.8-1):1. 77.77% patients(n=35) needed flurometholone, 4.44% cases(n=2) needed dexamethasone and 4.44% patients (n=2) needed prednisolone acetate topical eye drop to control inflammation. 13.33% patients (n=6) were not treated with any steroid as they resolved spontaneously. 91% patients needed anti glaucoma medications 9% needed filtration surgery to control IOP

Conclusion : Early diagnosis with meticulous examinations and investigations are needed to manage a GCC case. As it is an elusive disease, proper explanation of the disorder to the patient to get good compliance from them is necessary to achieve good medical treatment outcome. Good filtration surgery is still successful to control IOP. But regular careful monitoring to the patient is mandatory to perfectly manage and prevent the irreversible visual consequences of recurrence of the disease.

Keywords : GCC (glaucomatocyclitic crisis), inflammation, open-angle, trabeculectomy

Introduction :

Glaucomatocycliticcrisis, is an uncommon form of secondary open angle glaucoma. It is a condition with self-limited recurrent episodes of markedly elevated intraocular pressure (IOP) with mild idiopathic anterior chamber inflammation.[1,2] In 1948, Posner and Schlossmann published a series of 9 patients and described the features of this syndrome as unilateral, recurrent episodes of mild non-granulomatous uveitis; with elevated IOP during the acute attack, which persists for a few hours to several weeks;

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corneal edema with a few keratic precipitates; heterochromia with anisocoria; open angles; normal visual fields; and normal optic discs. In between the attacks, the IOP, outflow facility and provocative tests were within normal limits.[1] Since this original description, other cases attributed to PSS have been found to deviate from these criteria.[3] Additional features that are now recognized are that this condition affects individuals aged 20-50 years;both eyes may be involved at different times but rarely simultaneously.[4,5,6] The rise of IOP is out of proportion to the severity of the uveitis, and this rise in IOP precedes the identifiable inflammatory reaction, often by several days. A signi cant number of patients with GCC develop glaucoma overtime.[4] Topical beta-blockers and/or carbonic anhydrase inhibitors and other anti-glaucoma drugs are used patients with GCC. Filtration surgery is needed to prevent damage from high IOP with frequent attacks. Anti-glaucoma agents and surgery do not prevent recurrences of GCC. In most of the cases, it remains undiagnosed or sometimes over-diagnosed. Few symptoms and signs which are self remitting, respond to steroid but the recurrent attack of high IOPs leads to glaucomatous damage. Loss of vision from glaucoma is an important factor in the management of these patients.

The purpose of the current study is to describe clinical manifestations and management of patients who were diagnosed as glaucomatocyclitic crisis at the Glaucoma Department of Chittagong Eye Infirmary and Training Complex, Chittagong, Bangladesh.

Method :

This is a hospital based observational case series study.Study period: 1st July 2009to 30th June 2011. In this period, old cases of previously diagnosed GCC and newly diagnosed cases were included. New cases were followed up for at least 3 visits (1 week,1month, 3 months and/or 6 months). The following data were recorded: age of the patient at onset, gender, presenting complaints, mean IOP, visual acuity, grade of inflammation before and after treatment, optic disc appearance, medications, glaucoma surgery if needed and post operative follow up. Diagnosis of glaucomatocyclitic crisis was made by the following criteria : mild anterior chamber in ammation with small non-pigmented kpS, open angle and absence of posterior synechiae. There is never any vitreous activity and cystoid macula edema does not occur. The attacks usually resolve by 2 to 3 weeks, sometimes spontaneously, and are recurrent. Between attacks, the eyes are normal, although a few eyes continued to have one or two small non-pigmented keratic precipitates. IOPs were measured using Goldmann applanation tonometry. Patients were diagnosed as developing glaucoma from attacks of GCC as follows:

1. The IOP in the affected eye was >21 mmHg.
2. The affected eye had glaucomatous optic disc and/or visual field changes.

Details of anterior segment with slit lamp biomicroscopywere examined. Optic disc examination was done by indirect ophthalmoscope with 90D and 78D lens. Optic disc criteria for glaucoma included:[6-9]

- Cup/disc ratio greater than 0.7
- Notching or pathognomic change of neuroretinal rim or focal pit
- Narrowest remaining neuroretinal rim of 0.1 disc diameter or less
- Asymmetry in cup/disc ratio of more than 0.2
- Progressive thinning of the neuroretinal rim

All patients were reviewed by a single consultant. Data analysis was done by SPSS V-13.

Results :

A total number of 45 patients with GCC were included during the study period.The mean age of the patients was 48 years(Table 1). The age of the patients ranged from 20 years to 50 years and above. For better understanding of the results, the total patients (n=45) were categorized into 2 age–groups: 20 to 49yrs and >50yrs. Percentage of patients in these groups are 51.1% (n=23) and 48.9% (n=22)

respectively. Of the total 45 patients,37 were male and 8 were female. Numbers of male and female were almost equal in both age groups (Table 2).

Table-1 : Age Group

Age Group	Frequency	Percent
20-49	23	51.1
50+	22	48.9
Total	45	100.0
Mean 48.0, SD ±15.33		

Table-2 : Sex and Age Group Distribution

Sex	Age Group		Total
	20-49	50+	
Male	19	18	37
Female	4	4	8
Mean age 48 years, SD ± 15.33 Chi -square.624			

53.3% patients (n=24) presented with decreased vision;both pain and occasional redness were complaintsof 15.6% patients (n=7); 13.3% patients (n=6) presented with mild discomfort. 11.1% patients (n=5) presented with recurrent red ness, and 8.9% patients(n=4) with occasional halos. 4.4% patients (n=2) and 2.2% patient (n=1) presented with occasional redness and loss of vision respectively (Table 3). Mean IOP of affected eye was 30mmHg and 15mmHg before and after treatment respectively (Table 4).

Table-3 Presenting Complaints

Complaints	Responses N=56	Percent of Cases
Pain	7	15.6%
Decrease Vision	24	53.3%
Occasional Redness	7	15.6%
Occasional Haloes	4	8.9%
Occasional eye ache	2	4.4%
Recurrent redness	5	11.1%
Discomfort	6	13.3%
Loss of vision	1	2.2%

Table-4

Mean IOP of affected eye	
Before Treatment	After Treatment
30.0	15.0

Of the 45 patients, 42.2% (n=19) had VA of 6/6-6/18, 20% (n=9) had VA less than 6/18-6/60 and 37% patients(n=17) presented with VA less than 6/60 before treatment.After treatment 80% patients(n=36) had VA of 6/6-6/18, 13.3% (n=6) had VA <6/18-6/60 and6.7% patients (n=3) had VA <6/60.(Tables 5and 6)

Table-5 Visual acuity of affected eye before Treatment

VA	N	Percent
6/6-6/18	19	42.2
<6/186/60	9	20.0
<6/60	17	37.8
Total	45	100.0

Table-6 Visual acuity of affected eye after Treatment

VA	N	Percent
6/6-6/18	36	80.0
<6/186/60	6	13.3
<6/60	3	6.7
Total	45	100.0

Mild anterior chamber reaction (that is cell 1+) was found in 80.39% (n=41) of patients and 7.84% (n=4) patients had cells 2+ in anterior chamber.At presentation 81.2% patients (n=37) presented with glaucomatous optic disc (C:D ratio 0.8-1); 13.4% presented (n=6) with C:D ratio 0.6 to 0.7. Only 4.4% patients (n=2) had C:D ratio between 0.3-0.4.

Table-7 : Inflammation before treatment

Inflammation	Frequency	Percent
+	41	80.39
++	4	7.84
KP	6	11.76

Table-8 : CD ratio in affected eye

	Frequency	Percent
0.3:1	1	2.2
0.4:1	1	2.2
0.6:1	3	6.7
0.7:1	3	6.7
0.8:1	15	33.3
0.9:1	18	40.0
1:1	4	8.9
Total	45	100

Intraocular pressure was controlled by medical treatment in 91% cases. 9% cases needed surgery. 31.1% (n=14) patients were treated with one anti-glaucoma medication (timolol maleate 0.5%) and 68.9% (n=31) patients needed combination therapy (Timolol maleate and brimonidinetartrat 0.1%). 77.77% of patients (n=35) needed fluoromethalone, 4.44% of cases(n=2) needed dexamethasone and 4.44% patients (n=2)were treated with prednisolone to control inflammation. 13.33% patients (n=6) were not treated with any steroid as they spontaneously resolved (Figures 1 and 2, Tables 9 and 10).

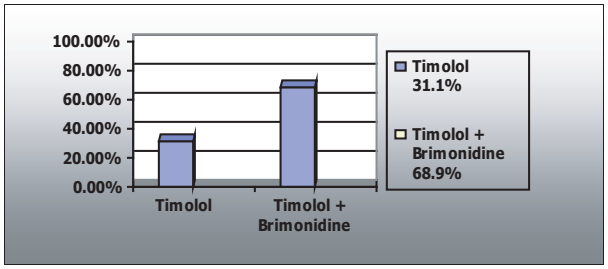


Figure-1 Bar chart for different anti-glaucoma medications

Medical Treatment

Table-9 : Anti-glaucoma medication

Medicine	N	%
Timolol	14	31.1%
Timolol + Brimonidine	31	68.9%
Total	45	100%

Table-10 : Steroid use

Medicine	N	%
Fluorometholone	35	77.77%
Dexamethasone	2	4.44%
Prednisolone	2	4.44%
No ster oid	6	13.33%
Total	45	99.98%

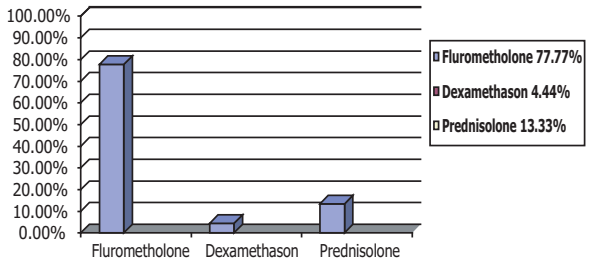


Figure-2 Bar chart for steroid used

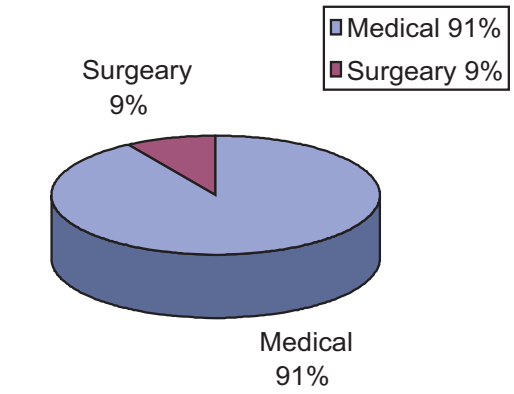
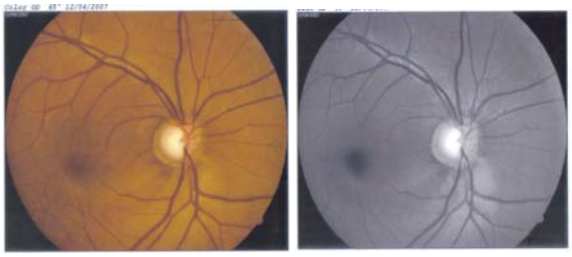


Figure-3 Pie chart for management options



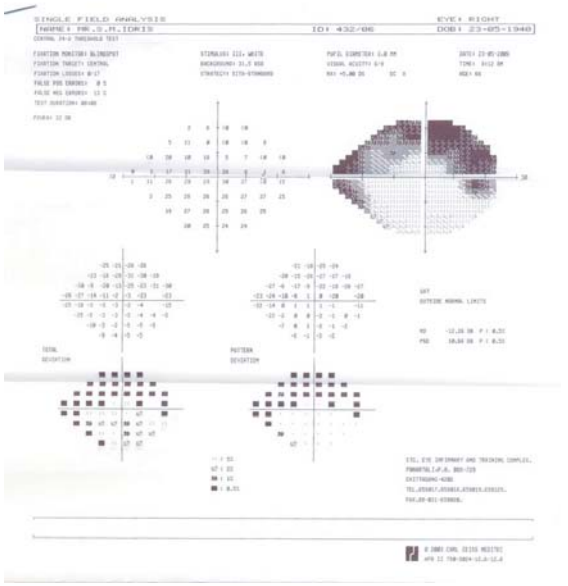


Figure-5 : Glaucomatous disc with nerve fiber loss with corresponding visual field defect

Discussion

Glaucomatocyclitic crisis is an uncommon form of secondary open angle glaucoma. Diagnosis of glaucomatocyclitic crisis is difficult and in most cases it is misdiagnosed as it is mimics other ocular conditions.[7] Here we reported 45 cases of

Glaucomatocyclitis crisis within two years.This indicates it is not so uncommon in Bangladesh. Glaucomatocyclitic crisis typically affects individuals aged 20–50 years.[8,9] In our study 51.1% patients were in the 20 to 49 yrs age group and48.9% patients belonged to the more 50 years old age group. Thus, older patients should also be carefully monitored. Males were predominant in both age groups. 53.3% of patients came into hospital with the complaints of decrease vision. As GCC is self remitting with minimal symptoms, repeated attacks are not noticed in most of the patients.[10] When vision decreased, patients then visited the hospital.Pain and redness were the second most common symptoms where 15.6% of patients presented with these symptoms. Some patients visited with typical features of GCC like discomfort, occasional halos, recurrent redness etc. Intraocular pressures in GCC are usually high ranging from 40 to 60 mmHg.[11,12] In our study, the mean IOP before treatment was 30 mmHg and after treatment IOP was controlled. Before treatment 37.8% patients visited with VA<6/60 and 42.2% with 6/6-6/18. After treatment 80% patients retain their vision within 6/6-6/18. Blurred vision in acute attacks is due to high IOP which induces corneal edema. After treatment 19.7% patients reported VA<6/18 visual acuity due to glaucomatous damage of the disc. 81.2% of patients presented with glaucomatous optic disc in which the cup disc ratio is 0.8 to 0.9. Thus, GCC is not always benign as previous thought to be described by Posner. The repeated attacks of high IOP causes permanent damage to the disc. In this observational case series study, every patient was asked to return earlier if they had an attack but all patients were not interested to come for every attack due to the self limiting and short lived nature of the disease, so it is difficult to determine the duration of elevated IOP during each episode and the numbers of attacks. So in this study we could not explore the possibility of duration of the attack and number of attacks as being factors responsible for causing glaucoma in these patients. The aim of medical treatment is to control inflammation and IOP elevation. The favored initial treatment is a combined regimen of a topical nonsteroidal anti-inflammatory drug (NSAID) and an anti-glaucoma drug (topical beta-blockers and/or carbonic anhydrase inhibitors). In our study, Fluorometholone was used to control inflammation in 77.77% patients. Timololmaleate was used as first line treatment for IOP control. Combination therapy was necessary in 68.9% patients.Topical carbonic anhydrase inhibitorswere not given as it is costly and not available in all places in Bangladesh.Topical NSAIDs like Bromofen was used in 11% patients. Surgical intervention was indicated when increase frequency of attacks and high fluctuation of IOP which may result in progressive optic nerve damage. 9% of cases needed filtration surgery (trabeculectomy) due to IOP not being controlled by only medical treatment and also when patient had nerve damage. Post-operatively, IOP remained controlled after 1 week, 1 month and 3 months. However, again in a short period case series study, there may have been missed episodes of follow up. Both Medical and surgical treatment does not prevent recurrences but glaucoma filtration surgery is able to control high rise of IOP even during the cyclitic attacks.[5] It may decrease the numbers of attacks.[5] Good functioning filtering bleb may decrease the inflammatory cells from the anterior chamber and ultimately prevent the bleb failure. Hence filtration surgery should be advised when any glaucomatous change has occurred. Because patients may miss follow ups, high spikes of IOP in every attack are not always noticed. The underlying cause of GCC still remainsa debate. Cytomegalovirus seems to be the most likely infectious cause.[13] New insights into possible infectious etiologies of PSS may lead to the development of effective treatment strategies to prevent recurrence for this elusive disease. In our study we didnot attempt to investigate causative factors.

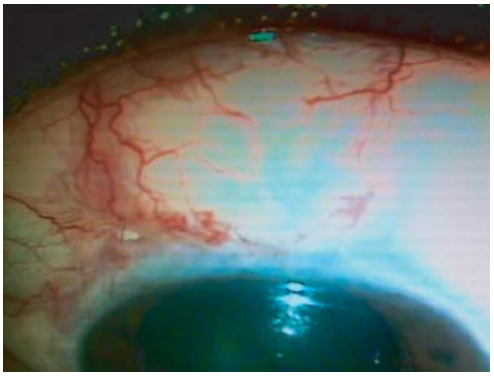


Figure-6 : Good filtering bleb after trabeculectomy

Conclusion :

Glaucomatocyclitic crisis is an uncommon but not rare disease.Early diagnosis with meticulous examination and investigationsare needed. Proper explanation of the disorder to the patient to get good compliance is necessary to achieve good treatment outcomes as it is an elusive disease (since the course of disease is not well understood). Good filtration surgery is still successful to control IOP but regular careful monitoring of the patient is mandatory to perfectly manage and prevent the irreversible visual consequences of recurrent attacks.

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Primary trabeculectomy with single suture verses multiple sutures

M. H. Rahman[1]

Abstract

Purpose : To compare the safety and effectiveness of single suture verses multiple sutures in eyes undergoing primary trabeculectomy.

Design : Prospective randomized clinical trial.

Methods : One hundred fifteen eyes of 103 patients were prospectively randomized into two treatment groups- single suture (SS) and multiple sutures (MS) in Islamia Eye Hospital from January to December 2005. Eyes underwent primary trabeculectomy with either single suture or multiple sutures with intraoperative use of MMC both. Primary outcome measure was the number of eyes achieving target pressures of 6 to 21mm Hg at 6 and 12 months postoperatively. Secondary outcome measures included best-corrected visual acuity with change of astigmatism, complications and interventions.

Results : Of the 115 eyes, 57 received single suture and 58 received multiple suture. A target IOP of 6 - 21 mm Hg at 6 months was achieved in 53 of 56 (95%) eyes in the single suture group and 54 of 57 (95%) eyes in the multiple suture group (P = 1.00). At 12 months, 51 of 54 (94%) eyes in the single suture group met a target IOP of 6 - 21 mm Hg while 48 of 54 (89%) eyes in the multiple suture group did (P=.49). The most common complications in each group were temporary bleb leak which may be related to MMC.

Conclusion : Single suture trabeculectomy is safe and effective as multiple suture trabeculectomy.

Introduction

Unlike most surgical procedures, success of glaucoma filtering surgery is achieved through the inhibition of wound healing[1]. Antimetabolites such as mitomycin C (MMC) has been used in trabeculectomy to delay wound healing and hence to improve the success of surgery. Since the 1980s, these agents have been used as adjuncts to obtain lower intraocular pressures (IOP) because of their inhibition of fibroblast migration and proliferation that would otherwise lead to scarring over the filtering site. [2,3,4,5]

Number of sutures and area of tissue dissection are the factors which influence overall outcome of trabeculectomy[2]. Multiple sutures have many drawbacks like longer operation time, more tissue handling leading to more postoperative inflammation, risk of more fibrosis and postoperative astigmatism etc. Surgically induced astigmatism is becoming increasingly important issue now days because it delays visual rehabilitation and exert negative effect on the final visual outcome. By reducing number of sutures we can reduce all these types of complication. So we used minimum suturing technique (single) during trabeculectomy and compared with conventional multiple suturing technique.

Design

We conducted a single center, prospective, randomized clinical trial to compare the safety and efficacy of single suture verses multiple sutures in primary trabeculectomy with MMC in achieving target intraocular pressures.

Methods

Eligible subjects included persons having deferent types of glaucoma with or without medical treatment, but without previous intraocular surgery. Subjects were recruited from the patient population of the Glaucoma

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Department of Islamia Eye Hospital from January to December 2005. All surgeries were done by single surgeon. Informed consent was obtained from all study subjects before enrollment.

Enrolled eyes were randomized to receive either single suture or multiple sutures during trabeculectomy. The percentage of eyes achieving target pressures of 6-14 and 15-21 mm Hg was the primary outcome measure. Secondary outcome measures included best-corrected visual acuity with changes of astigmatism, number of glaucoma medications, postoperative interventions, and complications.

All statistical methods were performed with SPSS. Final analysis included all randomized subjects as originally assigned. Best-corrected visual acuities were converted into logarithm of the minimum angle of resolution (logMAR) units and the difference between pre- and a post-trabeculectomy logMAR unit was calculated. For comparisons between groups, the Student t test was used for parametric data (age, IOP and the Fisher exact test for proportions (gender, race, success rate).

Successful IOP control was defined as an IOP equal to or lower than target IOP (6-21mm Hg) with or without glaucoma medications. Patients with preoperative IOP < 21 mm Hg were considered as failures if the IOP reduction was less than 20%. Surgical failure was defined as a postoperative IOP > target IOP after resumption of medical therapy. Eyes that required further surgery to lower the IOP were considered failures.

Procedure

All subjects underwent a standard primary trabeculectomy with triangular scleral flap. Each subject received a peribulbar anesthetic block using a 50/50 mixture of 2% lidocaine and 0.5% bupivicaine. 8-0 silk superior corneal traction suture was placed. A fornix based conjunctival incision was made in all cases. The conjunctiva and the Tennons fascia were dissected. Hemostasis was achieved with wet field cautery. Two cellulose sponges soaked with MMC(0.4 mg/ml) applied for 2 minutes.. After the sponges removal, the area was irrigated throughly with 30 ml of ringers lactate solution.

A partial thickness scleral flap was constructed and dissected anteriorly to the limbus and undermined into clear cornea. At this point, a paracentesis was made with 15 degree knife. The eye was entered with a blade and a sclerotomy performed by excision with scissors or by a punch followed by a peripheral iridectomy. The trabeculectomy flap was closed with single suture at apex by10-0 nylon in single suture group and in multiple suture group with three sutures (one at apex and two at two sides). The Tennons capsule and conjunctiva were closed with an 8-0 silk suture. The anterior chamber was reformed with ringers lactate solution and the wound checked for leaks. An antibiotic and homatropine drops were instilled, followed by a sterile eye patch and shield.

Postoperatively, all eyes received prednisolone acetate 1%, homatropine 2%, and an antibiotic. Subjects were evaluated on day 1, week 1, months 1, 3, 6, and 12, and as necessary. Glaucoma medications for the nonoperated eye were continued with the exception of any oral carbonic anhydrase inhibitors.

Results

A total of 115 eyes of 103 subjects were enrolled in this study, of which 57 received single suture while 58 received multiple sutures. Table 1 summarizes baseline characteristics including gender, age, race, glaucoma diagnosis, and operated eye for each group. There was no significant difference between the groups regarding these baseline characteristics. The majority of the patients in both groups had

primary open-angle glaucoma. All enrolled eyes had at least 6 months of follow up except for one subject in the single suture group and one subject in multiple suture group lost follow up. By 12 months, two additional eyes in single suture group and three additional eyes in multiple suture group were lost follow up.

Table 1. Preoperative Characteristics

	SS Group	MS Group	P Value
Total (n)	57	58	
Age in years (mean ± SD [range])	65.5 ± 12.8 (29–83)	65.4 ± 12.1 (32–82)	.99
Male : Female	28:29	36:22	.19
Eye operated (right : left)	30:27	27:31	.58
Type of glaucoma			
Primary open-angle glaucoma	48	49	1.00
Pigmentary glaucoma	2	4	
Chronic angle closure glaucoma	3	3	
Others	3 secondary open- angle glaucoma, 1 pseudoexfoliation	1 aniridia, 1 Fuchs iridocy clitis	

SS= single suture; MS = multiple suture; SD = standard deviation.

The preoperative and postoperative mean IOP and number of glaucoma medications are shown in Table 2. Mean preoperative IOP in the SS group was 24.3 mm Hg higher than the mean preoperative IOP in the MS group (21.9 mmHg), although this difference was not statistically significant (P = .09). The decrease in IOP from preoperative visit to 12 months postoperative was statistically significant for both the SS and MS groups (P < .0001). Both groups showed a significant drop in the number of glaucoma medications used at 12 months compared with preoperatively (P < .0001 for each group).

Table 2. Intraocular Pressure and Number of Glaucoma Medications Pre- and Postoperatively

IOP in mm Hg (mean ± SD)	SS Group	MS Group	P value
Preoperative	24.3 ± 8.1	21.9 ± 6.6	.09
6 months postoperative	10.1 ± 6.4	9.4 ± 4.6	.52
12 months postoperative	10.9 ± 6.4	9.9 ± 5.0	.36
Medications (mean ± SD)			
Preoperative	2.7 ± 1.2	2.4 ± 1.2	.17
6 months postoperative	0.1 ± 0.6	0.1 ± 0.5	.86
12 months postoperative	0.2 ± 0.6	0.1 ± 0.5	.90

SS=Single Suture; MS=Multiple Suture;IOP = intraocular pressure; SD = standard deviation.

The preoperative and postoperative BCVA and changes of astigmatism are shown in table 3.The changes in best-corrected logMAR vision from preoperative visit to 12 months postoperative was not statistically significant for each group (P=.49). But the change in astigmatism was more in MS group than SS group which is significant (p=.12)

Table 3- Best-corrected logMAR Visual Acuity

	SS Group	MS Group	P value
Best-corrected VA (LogMar)			
Preoperative	0.19 ± 0.15	0.21 ± 0.20	.40
6 months postoperative	0.23 ± 0.20	0.27 ± 0.25	.33
12 months postoperative	0.25 ± 0.22	0.30 ± 0.28	.49
Change of astigmatism at 12m	0.5 ± 0.5 D	1.00 ± 0.5 D	.12
VA Changes at 12 months			
Stable	46 (85.20%)	45 (83.35%)	.21
Improvement(>2 line)	5 (9.25%)	5 (9.25%)	.15
Deterioration(>2 line)	3 (5.55%)	4 (7.40%)	.12

Table 4 shows the failures and complications by 12 months in both groups. The IOP criterion for failure for this table was IOP > 21 mm Hg. While there were more complications in the MS group, the differences were not statistically significant for any of the categories or as a whole. All two failures in the SS group were due to bleb failures that required revision or further glaucoma surgery. There were three bleb failures in the MS group which required revision of surgery. Complications that resulted in permanent vision loss occurred in two eye in the MS group due to endophthalmitis and hypotony maculopathy that decreased vision to counting fingers.

Table 4. Bleb Failures and Complications by 12 Months Post Trabeculectomy

	SS Group	MS Group	P Value
Bleb failures (IOP > 21 mm Hg or bleb revision)	2	3	.68
Complications			
Bleb leak(early)	2	3	.68
Temporary hypotony	2	3	.68
Persistent hypotony maculopathy	0	1	1.00
Endophthalmitis	0	1	1.00
Total complications	5	9	.09
Total eyes with complications	4	6	.24

Success rates for various target IOPs were similar between the both groups. Table 5, FIGURE 1 and FIGURE 2 show the proportion of eyes with successful outcomes at 6 and 12 months for target pressures of 6-14 and 15-21 mm Hg. Successful eyes had IOPs that were at or lower than target IOP and had no serious complication that resulted in permanent vision loss. When a postoperative IOP of less than 21, with or without medications, was considered a success, 53 of 56 eyes (95%) in the SS group and 54 of 57 (95%) in the MS group had successful outcomes at 6 months (P = 1.00).

At 12 months, 51 of 54 eyes (94%) in the SS group and 48 of 54 eyes (89%) in the MS group met a target IOP of 6- 21 mm Hg (P = .49). Although the proportion of eyes considered successful was slightly higher in the SS group for each target IOP at 12 months, there was no statistically significant difference between the two groups

Table 5-Success rate

	SS group			MS group		
	6-14 mmHg	15-21 mmHg	%	6-14 mmHg	15-21 mmHg	%
At 6 months	32	21	95	30	24	95
At 12 months	29	24	94	24	24	89

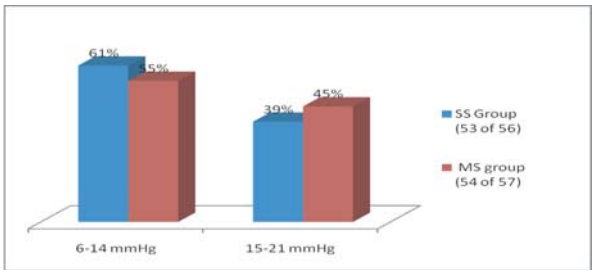

Figure 1. Proportion of eyes achieving various target intraocular pressures (IOP) at 6 months post-trabeculectomy.

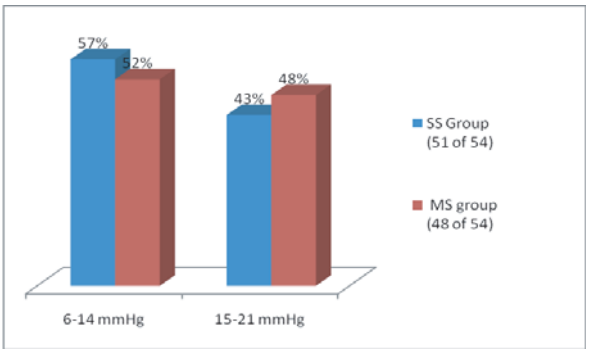

Figure 2. Proportion of eyes achieving various target intraocular pressures (IOP) at 12 months post-trabeculectomy.

Several eyes in each group were put on glaucoma medications after surgery to control the IOP. At 12 months postoperative, five of the 51 successful (IOP15- 21 mm Hg) eyes in the SS group and six of the 48 successful eyes in the MS group were on glaucoma medications to control their IOP. All were on just one medication except for one eye in the MS group that was on three medications.

Postoperative procedures were performed on several eyes in each group. Table 6 shows the immediate postoperative interventions

performed. In the SS group, four eyes underwent needle laser suture lysis, three received both needle suture lysis and subconjunctival MMC injections, , one received an autologous blood injection into the bleb to correct hypotony due to overfiltration, and one underwent Nd:YAG laser to the sclerostomy site within the first month to control the IOP.

In the MS group, six eyes underwent argon needle lysis, three received both needle suture lysis and subconjunctival MMC injections, , two received autologous blood injection into the bleb to correct hypotony resulting from overfiltration or bleb leak, and three underwent Nd:YAG laser to the internal sclerostomy.

Table 6. Postoperative Interventions by

Postoperative Interventions	SSGroup	MS Group	P Value
Autologous blood injection into bleb	1	2	.36
Needle suture lysis	4	6	.74
Subconjunctival MMC injections	3	3	.38
Nd:YAG laser to sclerotomy	1	3	.62

MMC=mitomycin C; Nd: YAG= neodymium: yttrium-aluminum-garnet.

During the initial 12-month postoperative period, four eyes in the SS group and 14 eyes in the MMC underwent phacoemulsification with intraocular lens implantation (P = .02). One of the four eyes in the SS group and two of the 14 eyes in the MS group that underwent cataract extraction had already experienced bleb failure before their cataract surgery. Of the remaining three eyes in the SS group and 11 eyes in the MS group that were still considered successful at the time of their cataract surgery, all remained successful at 12 months.

Discussion

Our results show excellent IOP control in the single suture group along with a lower rate of complications.

Although the percentage of subjects achieving target IOP in SS and MS groups were similar the MS group tended to have more complications including hypotony, maculopathy and infection which are not statistically significant. Although hypotony and maculopathy have been reported with the intraoperative use of these antimetabolites, a high rate of occurrence has been linked with MMC [3, 5, 6.]

Postoperative change in best corrected visual acuity was almost equal but MS group had more change in astigmatism.

Our study has several significant limitations. Our sample size allowed us to detect only fairly large differences in success rates between the SS and MS groups. In addition, because the complication rates were fairly low in both groups, to show a statistically significant difference in the complication rates would require considerably greater sample sizes.

Our study suggests that single suture technique is safe and effective as multiple suture technique in reducing IOP of eyes undergoing primary trabeculectomy. In addition, the rate of complication is slightly lower in SS group than MS group. However, long-term results are still needed before definite conclusions can be made.

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Original Article

Determinants of glaucoma awareness and knowledge in people of Jessore

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Abstract

Aim : To assess the awareness and knowledge levels about glaucoma and its determinants in the people of Jessore. Materials and Methods: The study was conducted by consultants of Jessore Community Eye Hospital, which was a population based prevalence study to estimate the prevalence of glaucoma in the population of Jessore. A total of 500 subjects aged 40 years or above participated in the study. All the subjects completed a questionnaire that assesses their awareness and knowledge level of glaucoma. Respondents "having heard of glaucoma" even before they were contacted/recruited for the study were defined as "aware" and respondents having some understanding of the eye disease were defined as "knowledgeable". Results: Overall 13.5% were aware of glaucoma, the age-gender adjusted rate for awareness was 13.3% (95% CI: 11.57 to 15.03). Two clinicians graded knowledge on glaucoma, based on the subject's knowledge of risk factors, definitions and treatment aspects of glaucoma. Overall 8.7% had some knowledge about glaucoma. Among those who had knowledge 0.5% had good knowledge about glaucoma, 4% had fair knowledge and 4.2% had poor knowledge. We observed a very good agreement between the clinicians in grading knowledge (k =0.92). Determinants of glaucoma awareness and knowledge were higher levels of education, females, age, religion and family history of glaucoma. Conclusion: Awareness and knowledge about glaucoma was very low among the population of Jessore. We have found that younger subjects and men were less aware of glaucoma. Subjects with lower levels of education were less aware and knew less about glaucoma than their counterparts. The study findings stress the need for health education for effective prevention of blindness due to glaucoma.

Keywords : Awareness, glaucoma, knowledge, jessore, population-based study.

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Introduction

Glaucoma is second only to cataract as the leading cause of preventable blindness in the world. It is estimated that over 65 million people throughout the world are affected by glaucoma.[1] Glaucoma causes irreversible blindness and many (50%) of the affected people are unaware of their condition.[2] Vijaya L et al in their study in the rural and urban south Indian population reported the prevalence of primary open angle and angle closure glaucoma; in both these population over 90% of the glaucoma patients were unaware about the disease.[3,4] Increased awareness about glaucoma will increase case detection and will thereby reduce blindness due to glaucoma. Social perceptions of health have changed globally; there is an impetus to move towards good health by using resources for preventive measures. Governmental agencies and several non-governmental organizations are looking to reduce the risk factors for ocular diseases, educate the public to understand the need to improve their health status, and are teaching individuals how to increase their own ability to maintain well being.[5]

Published evidence indicates that late diagnosis of glaucoma is an important risk factor for subsequent blindness and is associated with poor knowledge about the condition.[6] One third of those who become blind due to glaucoma had become visually impaired even before they had sought medical attention for their eyes.[8,9,10] Blindness due to glaucoma can be curbed to a certain extent by educating the masses about the condition, and thereby influencing at risk individuals to participate in regular ophthalmic care.[11]

Several studies on health behavior and health belief suggest that the patient's knowledge (or lack of knowledge) concerning eye care may play a significant role in seeking timely eye care treatment.[12,13,14] we did not find any publication reporting the exact figure of glaucoma awareness

status in Bangladesh. Figures in India when compared to the West reflect the poor awareness levels in Indian population also[15,16]. This study was aimed at understanding the awareness and knowledge about glaucoma and its determinants in a population based sample from urban cohort of the Jessore.

Materials and Methods

This is a population-based survey to estimate the prevalence of glaucoma in a rural and urban population of Jessore.1000 patients attended at Jessore community eye hospital out patient department was interviewed with a questionnaire. A systematic random sampling technique was used, i.e. every second participant (500 subjects) starting from the first of the 1000 registered participants was assessed for their knowledge attitudes and practice (KAP) on glaucoma. Complete data was available for1000 subjects. Demographic details and literacy level of all subjects were obtained. A brief structured open-ended questionnaire was designed to collect information about the subject's awareness and knowledge about glaucoma. (Annexure 1) Seventy-seven percent of the participants (n=385) responded to the questionnaire completely; incomplete questionnaires were not included for analysis. The questionnaire was pilot tested and had in built consistency checks. The questionnaire was translated to the vernacular language (Bengali) and back-translated to English. The questionnaire was validated against the Hong Kong study questionnaire,[18] there was good agreement between the responses (kappa: 0.92). There was good consistency in responses provided by subjects (ICC: 0.794, 95%CI: 0.77 to 0.81). The questions were administered verbatim during the interview process, so as to avoid interviewer bias. Subject's responses were recorded in the questionnaire. The questionnaire was administered prior to the history and examination procedures for glaucoma. Details on the knowledge about glaucoma were obtained only for subjects who were aware of glaucoma.

The study was conducted between June 2009 and May 2011. Written, informed consent was obtained from all subjects, and the study was performed in accordance with the tenets of the Declaration of Helsinki.

Awareness and knowledge about glaucoma-Definition: The response "having heard of glaucoma" even before being contacted/recruited for the study was defined as awareness and having some understanding of the eye disease was defined as knowledge.

Respondents answered questions pertaining to risk factors for glaucoma, description of symptoms and treatment aspects. Subjects were asked to describe the conditions and asked to select the most important risk factors and treatment options from the given choices. The following risk factor options were presented in the questionnaire namely obesity, increased intraocular pressure (IOP), smoking and alcohol use, steroid use, family history, cannot say and none of the above. Treatment options presented in the questionnaire were eye drops, surgery, laser, no treatment and cannot say. Knowledge was graded as good, fair and poor by two ophthalmologists independently based on the subjects collective responses to questions on the definition of glaucoma, patho-physiological risk factors and treatment aspects.

Defining knowledge levels of glaucoma: A subject was considered to have good knowledge, if he/she was able to identify the risk factors for glaucoma such as increased IOP, family history, and steroid use and was further able to meaningfully describe the condition and identify therapies for glaucoma such as eye drops, laser peripheral iridectomy, surgery. Fair knowledge was considered if at least two of the risk factors were identified and a description on at least one treatment option was correctly provided. Subjects were considered to have poor knowledge, if they were unable to identify even a single risk factor or treatment option for glaucoma.

Greater importance was given for the risk factors and description for grading knowledge. The key words that we looked for in the description were "increased eye pressure", "loss of side vision". Agreement was calculated for the two Ophthalmologists in grading the respondent's knowledge. The electronic form of the

data was stored in a MS access database; analysis was performed using SPSS statistical software. The Chi Square test was used to look for significant variations in knowledge and awareness about glaucoma with other studied variables. The influence of age, gender, religion, ethnicity, and economic status on the subject's knowledge and awareness of glaucoma was accessed using multiple logistic regression analysis. Age-gender adjustment was done. A P value less than 0.05 was considered statistically significant.

Results

Out of 500 subjects to whom the questionnaire was administered, three hundred eighty five subjects completed the questionnaire. (Response rate of 77%) Among the responders, 44% were males and 56% were females. The mean age of participants was 54 ± 11 years. Minimum age was 40 years and the maximum age was 103 years. The proportion of subjects in each age cohort decreased with increasing age for both genders; chi square p <0.001 [Figure 1]. Twenty four percent of the respondents were Illiterate, 35% had primary or below primary level of education, 28% had up to secondary level education, 12% had tertiary education. Education information was not available for 1% of the respondents. Eighty three percent of the respondents were Muslims, 13% were indus and 4% were Christians.

A total of 68 (13.5%, 95% CI: 11.76 to 15.24) subjects were aware of glaucoma, the age gender adjusted prevalence of awareness was 13.3% (95% CI: 11.57 to 15.03) [Table 1]. Only 10.95% (95% CI: 9.61 to 12.29) of the subjects felt that glaucoma was treatable. Among these 55 subjects, 37 subjects (68%) of them had heard about glaucoma but could not describe the condition.

There was no association between age group and awareness (p =0.108), however after adjusting for gender the odds for glaucoma awareness increase with increasing age. Subjects in the age groups 60 - 79 years were 2.7 to nearly 3 times more likely to be aware about glaucoma when compared to 40 - 49 year olds [Table 2], females when compared to males seemed to have higher levels of awareness, (Adjusted OR- 1.54; 95% CI: 1.06 to 2.25). Education levels clearly seemed to influence glaucoma awareness independent of age, gender, religion and ethnicity. (p <0.001) The wider confidence intervals are due to the fewer number in the literacy and illiterate categories. Subject's awareness of glaucoma was not influenced by the disease state (p =0.347) (either glaucoma or diabetes). Muslims were 4 times more likely to be aware of glaucoma when compared to Hindus. (Adjusted OR: 4.16, 95% CI: 1.41 to 12.5). People with family history of glaucoma when compared to those without family history were more likely to be aware of glaucoma (Adjusted OR:5.51, 95% CI: 2.21 to 13.75) [Table 2].

Knowledge about the risk factors for glaucoma among the study participants is presented in [Table 1]. Among the study participants only 8% considered increased IOP as a risk factor. Of the 55 people who were aware of glaucoma, 64.5% had knowledge about glaucoma.

In our effort to find out the predictors of glaucoma knowledge, we categorized subjects with good and fair knowledge as "subjects with knowledge" and those with poor knowledge as "subjects without knowledge" about glaucoma. Of the entire population, 8.7% had knowledge about glaucoma. Among them 0.5% had good knowledge about glaucoma, 4% had fair knowledge and 4.2% had poor knowledge. We observed a very good agreement between the clinicians in grading knowledge (k =0.92). [Table 3] shows the subjects knowledge level on treatment options for glaucoma. Knowledge levels about glaucoma were similar across both the males and females. (adjusted OR for males: 1.33, 95% CI: 0.75 to 2.38) [Table 2]. Age groups were not associated with knowledge of glaucoma (p =0.771).

We analyzed the effect of education on the subject's knowledge levels about glaucoma. Subjects without any formal education were considered as "illiterates" and the other categories are those with primary (1-5 years of education), secondary (5-10 years of education) and tertiary levels of education (education levels from 10+2 to degree or more). Subjects with primary level education were 9 times more knowledgeable about glaucoma than illiterates.

(adjusted OR:8.93; 95% CI: 1.14 to 69.86), people with secondary education were 27 times more likely to be knowledgeable than illiterate subjects and subjects with tertiary levels of education were 72 times more likely to be knowledgeable than the illiterates. (Adjusted OR: 71.8; 95% CI: 9.2 to 560.26) [Table 2].

Glaucoma patients were more likely to be knowledgeable than the normal subjects. (Adjusted OR: 1.82, 95% CI: 1.01 to 3.26) [Table 2]; however diabetic status did not significantly predict knowledge about glaucoma. (Adjusted OR: 1.09, 95% CI: 0.59 to 2.00). Likewise religion and mother tongue did not influence the knowledge about glaucoma. (p =0.655) [Table 3]. Persons with family history of glaucoma were 5 times more likely to be knowledgeable about glaucoma when compared to those without family history of glaucoma. (Adjusted OR: 4.57, 95% CI: 1.77 to 11.78) [Table 2]. Major determinants of glaucoma awareness were higher levels of education, age and muslims and that of knowledge of glaucoma were higher levels of education and glaucoma patients.

Discussion:

Glaucoma is an irreversible and asymptomatic condition until the advanced stage. Early detection and treatment plays a pivotal role in control of blindness due to glaucoma. One third of the patients who had become blind from glaucoma had done so even before they had sought medical attention. [8] Awareness does not mean that subject knows everything about the disease; it just means that he/she has heard about the condition.

Previous studies have showed that even though most people claim to be aware of the condition less than a percent could describe its symptoms or patho-physiology correctly.[18] Knowledge about the disease would be more useful, as it is presumed to influence their ocular health-seeking pattern. Age and sex adjusted prevalence of primary glaucoma in Jessore was 4.39%.[2,3] The age and sex adjusted glaucoma awareness rate among the general population of Jessore was 13.3% and only 8.7% of the Jessore residents had some knowledge about glaucoma.

Knowledge level about glaucoma between the Hong Kong (10.2%)[18] and Jessore (8.7%) populations were comparable. Dissimilarities exist in awareness levels between the two countries; we presume it could be largely due to easy access to health care and better utilization of eye care services for glaucoma in Hong Kong [Table 4]. In our study, glaucoma awareness was lower than reports from the developed Nations (United States, Australia, Singapore and Hong Kong).[6] In well-educated western population (Blue Mountains Eye Study population), 93% of participants were aware of glaucoma [Table 4], the proportion of undiagnosed glaucoma among all cases was found to be very high;[20] these undiagnosed glaucoma cases are a cause for alarm considering the low levels of awareness regarding the disease in our population.

In our study, we observed that people with family history of glaucoma and women were more likely to be aware and had good knowledge of glaucoma. Illiterates and people with below primary level of education were more likely to be unaware about glaucoma; this was consistent with studies done elsewhere.[6,14,15,18,21,22] and indicates the lack of education about glaucoma among those who are at risk. It calls for urgent health education on glaucoma, targeting initially, the population at risk.

Health promotion and communicating risk is a key public health strategy.[5,11,23] Public awareness of vision care especially glaucoma is very low. Effective health education about eye care may influence the behavior of individuals, to consider regular ocular care. Communicating visual prognosis by primary health clinicians and primary eye care practitioners would help enhance the knowledge and compliance among glaucoma patients. The education programs need to target the known cases, due to their disease status or other epidemiological risk characteristics such as people with family history of glaucoma, aged people and angle closure. The aims of education should focus not only on modifying individual's perception of risk of vision loss, but also on providing information regarding the benefits of early detection and treatment. In addition, education programs should

also be oriented towards the involvement of friends and family members in supporting the seeking of eye care and in alleviating the fear or anxiety concerning treatment.[5] It is important to note that the benefits of eliminating barriers to access can be fully realized only when the issue of adequate utilization of preventive services is also addressed. Studies across the globe have clearly documented the potential cost savings associated with regular preventive eye care as compared to cost of vision loss.[11] Community level programs and initiative taken as part of the World Glaucoma Day in increasing awareness on glaucoma through various media and setting up patient awareness groups would help improve the awareness in this population.[24]

It is also essential to ensure early detection through 'opportunistic case detection' by performing a comprehensive eye examination at every available instance, and commencing treatment or appropriate referral so as to meet the increased demand for services that is expected following effective health promotion and raised awareness about glaucoma.

In summary, awareness levels and knowledge about glaucoma were very low in our population. Younger subjects and men were less aware of glaucoma. Subjects with lower levels of education were less aware and knew less about glaucoma than their counterparts. The study findings stress the need for health education to effectively prevent blindness due to glaucoma.

Figure 1: The distribution of study subjects by age group and gender (n=500)

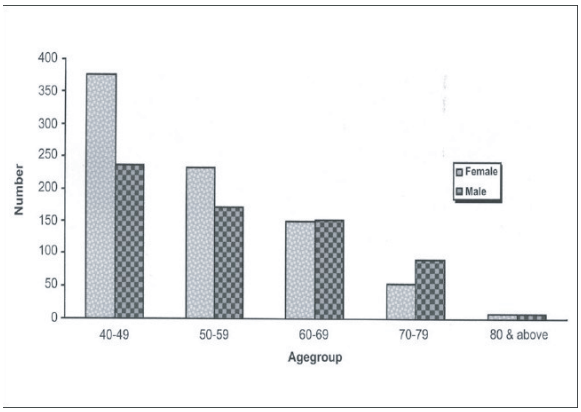

Table 1: Frequency distribution of awareness and knowledge of glaucoma among study participants

Variable	%
Awareness	
Have you ever heard of the eye condition glaucoma	13.5
Not aware of glaucoma	86.5
Is glaucoma treatable?	10.0
Knowl edge	
Risk factors for glaucoma	
One factor	
Obesity	0.14
Increased IOP	8.11
Steroids	0
Chronic smoking+ alcohol using	0.405
Family history of glaucoma	1.42
Diabetes	1.35
Two factors	
IOP and steroid	0.47
IOP and family history	1.55
Steroid an d family history	0.41
Three factors	
IOP and steroids and family history	0.27
Risk factors not known	15.5
Meaningful description of glaucoma	
Key words	
Increased IOP	1.48
Loss of side vision	0.47

Table 3: Frequency distribution of treatment procedure for glaucoma among study participants

Variables therapies for treating glaucoma	%
Aware of only a single therapy	
Eye drops	66
Surgery	21
Laser treatment	34
Aware of two therapies	
Eye drops and Surgery	6
Eye drops and Laser treatment	10
Surgery and Laser treatment	10
Aware of more than two therapies	
Eye drops ,Surgery and Laser treatment	15
Treatment not known	32
Can't say/ no answer	6

Table 4 : Glaucoma awareness and knowledge level across the globe.

Author	Year	Country	Study population	Awareness of glaucoma%	Knowledge of glaucoma%
Present study	2011	Jessore, Bangladesh	Urban population- Adult above 40 yrs	13.30	8.70
Dandona et al [15]	2001	India	Urban population- Adult above 15 yrs	2.30	Not reported
Krishnaiah et al	2005	India	Rural population- Adult above 15 yrs	0.27	0.012
Gasch et al [20]	2000	USA	General eye service population- All ages	72	Not reported
Mitchell et al [19]	1996	Australia	Community – Adult above 49 yrs	93	Not reported
Livingston et al [21]	1995	Austrelia	Community – Adult above 40 yrs	70	Not reported
Michielutte [14]	1984	USA	Community - Above 14 yrs	81	Not reported
Saw et al [6]	2003	Singapore	Tertiary eye hospital patients Adults 35yrs and above	23	Not reported
Lau et al [18]	2002	Hong kong	Community – Adult above 49 yrs	78.40	10.20

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Review Article

Diagnostic Challenges in Normal Tension Glaucoma

M M Hossain[1]

Introduction :

Normal tension glaucoma (NTG) can be a challenging condition to diagnose and manage. Although it is similar in many aspects to high tension primary open-angle glaucoma (POAG), several clinical aspects differentiate the two conditions. The most obvious difference is that intraocular pressures tend to run at the lower end of the spectrum in normal tension glaucoma. But other, more subtle differences also may be found in patients with NTG.

Whether NTG is a separate entity from primary open angle glaucoma or part of the spectrum of disorders remains unknown. It is likely that both NTG and POAG represent groups of disorders that share common clinical features such as a characteristic progressive optic nerve appearance and pattern of retinal nerve fiber loss. However, until the pathophysiology of glaucoma is better characterized or distinct genes are identified that account for most NTG and POAG cases, some authors still tend to think of NTG as a subset of POAG.[1]

Discussion :

Because the intraocular pressure is usually normal in persons with NTG, making the diagnosis of NTG requires more attention to other details, especially the optic nerve examination. When the intraocular pressure is elevated, we naturally tune into the possibility of glaucoma. However, with the pressure normal, we need to remain vigilant and look for other clues of glaucoma.

It may be important, but not always possible, to rule out other conditions that mimic NTG. The most common condition that looks like NTG is primary open-angle glaucoma. The intraocular pressure in POAG may be intermittently in the "normal" range (i.e., below 21 mm Hg) and we may have happened to catch the person when the pressure was low. Subsequent measurements at different visits and/or different times of the day may reveal elevated pressures consistent with high tension glaucoma.

We know that corneal elasticity can affect Goldmann applanation measurements. Persons with thin central corneal thickness or low corneal hysteresis tend to have Goldmann applanation pressures that are lower than their true intraocular pressures. Persons with NTG tend to have thinner central corneal thickness than normal or high tension glaucoma patients, so it may be that some NTG patients truly do have elevated intraocular pressures.[2]

Because a hallmark of NTG is its progressive nature, we are frequently unable to make a definitive diagnosis of NTG at the initial visit. This is technically true for POAG as well; however, when I see a person with elevated intraocular pressure, optic nerve cupping and characteristic visual field loss, I usually make the diagnosis of POAG even without documented progression.

In the absence of elevated intraocular pressure, I feel more comfortable with the initial diagnosis of NTG suspect and I look for other possible causes of optic nerve cupping. Optic nerve cupping may have been caused by a prior history of elevated pressure, due to iritis, pigmentary dispersion, steroid usage or intermittent angle closure. Other optic neuropathies can cause shallow cupping, so I inquire about past history of sudden vision loss, perhaps due to optic neuritis or anterior ischemic optic neuropathy. Acute or severe blood loss or anemia can result in an optic

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neuropathy that resembles cupping, so I ask about major surgeries or trauma or blood transfusions. I have very rarely requested brain imaging in a NTG suspect and only for unilateral cupping. In the absence of other neurologic signs, I do not think the yield of an MRI or CT scan is very high.

After a detailed history and review of systems has eliminated or lessened the likelihood of another cause, I then look for exam findings that may suggest NTG. If one eye has consistently higher intraocular pressure than the fellow eye then I would expect that eye to have worse cupping in NTG. Gonioscopy to rule out intermittent angle closure or pigment accumulation due to pigmentary dispersion or pseudo exfoliation is critical but often must be done during a return visit if the pupil is already dilated when the suspicion for glaucoma is raised. In my experience, the optic nerve cupping in NTG patients tends to be shallower than in high tension glaucoma.

Peripapillary atrophy and disc hemorrhages are common in normal tension glaucoma and so the presence of either or both is suggestive of NTG. As with POAG, the extent of optic nerve changes in NTG may be asymmetric between the two eyes but severe asymmetry (>0.2 difference in cup-to-disc ratio), especially in the absence of IOP asymmetry, makes me concerned about other causes.

Visual field defects in normotensive are similar to those found in primary open-angle glaucoma. Some reports in the literature suggest that NTG visual field defects are more often "deep and steep" and nearer to fixation. Nerve fiber layer analysis should confirm glaucomatous pattern loss with localized thinning primarily at the inferior and superior sectors. Corneal pachymetry is often helpful. Thin central corneas increase my concern because Goldmann applanation

We have learned from the Collaborative Normal Tension Glaucoma Study that the natural course of NTG is highly variable, with some patients suffering continued optic nerve damage within a few months, while others show no change at all over five years.[3] Factors that were found to be risks for progression were being female, having a history of migraines, and having disc hemorrhages.[4] We also learned that lowering intraocular pressure by at least 30% slows the progression of the disease but that some patients will still progress despite treatment.

I monitor my patients with NTG in much the same way I monitor my patients with other forms of glaucoma, with serial visual field testing and optic nerve evaluations/ imaging. Visual field testing is quite variable in NTG, and multiple fields are needed to confirm true progression. In the Collaborative Normal Tension Glaucoma Study, three confirmatory visual fields were used before progression was declared.[5] More recent visual field testing algorithms, such as SITA-standard, may be less variable but I still want to see at least two confirmatory fields before I am convinced that progression has occurred. Even the recently developed Glaucoma Progression Analysis probability plots and the Visual Field Index linear regression analysis require multiple (three or more) tests to demonstrate likely progression.

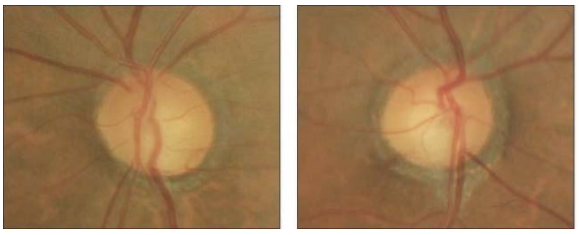

Figure 1. A 65-year-old woman with normal tension glaucoma. Prior to treatment, her IOP typically measured in the 15-18 mm Hg range (highest 20 mm Hg). Optic nerves have shallow cups and thinning of the inferior neuroretinal rim in each eye. Right optic nerve showed a disc hemorrhage inferotemporally before treatment was initiated. Visual fields consistently show severe superior arcuate and nasal step defects in each eye. Corneal pachymetry was 490 µm (OD) 500 µm (OS).

I rely on serial retinal nerve fiber layer analysis/ imaging to monitor optic nerve structure. Since criteria for progression with imaging technologies is not well established for the newer technologies such as OCT or GDx. I want to see structure-function correlation with the visual fields. Seeing disc hemorrhages raises my suspicion that progression is occurring but I still want to see corroborating

evidence on visual field testing or optic nerve imaging.

Conclusions :

Diagnosis of patients with normal tension glaucoma remains a challenging endeavor because IOP is already relatively low. In addition, factors other than IOP probably play a more important role in NTG than in high-tension glaucoma, but lowering IOP is still our only proven treatment. Thus, we may be more limited in our ability to mitigate the natural course of disease with NTG compared to high tension glaucoma. Diagnosing and managing patients with NTG requires diligence and persistence, but with proper care most patients with NTG maintain good visual functioning.

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Medical management of primary open angle glaucoma

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Summary

According to the American Academy of Ophthalmology Preferred Practice Patterns, primary open angle glaucoma (POAG) is defined as an optic neuropathy with associated visual field loss for which elevated intraocular pressure (IOP) is a major risk factor. As a result, most of our treatment strategies are directed at reducing IOP, either with medical therapy, laser surgery, or incisional surgery, with medical therapy being the most common initial course of treatment. Two important questions often confront a glaucoma specialist when initiating therapy: Who needs to be treated? and How should a patient be treated and to what extent? With advent of newer drugs with improved efficacy, reduced frequency of dosing, and fewer ocular and systemic side effects, our treatment options have been expanded. While it is important to have more choices, it also adds confusion as to which medication may be best suited for a particular patient. In general, the goal of treatment is to choose a therapeutic agent that is effective, safe, tolerable, and affordable to ensure patient acceptance and adherence. This brief review provides a summary of various classes of drugs available at present for glaucoma treatment. Their mechanisms of action and side effects are described to help clinicians choose primary therapy or adjunctive therapy to lower IOP and to ultimately slow down the progression of glaucoma to preserve visual function.

Disease Entity

Glaucoma refers to a group of disorders which causes progressive optic neuropathy with the major risk factor being elevated intraocular pressure. Glaucoma can exist at any level of intraocular pressure; however, prevalence increases with uncontrolled IOP affecting the optic nerve and resulting in subsequent loss of visual function. Glaucoma is the leading cause of irreversible blindness worldwide and the 2nd leading cause of blindness in Bangladesh.

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Disease

Primary open angle glaucoma is characterized by the presence of an anatomically open angle on gonioscopy; chartacteristic optic nerve changes, such as cupping and/or thinning or the neuroretinal rim; and characteristic patterns of viual field loss.

According to the Preferred Practice Patterns of AAO, two of the three findings (elevated IOP, optic nerve damage, or visual field loss) must be present for the diagnosis of primary open angle glaucoma.

Risk Factors

Family history, Age, Race , increased intraocular pressure, thin central corneal thickness. Other possible risk factors include: perfusion pressure, coronary artery disease, diabetes, myopia

Pathophysiology

Not entirely understood. Two commonly discussed theories are:

1) Mechanical theory-direct pressure induced-damage to the retinal ganglion cell axons at the level of the lamina cribrosa.

2) Vascular theory-microvascular changes and resultant ischemia in the optic nerve head.

Primary prevention

The only way we currently know to prevent and/or

delay primary open angle glaucoma is by reducing the intraocular pressure.

Diagnosis

POAG is diagnosed by taking a comprehensive history, clincal exam, and visual field testing. Optic nerve and nerve fiber layer imaging by Heidelberg retinal tomography (HRT), optical coherence tomography (OCT), or laser scanning polarimetry (GDx) can aid in the evaluation and diagnosis.

Signs

Elevated Intraocular pressure, corneal edema (typically only seen with acutley elevated IOP), optic nerve asymmetry, optic nerve cupping, neuroretinal rim thinning/notch

Symptoms

Symptoms are typically only experienced with acutly elevated IOP or with advaced optic nerve damage, resulting in visual field loss.

Clinical diagnosis

Comprehensive eye exam including evaluation of: visual acuity, afferent pupillary defect, gonioscopy, slit lamp exam, dilated fundoscopic exam, confrontation visual fields (later confirmed by standard automated perimetry)

Differential diagnosis

- Physiologic optic nerve cupping: Typically normal IOP, large optic nerves, and static appearance
- Congenital disc anomalies: optic nerve coloboma, congenital pit, and tilted disc syndrome
- Normal Tension Glaucoma
- Ocular hypertension (high IOP in the presence of normal optic nerves and visual field)
- Secondary open-angle glaucoma: e.g pigmentary, steroid induced, lens particle, etc
- Previous glaucomatous damage: Due to prior episodes of elevated intraocular pressure, e.g. from trauma, uveitis, steroid use, that have resolved. IOP is normal and optic nerve appearance remains static.
- Acquired conditions: e.g. arteritic anterior ischemic optic neuropathy, compressive lesions such as intracranial

Management

Current treatment of glaucoma is limited to lowering the intraocular pressure to a level that will decrease the likelihood of further optic nerve damage. Most ophthalmologists initially try medical management or laser trabeculoplasty (ALT or SLT). If conservative therapy fails, then incisional surgery with either trabeculectomy or glaucoma drainage implant may be required. Once the decision to treat has been made, one has to decide how much to treat. Factors such as age of patient, life expectancy, and other risk factors must be kept in mind. It is essential to obtain a full history of concomitant systemic diseases to avoid side effects. The goal of treatment should be preservation of vision as well as quality of life.

General treatment

Glaucoma clinical trials over the past 20 years have provided critically important, evidence-based guidelines in the management of patients with glaucoma. Whether treatment is provided with medical therapy, laser, or surgery, these trials have shown that glaucoma development and progression can be controlled by lowering IOP, a well-established risk factor for glaucomatous optic neuropathy. IOP lowering has been found to be beneficial even in eyes with normal tension glaucoma. The Collaborative Normal Tension Study Group found that a 30% IOP reduction dropped the rate of progression from 35% in the observation group to 12% in the treated group. The Early Manifest Glaucoma Trial (EMGT) found that an IOP reduction by at least 25% reduced progression from 62 %to 45% in the treated group compared to an untreated group. Setting an initial target of 20-30% IOP reduction is recommended, however it is very important to constantly reassess for

optic nerve or visual field changes, and change target pressure, as needed.

Medical therapy

The medications currently used to treat glaucoma work by lowering the intraocular pressure by two main mechanisms 1) reducing aqueous humor production and/or 2) increasing aqueous humor outflow.

MEDICATIONS THAT SUPPRESS AQEUOUS HUMOR PRODUCTION

Beta Blockers

Mechanism of action: Lower IOP by suppressing aqueous humor production. They inhibit synthesis of cyclic adenosine monophosphate (c-AMP) in the ciliary epithelium and lead to a decrease in aqueous secretion.

Side Effects: Ocular side effects of topical beta-blockers are minor and include burning and decreased corneal sensation. Systemic side effects can be more severe. They include bradycardia; arrhythmia; heart failure; heart block; syncope; bronchospasm or airway obstruction; central nervous system effects (depression, weakness, fatigue, or hallucinations); impotence, and elevation of blood cholesterol levels. Topical beta-blockers have been shown to decrease HDL and increase cholesterol. Diabetics as may experience reduced glucose tolerance and hypoglycemic signs and symptoms can be masked. Beta-blockers may aggravate myasthenia gravis and abrupt withdrawal can exacerbate symptoms of hyperthyroidism. The beta-1 selective antagonist, betaxolol, has fewer pulmonary side effects.

Adrenergic Agonists

Mechanism of action: Lower IOP through alpha 2 agonist mediated aqueous suppression and a secondary mechanism that increases aqueous outflow.

Nonselective adrenergic agonists such as epinephrine lower IOP by several different mechanisms. Initially, a vasoconstrictive effect decreases aqueous production and c-AMP synthesis increases the outflow facility.

Side Effects: Ocular side effects include follicular conjunctivitis, burning, reactive hyperemia, adrenochrome deposits, mydriasis, maculopathy in aphakic eyes, corneal endothelial damage, and ocular hypoxia. Systemic side effects include hypertension, tachycardia and arrhythmia. Dipivefrin is a prodrug that is hydrolyzed to epinephrine as it traverses the cornea. It has significantly fewer systemic side effects than epinephrine. The potential side effects of nonselective adrenergic agonists has led to decline in their use.

Selective adrenergic agonists include apraclonidine and brimonidine (0.1-0.2%) with the latter having much greater selectivity at the alpha 2 receptor.

Brimonidine (0.1-0.2%) appears to also increase uveoscleral outflow and lower IOP by about 26%.

Side Effects of selective adrenergic agonists: Common ocular side effects include contact dermatitis (40% with apraclonidine, < 15% for brimonidine, and <0.2% for brimonidine-Purite), follicular conjunctivitis, eyelid retraction, mydriasis, and conjunctival blanching. Systemically, they can cause headache, dry mouth, fatigue, bradycardia, and hypotension. Long-term use of topical apraclonidine is frequently associated with allergy and tachyphylaxis. The use of brimonidine is contraindicated in infants and young children (especially those with low body weight) due to an increased risk of somnolence, hypotension, seizures, and apnea, believed to be due to increased CNS penetration of the drug secondary to high lipophilicity. Generally, brimonidine seems to produce fewer ocular side effects than apraclonidine.

Carbonic Anhydrase Inhibitors (CAI)

Mechanism of action: Lower IOP by decreasing aqueous production by direct antagonist activity on the ciliary epithelial carbonic anhydrase. Over 90% of ciliary epithelial enzyme activity needs to be abolished to decrease aqueous production and lower IOP. Systemic CAI include acetazolamide (Diamox) and methazolamide (Neptazane). Topical CAI are

brinzolamide 1% (Azopt) and dorzolamide 2% (Trusopt). A 14-17% reduction in IOP is seen with these agents. Side Effects: Systemic CAI are associated with numerous side effects, including transient myopia; parasthesia of the fingers, toes, and perioral area; urinary frequency; metabolic acidosis; malaise; fatigue; weight loss; depression; potassium depletion; gastrointestinal symptoms; renal calculi formation; and rarely, blood dyscrasia. Due to the side effects of the systemic CAI, they are most useful in acute situations or as a temporizing measure before surgical intervention. The topical CAI have significantly fewer systemic side effects than oral carbonic anhydrase inhibitors and have been reported to have clinical efficacy comparable to that of timolol. Common side effects of topical CAI include bitter taste, blurred vision, punctate keratopathy, and lassitude.

MEDICATIONS THAT INCREASE AQUEOUS OUTFLOW

Prostaglandin Analogs

Mechanism of action: Lower IOP by increasing aqueous outflow through the unconventional outflow pathway or uveoscleral outflow. The exact mechanism by which prostaglandins improve uveoscleral outflow is not full understood, but may involve relaxation of the ciliary muscle and remodelling of the extracellular matrix elements of the ciliary muscle. These agents have been shown to increase the outflow by as much as 50%.

Latanoprost and travaprost, and bimataprost (prostamide), represent the newest, the most effective, and most commonly used class of medications. Latanoprost 0.005% and travaprost 0.004% are pro-drugs that penetrate the cornea and become biologically active after being hydrolyzed by corneal esterases. Bimataprost 0.03% decreases IOP by increasing uveoscleral outflow by 50% and increasing trabecular outflow by approximately 25-30%. Both latanoprost and travaprost reduce IOP by approximately 25-30%.

Side Effects: Ocular and systemic side effects such as conjunctival injection, hypertrichosis, trichiasis, hyperpigmentation of periocular skin and hair growth around the eyes are generally were well-tolerated. These tend to be reversible with cessation of the drug. A unique side effect is increased iris pigmentation which is thought to be secondary to increased melanin content in the iris stromal mealnocytes without proliferation of cells. This tends to occur in 10-20% of blue irides within 18-24 months of initiating therapy, and 60% eyes with mixed green-brown or blue-brown irides. Use of prostaglandin analogs and prostamides have also been associated with exacerbations of herpes keratitis, anterior uveitis, and cystoid macular edema in susceptible individuals.

Parasympathomimetic Agonists

Mechanism of action: Lower IOP by increasing aqueous outflow related to contraction of the ciliary muscle in eyes with open angles and pupillary constriction in cases of pupillary block glaucoma.

Topical cholinergic agonists such as pilocarpine cause contraction of the longitudinal ciliary muscle, which pulls the scleral spur to tighten the trabecular meshwork, increasing outflow of aqueous humor. This results in a 15-25% reduction in IOP. The direct agents (pilocarpine) are cholinergic receptor agonists; the indirect agents (echothiophate iodide) inhibit cholinesterase and prolong the action of native acetylcholine. Carbachol is a mixed direct agonist/acetylcholine releasing agent.

Side Effects: Systemic side effects of pilocarpine are rare; however, ocular side effects are common. Ocular side effects include brow ache, induced myopia, miosis (leading to decreased vision), shallowing of the anterior chamber, retinal detachment, corneal endothelial toxicity, breakdown of the blood-brain barrier, hypersensitivity or toxic reaction, cicatricial pemphigoid of the conjunctiva, and atypical band keratopathy

COMBINATION MEDICATIONS Fixed combination medications offer the potential advantage of increased convenience, compliance, efficacy, and cost.

In Bangladesh there are currently 2 fixed-combination medications on the market, (1) Dorzolamide hydrochloride 2% and timolol maleate ophthalmic solution 0.5% and (2) Brimonidine tartrate 0.2% and timolol maleate ophthalmic solution 0.5%. Prior to initiating monotherapy with a fixed-combination medication, it is important to prove the efficacy of the individual components of the medications. The efficacy and ocular side effects for both fixed-combination medications are similar to their individual components. The efficacy and tolerability of both dorzolamide hydrochloride-timolol maleate 2%/0.5% and brimonidine tartrate-timolol maleate 0.2%/0.5% appear to be similar to each other.

HYPEROSMOTIC AGENTS

Hyperosmotic agents such as oral glycerine and intravenous mannitol can rapidly lower IOP by decreasing vitreous volume. They do not cross the blood-ocular barrier and therefore exert oncotic pressure that dehydrates the vitreous. Side effects associated with the hyperosmotic agents can be severe and include headache, back pain, diuresis, circulatory overload with angina, pulmonary edema and heart failure. Because of these potentially serious side effects, they are not used as long-term agents. They are typically used in acute situations to temporarily reduce high IOP until more definitive treatments can be rendered.

Goal of treatment for POAG

Slow or arrest Retinal ganglionic cell death and thereby stabilizing visual field by achieving Target intraocular pressure.

Setting of Target IOP

Method:

Target IOP=maximum IOP - maximum IOP% - Z

Z-0 Normal disc & Visual Field

Z-1 Abnormal disc & normal Visual Field

Z-2 Visual Field loss not threaten fixation

Z-3 Visual Field loss threaten fixation

Rational for Target intraocular pressure

Intra-Ocular pressure is the main risk factor for glaucoma and it is the only risk factor that can be modify

Medical treatment for POAG

Primary open angle glaucoma treatment depends upon the stage of the disease, the level of IOP at which damage occurred or continues to progress and the estimated lifetime risk of visual disability for patients.

Initial medical treatment depends upon the baseline IOP and the presence of other risk factor. A target pressure for the patient needs to be set and an assessment made for achieving the target pressure.

Principles of drug choice:

Initial treatment with one drug either beta-blocker or prostaglandin analogue. Start with lowest concentration and Infrequent dose. Drug with fewest potential side effects should be choice.

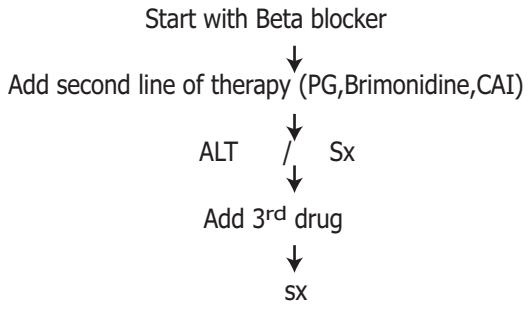
Follow-up after 4 weeks:

- Response satisfactory: continue the treatment.
- Response unsatisfactory:

  Initial drug is withdrawn and another substituted.

  If response but still unsatisfactory. In this situation add another drug.

Flow chart of glaucoma therapy



Anti-glaucoma therapy in pregnancy and nursing mother

- CAI - Teratogenic in rodent
- Prostagandins-Increase uterine contraction. So risky in pregnancy.
- Beta blocker concentration 5 fold in breast milk so also risky in lactating mother.
- Brimonidine-Due to increase permeability of Blood Brain Barrier of infant it may causes Apnea, Hypotension and Bredicardia.

Medical compliance and Adherence

It is a major issue for long term management of POAG and may improve by simplification of regimes, education and self reporting of drugs. Patient cooperation, understanding and realization may also improve compliance and adherence.

Causes of failure of medical treatment

Inappropriate target pressure fix up is the main cause of failure of medical treatment. Non-compliance with therapy of the patients and Wide fluctuation of IOP are other causes of failure of medical treatment

New horizone for POAG

Neuroprotection ,Stem cell theray and Gene therapy are new thinking for POAG management.

Prognosis

Most patients with glaucoma retain useful vision for most of their lives if caught early and treatment is initiated. Incidence of unilateral blindness has been reported to be 27% and bilateral blindness 9% at 20 years following diagnosis.

Conclusion messages

The goal of medical treatment is to choose a therapeutic agent that is effective, safe, tolerable and affordable to ensure patient acceptance and adherence.

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Medical Management of Primary Angle Closure Glaucoma

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Abstract

Primary angle closure glaucoma (PACG) is a leading cause of blindness worldwide. It is equally prevalent in Asian population as the primary open angle glaucoma. Eighty-six percent of people with PACG are in Asia, with approximately 48.0% in China, 23.9% in India and 14.1% in southeast Asia. To understand PACG, it is mandatory to understand its classification and type of presentation with the underlying pathophysiology. The treatment options are medical, laser and/or surgical. The present article provides an information regarding classification, presentation and medical treatment of PACG.

Keywords

Acute attack glaucoma, laser iridotomy, primary angle closure, primary angle closure suspect, primary angle closure glaucoma, chronic angle closure glaucoma.

Introduction

Glaucoma is ranked as the leading cause of irreversible blindness worldwide by the World Health Organization.[1] It has been estimated that 3.9 million people with glaucoma will be blind due to primary angle closure glaucoma (PACG) by 2010. By 2020, this number is projected to increase to 5.3 million.[1] Eighty-six percent of people with PACG are in Asia, with approximately 48.0% in China, 23.9% in India and 14.1% in southeast Asia.[2] These numbers highlight the importance of understanding the disease, its natural history, and its underlying pathophysiology, so that we may try to establish effective methods of treatment and preventative

measures to delay, or even arrest, disease progression, thereby reducing visual morbidity.

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Epidemiology

In China, it is estimated that nearly one in six individuals over the age of 50 has an angle appearance that puts him/her at risk of PACG and acute angle closure attacks. Asian populations are aging so the number of people with PACG will increase dramatically in the coming decades. While it is often said that Chinese populations (and others in East Asia) have ten times the risk of PACG as Europeans, the truth is that in carefully conducted studies the number is closer to four times as much, and nearly one in 200 Europeans over the age of 40 has PACG. In Bangladesh according to survey by Prof. Mustafizur Rahman it was shown that o.5% of population above 40 yrs are suffering from PACG. PACG occurs in about 0.5% of whites and blacks over the age of 40, and about 1.5% of Chinese and Indian individuals in this age group, but is much more common in older population.

PACG is often missed in these populations, and efforts must be taken to identify it so that needless loss of vision is avoided. Furthermore, it is essential that adequate evaluation is given to the higher risk populations (older persons, Asians, and in particular, older woman.)

Classification

In order to allow for more uniform reporting, and to improve how we think about the mechanisms of angle closure, a new terminology was proposed and subsequently modified during a consensus panel meeting involving over 100 glaucoma specialists from around the world. There are currently four categories for describing persons with angle closure, three of which require specific gonioscopic findings. Each of these requires that the pigmented trabecular meshwork is blocked by iris (what is termed

"iridotrabecular contact or ITC") in at least one quadrant. There is no firm agreement on how many quadrants must have ITC for angle closure to be present, but current consensus appears to be that at least 180 degrees is required. The amount of ITC is determined in a dark room using a one mm beam on a bright setting while performing gonioscopy. Greater amounts of illumination (a long wide beam, for example) will allow light to enter the pupil which can artificially open the angle.

Patients with primary narrow angle may be classified as a primary angle closure suspect (PACS), or as having primary angle closure (PAC) or primary angle closure glaucoma (PACG)[3]

Management of patients with PAC depends on the type of clinical presentation, making the diagnosis of PACS, PAC or PACG, as well as correctly identifying the underlying pathophysiology. Treatment options may be medical, laser and/or surgical.

1. Primary Angle Closure Suspect (PACS): Some people are completely normal except for the fact that the anterior chamber angle has ITC on gonioscopy. There is no "disease" present, and no evidence of harm to the patient. The clinician is concerned by the appearance, but the IOP and the optic nerve are both normal, and there are no peripheral anterior synechiae. How much angle closure must be present to apply this categorization remains controversial, but I typically use 180 degrees or more. Gonioscopy is performed as above, having the patient look straight ahead and only modestly tilting the lens if the view is difficult. Again, this is a somewhat subjective evaluation, but there are no better approaches available.

2. Primary Angle Closure (PAC) : This category includes people with ITC for 180 degrees or more as described above for PACS. Furthermore, these people have some evidence that the angle appearance is causing harm to the eye. More specifically, they have either peripheral anterior synechiae (PAS) or elevated IOP, but they do not have optic nerve damage and visual field loss. This condition is considered pathologic (although there is almost no long-term data on people with these findings), and most clinicians recommend laser iridotomy for these people.

3. Primary Angle Closure Glaucoma (PACG): This category requires the presence of ITC for 180 degrees or more, as described above, along with glaucomatous optic neuropathy and visual field loss. The glaucoma definition requires the same findings as one would expect for open-angle glaucoma.

4. Chronic Angle Closure Glaucoma

Chronic angle-closure glaucoma (CACG) refers to an eye in which portions of the anterior chamber angle are closed permanently by peripheral anterior synechiae (PAS). Variable and sometimes conflicting terminology has been used to describe different appearing forms. The problem arose from the fact that the terminology developed prior to the advent of indentation gonioscopy and laser iridotomy when the mechanisms of angle-closure glaucoma were poorly understood.

The 5 types now recognized are as follows: (1) CACG, (2) combined mechanism, (3) mixed mechanism, (4) plateau iris, and (5) miotic-induced angle-closure glaucoma.

In the era of surgical iridectomy, an attack of acute angle-closure glaucoma(AACG) could arise in an eye that had developed PAS because of gradual angle-closure prior to the development of the attack. Conversely, a prolonged acute attack or a series of subacute attacks could lead to progressive PAS formation. Patients undergoing surgical iridectomy were dilated routinely after surgery. Shallow anterior chambers were not uncommon. Patients undergoing surgical iridectomy for AACG who were dilated postoperatively and had shallow anterior chambers not infrequently formed PAS.

All of these conditions were lumped under the term CACG. The diagnosis was made because of

the presence of PAS. The term CACG is used to denote eyes in which chronic appositional closure without PAS has led to elevated intraocular pressure (IOP) or in which appositional closure with the formation of PAS has occurred in the presence, and gradually expanding in width. In early cases, in which appositional closure is present and IOP is normal, but in which PAS has not yet formed, the term chronic appositional closure is preferred. This condition can lead to elevated IOP and glaucomatous disc and visual field damage without PAS formation.

Medical Management

PACS : Patients assessed to be at risk of angle closure (AC) warrant prophylactic laser peripheral iridotomy. Prior to laser therapy, a parasympathomimetic like pilocarpine is helpful to induce pupil miosis and iris stromal thinning so that laser may be more easily performed. The á$_2$-agonists like brimonidine work quickly to lower IOP and may be used prior to and/or after laser peripheral iridotomy to prevent an IOP spike. Topical steroids instilled four times daily for a week after laser are beneficial in reducing post-laser intraocular inflammation.

Acute ACG : The treatment of acute angle-closure glaucoma (AACG) consists of IOP reduction, suppression of inflammation, and the reversal of angle closure. Once diagnosed, the initial intervention includes acetazolamide, a topical beta-blocker, and a topical steroid.

Acetazolamide should be given as a stat dose of 500 mg PO. A dose of a topical beta-blocker (ie, carteolol, timolol) will also aid in lowering IOP. Studies have not conclusively demonstrated the superior neuronal or visual field protectiveness of one beta-blocker over another. Both beta-blockers and acetazolamide are thought to decrease aqueous humor production and to enhance opening of the angle. An alpha-agonist can be added for a further decrease in IOP.

Inflammation is an important part of the pathophysiology and presenting symptomology. Topical steroids decrease the inflammatory reaction and reduce optic nerve damage. The current recommendation is for 1-2 doses of topical steroids.

Addressing the extraocular manifestations of the disease is critical. This includes analgesics for pain and antiemetics for nausea and vomiting, which can drastically increase IOP beyond its already elevated level. Placing the patient in the supine position may aid in comfort and reduce IOP. It is also believed that, while supine, the lens falls away from the iris decreasing pupillary block.

After the initial intervention, the patient should be reassessed. Reassessment includes evaluating IOP, evaluating adjunct drops, and considering the need for further intervention, such as osmotic agents and immediate iridotomy.

Approximately 1 hour after beginning treatment, pilocarpine, a miotic that leads to opening of the angle, should be administered every 15 minutes for 2 doses. In the initial attack, the elevated pressure in the anterior chamber causes a pressure-induced ischemic paralysis of the iris. At this time, pilocarpine would be ineffective. During the second evaluation, the initial agents have decreased the elevated IOP and hopefully have reduced the ischemic paralysis so pilocarpine becomes beneficial in relieving pupillary block.

Pilocarpine must be used with caution. Theoretical concerns exist about its mechanism of action. By constricting the ciliary muscle, it has been shown to increase the axial thickness of the lens and to induce anterior lens movement. This could result in reducing the depth of the anterior chamber and worsening the clinical situation in a paradoxical reaction. Despite this, pilocarpine is recommended to be used as an additional agent.[14]

No standard rate of reduction for IOP exists; however, Choong et el identified a satisfactory reduction as IOP less than 35 mm Hg or a

reduction greater than 25% of presenting IOP. If the IOP is not reduced 30 minutes after the second dose of pilocarpine, an osmotic agent must be considered. An oral agent like glycerol can be administered in nondiabetics. In diabetics, oral isosorbide is used to avoid the risk of hyperglycemia associated with glycerol. Patients who are unable to tolerate oral intake or do not experience a decrease in IOP despite oral therapy are candidates for IV mannitol.

Hyperosmotic agents are useful for several reasons. They reduce vitreous volume, which, in turn, decreases IOP. The decreased IOP reverses iris ischemia and improves its responsiveness to pilocarpine and other drugs. Osmotic agents cause an osmotic diuresis and total body fluid reduction. They should not be administered in cardiovascular and renal patients. Choong et el demonstrated that 44% of patients required the addition of an osmotic agent to decrease IOP.[14] Repeat doses may be necessary if no effect is seen and if tolerated by the patient.

When medical therapy proves to be ineffective, corneal indentation (CI) can be used as a temporizing measure to reduce IOP until definitive treatment is available. As the cornea is indented, aqueous humor is displaced to the periphery of the anterior chamber, which serves to temporarily open the angle. This leads to immediate reduction of IOP and occasionally may completely abort the attack. After applying topical anesthetic, any smooth instrument can be used to perform this procedure, including a gonioprism (ideal, if available), or a cotton-tipped applicator. Obviously, a concern with performing CI is the possibility for damage to the corneal epithelium, which may complicate the patient's course.[15]

Laser peripheral iridotomy (LPI), performed 24-48 hours after IOP is controlled, is considered the definitive treatment for AACG. Furthermore, LPI may be offered prophylactically to individuals anatomically predisposed to AACG if identified before the first acute attack.

Chronic PAC/PACG: Once the patient has been treated with laser peripheral iridotomy (and laser iridoplasty where indicated), long-term medical treatment including topical beta-blockers, alpha$_2$-agonists and carbonic anhydrase inhibitors can be used if IOP control remains suboptimal. Recent studies have demonstrated that prostaglandin analogues such as latanoprost, bimatoprost and travoprost are also effective in lowering IOP in chronic PACG, even in the presence of 360° of PAS.[5–10]

In a prospective observational case series[11] of 137 Asian subjects with CACG, the IOP-reducing efficacy of latanoprost was not affected by the degree of PAS. In a crossover comparison of latanoprost and timolol in CACG in Indian patients,[12] those with PAS involving more than 180° achieved greater IOP reductions with latanoprost. A recent case series found significant reduction in IOP with latanoprost in CACG patients with 360° of PAS on gonioscopy.[13] As further evidence, a report of the Third Consensus Meeting of the Association of International Glaucoma Societies on the management of angle closure glaucoma concluded that PGAs are the most effective medical agents in lowering IOP following LPI, regardless of the extent of synechial closure.[14]

Though the mechanism of action of PGA in eyes with closed angles is not well understood, Yet in respect of positive results with the use of PGA in CACG, it has been hypothesized that PGA may increase the uveoscleral outflow by gaining access to the ciliary body either through the partially open part of the anterior chamber angle or through other routes such as the posterior chamber between the iris and lens, the iris root itself, or the sclera.[11]

Parikh et al[15] have also stated that the effect of PGA on IOP reduction is minimal if the patient is treated with pilocarpine

Conclusion

Angle closure can be associated with good visual prognosis, provided it is detected early and the appropriate treatment.

Perhaps one of the most important and cost-effective methods of managing PACG in the population currently is by increasing public awareness of the disease so that patients at risk, such as those with a positive family history or with ocular risk factors, can undergo risk assessment and prophylactic treatment where necessary. Along with this, better imaging devices and sound population screening strategies will go a long way to help identify others at risk and thus help to reduce visual morbidity due to this disease.

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Management of Secondary Glaucoma- a short review

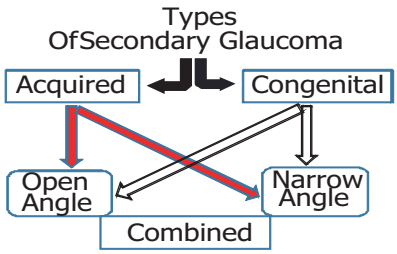
M. H. Rahman[1]

Introduction :

The relative frequency of various causes leading to secondary glaucoma is likely to show variation in different parts of the world with passage of time. Phacogenic glaucoma is likely to be encountered more frequently in the areas where hypere maturity of the lenses is seen more often. The use of corticosteroids whilst reducing secondary uveitis has resulted in an iatrogenic glaucoma. The regional variations in the frequency of corneal ulcers & their complication would also change the pattern. Further, the improvements in techniques for lens extraction should reduce the frequency of aphakic glaucoma. Treat carefully the diseases that can produce glaucoma subsequently as a consequence or complication of treatment. Treatment of cause and glaucoma should started simultaneously.

Definition and Classification :

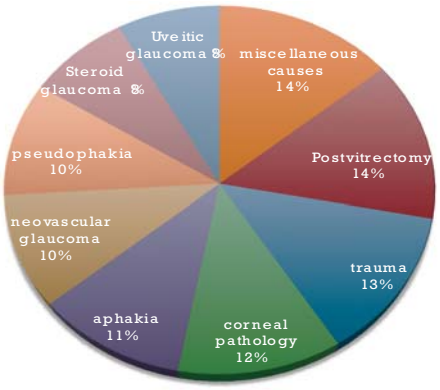
Glaucoma is a chronic progressive optic neuropathy characterized by optic nerve head damage and corresponding visual field defects in which IOP is major risk factor. When it is due to ocular or systemic disorders, trauma and drugs then it is called secondary glaucoma. In most of the cases secondary glaucoma does not fulfill the criteria of glaucoma, when we see raised IOP we call it secondary glaucoma even without optic nerve head and visual field evaluation-a misnomer. Usually unilateral and preventable mostly.



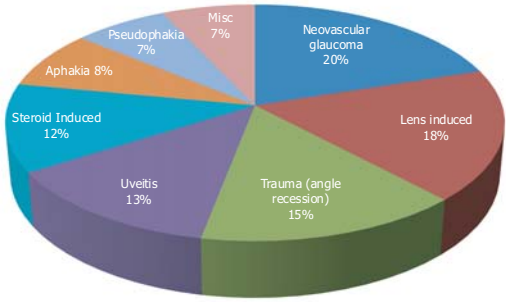
Prevalence :

Prevalence of secondary glaucoma in Singapore is 16%, in Japan- 24%, in AIMS, India, 2005 - 24%, in Nepal, 2005 - 21 %, in IIEH, Dhaka, 2006 -16% and in Dhaka, Bangladesh - 10 % (Rahman MM et al, BJO 2004,88: 1493-1497)

WHO Survey 2002 :



Study in Islamia Eye Hospital, 2006:



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Etiology-

i. Trauma-
  a. Accidental – Blunt or penetrating
  b.Surgical–Complicated cataract surgery, VR surgery(oil)
ii. Corneal pathology
iii. Uveitis
iv. Lens related disorders
  - Lens induced glaucoma
v. Aphakia & pseudophakia
vi. V-R disorders-
  - DR
- Vascular occlusion
- Misc
vii. Ocular tumors-
- RB, - choroidal melanoma,
  - Ocular metastasis
viii. Drugs-steroid
ix. Miscellaneous-PDS, PXFS

A. Secondary Open Angle Glaucoma

a. Traumatic glaucoma

A. Accidental Trauma: Glaucoma develops after various types of injuries like concussion, contusion, penetrating injury and chemical burn. Prompt & meticulous management can prevent development of glaucoma. Control of inflammation is very important.

Raising of IOP of two types-

1. Early rise IOP- occurs within hours to days

- Aqueous suppressants is the choice of drugs

2. Chronic rise of IOP- occurs within weeks to months or years

- Glaucoma develops due to recession of angle called angle recession glaucoma. It behave and treatment is similar to POAG.

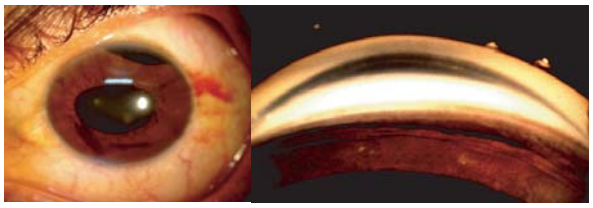

Fig-Traumatic glaucoma (early and late)

B. Surgical Trauma: Iatrogenic glaucoma due surgical trauma is not uncommon. It is more frequently happen after Cataract surgery, VR surgeries and Penetrating Keratoplasty.

IOP Rise occurring after cataract Surgery is commonly transient after uneventful cataract surgey. Mechanism is not always known but Inflammation & visco may be responsible. IOP goes down spontaneously but aqueous suppressants may be required in few cases.

Rise of IOP may be Persistent after Complicated cataract Surgery. Aqueous suppressants may control IOP but I/V mannitol may need in some cases. Filtration surgery required in many cases as last option.

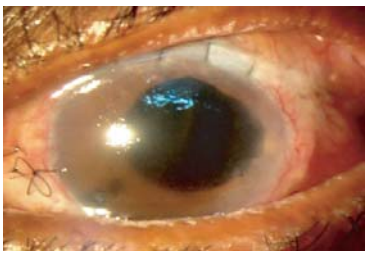

Fig- Glaucoma after complicated cataract surgery

Glaucoma after VR surgery and PK is common. Medical treatment is enough to control IOP but filtration may require in some cases.

b. Steroid induced glaucoma-

Steroid induced glaucoma is common as a complication of treatment of many ocular diseases specially VKC and longstanding uveitis. Culprit is the corticosteroids. Steroid sensitivity is important factor. 30% of general population is sensitive to steroid and 5% is highly sensitive. Rise of IOP may be immediate occurring within

days weeks or chronic occurring within months to years.

It is a time limited condition. First of treatment is stopping of steroid or switch to soft steroid if unavoidable. IOP lowering agents is required according to need. Filtration surgery may essential for some cases as a last option.

c. Pseudoexfoliation glaucoma

Pseudoexfoliation Syndrome is strongly related to age but may be sporadic. It is more common in female than male but risk of development of glaucoma is more in male accounting about 5% in 5 years and 15% in 10 years. It is frequently overlooked with POAG. Treatment is similar POAG.

d. Pigmentery glaucoma

Pigment Dispersion Syndrome has strong relation to myopia. It is more common in young male than female (2:1). Risk of glaucoma development is 50% in 15 years. Important charectaristic is wide fluctuation of IOP related to bouts of pigment dispersion. Treatment is similar as POAG but Yag PI may help.

B. Secondary Narrow Angle Glaucoma

Two different fundamental mechanisms for secondary angle closure-

i. Anterior pulling mechanism-Peripheral iris is pulled forwards to trabecular meshwork by contraction of membrane, exudates or fibrous band.

ii. Posterior pushing mechanism-Peripheral iris is displaced forward by lens, vitreous or cilliary body.

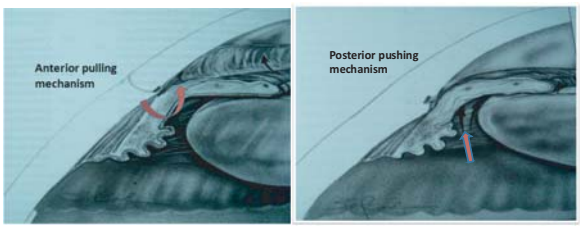

Fig- Anterior pulling and posterior pushing mechanism

1. Secondary Glaucoma with Anterior pullin mechanism

a) Neovascular glaucoma

b) Iridocorneal Endothelial Syndrome

c) Glaucoma with Penetrating keratoplasty

d) Inflammatory glaucoma

e) Others

a) Neovascular glaucoma(NVG)

NVG develops secondary to chronic retinal ischemia (VEGF).Common Causes are diabetic retinopathy and ischemic CRVO. Presentation depends on stage- Rubiosis iridis, open angle glaucoma and narrow angle glaucoma.

Treatment depends upon Stage & Severity of disease, Medial clarity &Visual potential. The principals-

1. Control of IOP–by medical / surgical options
2. Control of NV- Anti-VEGF /+ PRP
3. Control of inflammation-Steroid & Atropine
4. Control of pain- as Palliative therapy

Medical treatment has limited role. Among surgical options filtration surgery with MMC is very effective. Transscleral cyclophotocuagulation (TSCPC) may be helpful for some cases. Glaucoma valve implantation is required in many cases.

b. Iridocorneal Endothelial Syndrome

Proliferation of abnormal corneal endothelial cells over angle structures and subsequent contraction produce secondary angle closure glaucoma. Typically affects young to middle aged women. Corneal endothelium shows beaten bronze appearance. High PAS is the characteristic of ICE syndrome. There are three syndromes with certain overlaps-

i. Progressive iris atrophy (Iris atrophy in 100%)

ii. Iris naevus syndrome (Iris atrophy in 50%)

iii. Chandler syndrome(Iris atrophy in 40% and Corneal changes predominate)

Treatment :

In early stage medical treatment can control IOP. Aqueous suppressants may be used for IOP reduction and hypertonic saline is helpful to reduce the corneal signs but surgical treatment is required ultimately in many cases due to progression. In advanced stage surgical treatment is required. Trabeculectomy + MMC is usefull but glaucoma shunt surgery is required in some cases.

c) Glaucoma with Penetrating keratoplasty

B. Secondary angle closure glaucoma with Posterior pushing-

1. Malignant glaucoma
2. Glaucoma due to intraocular tumors
3. Lens induced angle closure glaucoma (Phacomorphic glaucoma)
4. Others

a) Malignant glaucoma

It is a potentially devastating condition. It happens after some intraocular operations like cataract surgery, trabeculectomy, even after yag capsulotomy. It presents with acute onset of pain, decrease visual acuity, uniform flat AC, high IOP. Mechanism is not known but aqueous is misdirected backwards into vitreous cavity and iris-lens diaphragm pushed forward swallowing AC progressively.

Treatment :

Medical therapy should be the first line of management and should be started immediately.

Strong cycloplegic agents- Atropine

IOP control–Aq. Suppressants and Osmotic agents

Before going to surgiucal treatment Laser therapy (YAG laser capsulotomy in pseudopkakic eye and Yag PI in Phakic eye) should be tried. Pars plana vitrectomy with communication between vitreous xcavity and anterior segment is needed in many cases.

b) Glaucoma due to intraocular tumors

Glaucoma may develop secondary to intraocular tumors. It is commonly associated with choroidal melanoma, ciliary body tumor, choroidal metastasis and retiblastoma in children. Treatment should be started for both glaucoma and tumor.

c) Secondary glaucomas having both open and close angle

1. Lens induced glaucoma

▪ Open angle-	▪ Narrow angle-
i. Phacolytic glaucoma	i. Phacomorphic glaucoma
ii. Lens particle glaucoma	ii. Ectopia lentis
iii. Phacoanaphylexis	

2. Inflammatory glaucoma

▪ Narrow angle-	▪ Open angle-
i. With pupilary block	i. Fuchs h/chromic iridocyclitis
ii. Without papillary block	ii. Posner-Schlossman syndrome

Phacolytic glaucoma

Phacholytic glaucoma happens in older age and associated with hypermature cataract. Onset is acute. Altered lens Protein (HMW) come out from lens capsule and blocks pores of trabecular meshwork producing raised IOP.

Treatment- Cataract surgery is the definitive treatment. Before that we should control IOP by aqueous suppressants.

Phacomorphic glaucoma

It is an acute secondary ACG associated with intumescent cataractous lens. The cataractous lens imbibes water and increase in size which pushes iris forwards narrowing angle and raise IOP. Presentation is same as acute PACG when IOP is very high.

Treatment: Same as PACG - Control I0P by aqueous suppressants. If not controlled I/V mannitol may be given. Pilocarpine has controversy. When IOP is controlled do Laser iridotomy and prepare for surgery. Definitive treatment is cataract surgery.

Inflmmatory angle colsure glaucoma

It may be associated i) With pupilary block having shallow A/C and iris bombe or ii) Without papillary block having centrally deep AC and closed angle by extensive PAS.

Treatment is a great challenge. It consists of i) Control of inflammation by using Steroid + Atropine and ii) Control of IOP by using aqueous suppressants. Yag PI & fitration surgery is required in most of the cases.

Inflammatory open angle glaucoma

- Fuchs heterochromic iridocyclitis-

It is a chronic form of iridocyclitis. Common features are i) PSC cat-constant features and ii) Secondary OAG-15%.

Treatment- Like POAG.

- Posner-Schlossman syndrome-

It is an acute secondary OAG having recurrent mild anterior uveitis.

Treatment is control of inflammation by steroid and Control of IOP by Aq suppressants.

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Review Article

Imaging in early diagnosis of Glaucoma

M M Hossain[1]

Abstract :

The purpose of the review is to provide an update on the role of imaging devices in the diagnosis and follow-up of glaucoma with an emphasis on techniques for detecting glaucomatous progression and the newer spectral domain optical coherence tomography instruments. Imaging instruments provide objective quantitative measures of the optic disc and the retinal nerve fiber layer and are increasingly utilized in clinical practice. This review will summarize the recent enhancements in confocal scanning laser ophthalmoscopy, scanning laser polarimetry, and optical coherence tomography with an emphasis on how to utilize these techniques to manage glaucoma patients and highlight the strengths and limitations of each technology. In addition, this review will briefly describe the sophisticated data analysis strategies that are now available to detect glaucomatous change overtime.

Introduction :

The detection of glaucomatous structural damage and change is one of the most important yet challenging aspects of glaucoma management. In recent years, imaging instruments, providing objective quantitative measures of neuroretinal rim thinning, retinal nerve fiber layer (RNFL) atrophy and excavation of the optic cup, are increasingly utilized in the clinical management of glaucoma patients. This is due in part to the provision of summary information that can be easily used in clinical management decisions. For example, most instruments now include a normative database with analyses indicating whether a measurement is "outside normal limits" or "within normal limits". In addition, each provides a measure of image quality so that the clinician can determine whether the image is of sufficient quality to be utilized in clinical management decisions. With recent developments in technology such as spectral domain optical coherence tomography (SDOCT), the value of the imaging instruments in glaucoma management is likely to continue to grow.

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Although in vivo imaging with confocal scanning laser ophthalmoscopy (CSLO), scanning laser polarimetry (SLP) and time-domain optical coherence tomography (TDOCT) has been commercially available for the management of glaucoma for over 10 years, interpretation of instrument results for detection of glaucoma and monitoring its progression remains a challenge.

Only relatively recently, sophisticated data analysis strategies that efficiently analyze the high-dimensional retinal data have been developed and evaluated to detect glaucomatous change overtime.[1–9] Ultra sound biomicroscopy(UBM) and Anterior segment (OCT) are two important tools to assess Anterior chamber angle. Color Doppler imaging of ophthalmic & posterior ciliary arteries is also essential tool to assess blood flow velocity of retrobulbar circulation.

This review provides a brief update to recent reviews[10-17] describing advances in optical imaging for glaucoma management, with an emphasis on techniques for detecting glaucomatous progression and the newer SDOCT instruments.

Discussion :

Confocal Scanning Laser Ophthalmoscopy

CSLO has been available for glaucoma detection since 1992. In brief, CSLO utilizes confocal optics to obtain multiple measures of retinal height at consecutive focal planes to provide a topographic map extending from the lamina cribrosa to the retinal anterior surface.

The latest generation CSLO, the Heidelberg retina tomograph III (HRT III) (Heidelberg Engineering, Heidelberg, Germany) employs the same image acquisition technology and similar software as the original Heidelberg retina tomograph classic (HRT), and the newer Heidelberg retina tomograph II (HRT

II). Regardless of which instrument was used to acquire the images, all images can be analyzed with the new software (version 3.0 or higher) and imported into the newer instruments, although it remains to be evaluated whether progression analysis results are completely compatible when combining images acquired with the newer and older versions of the HRT. The instrument provides numerous stereometric parameters, including disc area, rim area, and cup area, to assist clinicians in assessing the anatomical features of the optic disc.

Numerous studies have shown that the reproducibility for the HRT and the HRT II stereometric parameters is good, with variability usually somewhat higher in glaucomatous eyes than in healthy eyes.[14,18-22] In addition, classification indices such as the Moorfields regression analysis (MRA) and the glaucoma probability score (GPS), which highlight regions as "outside normal limits" are among the HRT tools currently used to discriminate between healthy and glaucomatous discs.

HRT Printouts

In Fig. 1a, a typical HRT "Follow-up Report" is divided into three parts to summarize cup, rim, and RNFL measurements for each eye, and asymmetry between eyes. Green checks indicate that the measurements are "within normal limits", yellow exclamation points indicate measures are "borderline", and red "x"s indicate measurements "outside normal limits".

All stereometric parameters require a user-drawn contour line to set a reference plane. Details of each section of the printout are provided below.

Figure 1(a, b)

HRT "Follow-up Report" (a) with results from the topographic change analysis (top) and the Moorfields Regression Analysis (middle). RNFL thickness measurements and inter-eye asymmetry are provided in the bottom section of the printout. ...

Information on image quality is reported at the top of the HRT Follow-up printout as color-coded text with the standard deviation (SD) in parentheses. In Fig. 1a, the quality of both right eye (OD) and left eye (OS) scans are "very good" (indicated in green at the top of the page), with SDs of 11 ìm and 14 ìm, respectively. Standard deviations of greater than 50 ìm are considered as "poor quality" topographies, and the values are outlined in red to denote that the results should not be used or at least should be interpreted with caution.

The stereometric measurements of the cup are presented in the first section. In this example, linear cup/disc ratio and cup shape measurements of both eyes are within normal range, with symmetry of the linear cup/disc ratio indicated as "borderline". The HRT images presented next to the cup summarize visually the topographic change analysis when there are sufficient follow-up scans available to complete the analysis (See "Topographic Change Analysis" in the "Detection of Glaucomatous Progression" section for additional details). In brief, pseudo-colors are used to indicate areas that are significantly elevated and areas that are significantly depressed (green and red colors, respectively) on consecutive follow-up examinations compared to baseline topographies.

In the center of the printout, overall neuroretinal rim area and rim volume measurements are presented and compared to the normative database. In this example, with the exception of OS rim area, which is "borderline", the OD, OS, and asymmetry measurements are "within normal limits" (green checks). The HRT optic nerve head images presented next to the rim measurements visually summarize the results of the MRA which divides the ONH into six areas and compares rim area measurements of the examination to regression analysis results of rim area in normal eyes after adjusting for disc size and age. For the right eye of this example, the MRA is "within normal limits" overall (green checks in the middle of the image) and in each sector. In contrast, several sectors of the disc of the left eye are "outside normal limits", as indicated by the red "x"s. Moreover, the MRA result is labeled with text "outside normal limits" as at least one sector is "outside normal limits".

The bottom section of the printout shows the RNFL height variation contour and mean RNFL thickness

values and the degree of asymmetry all "within normal limits". The RNFL profile graphs on either side of the RNFL measurements map the RNFL measures along the optic disc margin of the baseline and current exam. In this example, the OS RNFL profile dips into the "outside normal limits" area in the temporal superior region.

Scanning Laser Polarimetry

SLP takes advantage of the birefringence property of the RNFL that modifies the polarization of the light (retardation) when illuminated. The retardation is proportional to the thickness of the birefringent tissue, thus allowing the instrument to obtain objective and quantitative measurements of the RNFL thickness. The reliability of the measurements is dependent, at least in part, on the machine's ability to extract the RNFL retardance from the total ocular retardance, since the cornea and the lens also exhibit some degree of birefringence.

The commercially available SLP instruments are the GDx VCC (variable cornea compensation) and the latest GDx ECC (enhanced corneal compensation) (both from Carl Zeiss Meditec, Dublin, CA, USA). The

GDx has undergone numerous implementations over the years, with the goal of providing more reliable and reproducible measurements of the RNFL thickness. Initially, the instrument was equipped

with a fixed corneal compensation. However, the device was not able to adjust for the variability of corneal thickness and properties among different individuals. This important issue was later addressed by providing the GDx with a variable corneal compensator. The GDx has been shown to discriminate well between glaucomatous and healthy eyes.[23] However, a major challenge in the ability of the instrument to describe the RNFL thickness pattern relies in the occurrence of atypical retardation patterns (ARPs), likely the result of poor signal-to-noise ratio (SNR) as a consequence of light scattering in the eye. ARP scans typically show irregular patches of elevated retardation values that do not match the expected retardation based on the RNFL anatomy. The measurements could either mask true RNFL loss or give a false glaucomatous appearance. Medeiros et al. showed that the appearance of ARPs had a significant negative influence on the ability to detect progressive RFNL loss with the GDx VCC.[24] The newer instrument, the GDx-ECC was designed to limit the occurrence of ARPs. Recent studies have shown that in general the ability to discriminate between glaucomatous and healthy eyes is higher with the ECC compared to previous SLP technology, particularly in eyes with earlier stages of disease and severe ARPs.[25,26]

GDx Printout

The GDx VCC symmetry analysis printout is divided into three sections [Fig. 2]. In this example, the scans are of good quality with "Q" values presented next to the "fundus image" for the right and left eyes being 9 and 8, respectively. The nerve fiber layer map is shown in pseudo-colors for the right and the left eyes (center), with brighter colors indicating a thicker RNFL. The deviation map compares RNFL thickness results to the instruments' normative database (bottom). In the example provided, the OS RNFL is particularly thin and "outside normal limits" in the supero-temporal and infero-temporal regions, as evidenced by the red pattern in the left deviation map. The RNFL thickness pattern for the two eyes is visualized, and a symmetry analysis is provided at the bottom of the printout. Several important RNFL thickness parameters, such as the temporal superior nasal inferior temporal (TSNIT) average and the nerve fiber indicator (NFI), also are displayed with pseudo-colors used to flag parameters "borderline" (blue and yellow) or "outside normal limits" (red).

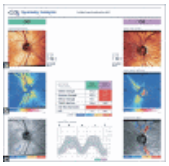

Figure 2

GDx VCC symmetry analysis printout displaying a fundus image of the optic nerve (a), the nerve fiber layer map in pseudo-colors (b), and the deviation map (c). VCC: variable corneal compensator.

Strengths and limitations

The major strength of the SLP relies in the ability to obtain reproducible measurements of the RNFL thickness without pupil dilation, a reference plane or magnification correction. Some of the limitations with

previous versions of the device, such as the variable corneal birefringence or the occurrence of ARPs have been overcome with the introduction of the GDx VCC and the software enhanced GDx ECC, respectively. However, ARPs are still present even when using GDx ECC in some patients, and this must, therefore, be considered a limitation of the SLP technology. In addition, the newer GDx instruments are not backward compatible with older instruments, so that RNFL measures acquired with different GDx instruments are not comparable.

Time Domain Optical Coherence Tomography

Optical coherence tomography (OCT) is an imaging method analogous to ultrasound B mode imaging, except that light instead of sound is used to acquire high-resolution images of ocular structures. By applying the principles of low coherence interferometry to light backscattered from ocular structures, OCT provides cross-sectional images of the macula, the peripapillary retina, and the optic nerve head. The final image is artificially color-coded by the OCT software. High reflective tissue, such as the RNFL, appears green and yellow whereas less reflective tissue has darker colors such as black and blue. TDOCT is the term now widely used to distinguish Stratus OCT from the newer SDOCT technology (see "Spectral Domain Optical Coherence Tomography" section below for more details). With TDOCT, the different echo time delays produced by the back reflected light are measured separately. The first TDOCT was introduced over a decade ago. The commercially available time domain Stratus OCT (Carl Zeiss Meditec, Dublin, CA, USA) provides better resolution (8-10 ìm), increased number of A-scans, and reduced need for pupil dilation compared to previous OCT instruments.

Several studies have reported good reproducibility of RNFL thickness measurements using Stratus OCT in normal and glaucomatous eyes and good diagnostic ability for glaucoma detection.[27-32] In addition, studies performed using previous and current versions of the OCT have demonstrated its ability to detect RNFL thickness damage in glaucomatous eyes in agreement with red-free RNFL photographs and visual fields.[33-35]

Stratus OCT Printout

The Stratus OCT RNFL thickness average analysis is shown in Fig. 3a for OS. This analysis displays the RNFL thickness profile for the study eye (black line), superimposed on the characteristic double hump profile pattern resulted from the internal normative database. In this example, the RNFL is clearly thinner in the inferior region. RNFL thickness measurements by sectors and clock hours also are shown in the center, above several other calculated parameters. In the example shown, the inferior sector and corresponding clock hours are flagged as "red", i.e., "outside normal limits". For quality assessment, the average signal strength (from 1 to a maximum of 10) for the Fast RNFL thickness protocol is provided. For this scan, the signal strength is "8" indicating good quality.

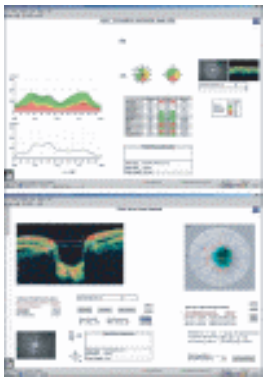

Figure 3

(a, b) Stratus OCT RNFL thickness average analysis (a) and optic nerve head analysis (b) of the left eye. RNFL: retinal nerve fiber layer

The Stratus OCT optic nerve head analysis is shown in Fig. 3b for a good quality (signal strength = 8) OS scan. This analysis results from data processing derived from six radial scans centered on the optic disc by the operator. The instrument provides optic nerve head analysis results that include several optic disc parameters, such as disc area, cup area and rim area along with an image (above) that describes the contour of the disc (in red) and the area of the cup (in blue). Individual radial scan measures are also provided (top left). Each scan can be evaluated separately for quality purposes and to ensure that retinal structures are properly identified by the

segmentation algorithm.

Strengths and limitations

Strengths of the Stratus OCT include its ability to measure peripapillary RNFL thickness without the need for a reference plane or magnification correction, and that RNFL, optic disc, and macula scans are available in one instrument. There is little evidence, however, that combining OCT information from RNFL thickness, ONH topography, and macula measurements improves glaucoma diagnostic accuracy over each of the analyses alone.[30]

A limitation of the Stratus OCT relies in the fact that the instrument acquires a limited amount of data for each of its scanning protocols. For example, for the fast ONH scan, there is interpolation of data between the six radial scans. In addition, there is no scan registration available.

Spectral Domain Optical Coherence Tomography

Until recently, clinically available TDOCT instruments have used a technique to obtain images wherein the different echo time delays produced by the back reflected light were measured separately leading to slow acquisition time and limited data gathering. With the introduction of SDOCT, it has become possible to image ocular structures with better resolution and with a much faster scan rate. These instruments are known as "Spectral" or "Fourier domain" because echo time delays of light are measured by taking the Fourier transform of the interference spectrum of the light signal. Because OCT with Fourier domain detection can measure all light echoes from different delays simultaneously, it has a dramatic speed compared with TDOCT.[40-48] Compared to TDOCT which collects 400 axial measurements per second with an axial resolution of around 10 ìm, the scan rate of SDOCT is at least 20,000 axial measurements per second with an axial resolution of 5 ìm.

Shorter image acquisition time leading to less eye motion artifacts, acquisition of large number of data points to allow three-dimensional imaging and scan registration from session to session, and higher resolution with more precise segmentation of retinal layers are some of the advantages of SDOCT over TDOCT.

There are several SDOCT devices commercially available at this point in time, each with several unique advantages. For example, the RTVue (Optovue Inc., Fremont, CA) offers the ganglion cell complex (GCC) protocol, which is designed to measure the inner retinal thickness to include the nerve fiber layer, ganglion cell layer, and the inner plexiform layer, collectively called the GCC, believed to be the primary region of affection in glaucoma. The Cirrus HD-OCT (Carl Zeiss Meditec Inc., Dublin, CA) includes the optic disk cube 200 × 200 protocol that provides automated alignment of the scan circle around the optic disc, allowing manual centering of the measurement cube on the optic disc center after image acquisition in cases of decentration due to eye movements. The Spectralis OCT (Heidelberg Engineering, Dossenheim, Germany) incorporates a real time eye tracking system that couples CSLO and SDOCT scanners to adjust for eye movements and to ensure that the same location of the retina is scanned over time. This method allows B-scans to be re-sampled to improve the SNR ratio. The Topcon 3D OCT-1000 (Topcon, Paramus, NJ) has the advantage of combining a nonmydriatic fundus camera with the imaging capabilities of SDOCT technology.

In general, all SDOCT devices incorporate sophisticated software for image acquisition and data analysis that provides real-time image quality information to the operator, and compares measurements to normative databases with color-coded results as red ("outside normal limits"), green ("within normal limits"), and yellow ("borderline"). It is important to note that these systems are evolving rapidly, and it is likely that numerous software enhancements will be made available in the near future.

Figs. Figs.4a4a–c are printouts from the RTVue, Cirrus HD-OCT, and Spectralis OCT, respectively. RTVue printout [Fig. 4a] provides the color-coded GCC, and the optic nerve head maps with their respective parameters in a tabular form. Image quality is summarized as the "signal strength index" (SSI) with scans above 45 considered good quality. The optic nerve head protocol provides the optic nerve head parameters as well as the RNFL parameters similar to the Stratus OCT optic nerve

head and RNFL maps. The GCC protocol, in addition to the inner retinal thickness at the macula, also provides two other parameters called global loss volume (GLV) and focal loss volume (FLV). GLV measures the average amount of GCC loss over the entire GCC map, and FLV measures the average amount of focal loss over the entire GCC map, much like the total and pattern deviation maps in the visual fields.

Figure 4

(a-c) Printouts from the commercially available spectral domain optical coherence tomography devices. (a) RTVue, (b) Cirrus HD-OCT, and (c) Spectralis OCT

The Cirrus HD-OCT printout [Fig. 4b] is of the optic disc cube protocol, which is a three-dimensional scan of a 6 × 6 mm[2] area centered in the optic disc. Image quality is measured by signal strength with values six or above considered good quality.

The printout provides summary information in several sections including the RNFL thickness map and RNFL thickness deviation (analogous to the GDx Nerve Fiber Layer and Deviation Maps), and RNFL TSNIT normative data (with presentation of information similar to that of the Stratus OCT).

The Spectralis OCT RNFL thickness printout provides the RNFL scan and profile corresponding to a circle of 3.4 mm diameter centered on the optic disc, as shown in Fig. 4c. The RNFL thickness around the optic disc is measured in six sectors corresponding to the sectors generated by the HRT MRA and GPS. A SNR of 15 dB or higher is considered good quality.

Studies have shown the SDOCT devices to have excellent intrasession repeatability for RNFL,[43-45] ONH, and macular measurements [46-48]Leung et al. also found that the intervisit variability of Cirrus HD-OCT was significantly lower than that of Stratus OCT.[49]

There have been few studies to date evaluating the diagnostic performance of these devices. Leung et al.[49] evaluated RNFL measurements of Cirrus HD-OCT and found that the average (AUC, 0.962), superior (AUC, 0.963), and inferior (0.949) quadrant RNFL thickness measurements had the best discriminating ability to differentiate normal eyes from eyes with glaucomatous visual field defects. They also found that the diagnostic performance of Cirrus HD-OCT was similar to that of Stratus OCT.[49] Sehi et al. evaluated the RNFL measurements of RTVue, and they too found that the diagnostic ability of RTVue was similar to Stratus OCT; inferior (0.95), average (0.87) and superior (0.79) quadrant RNFL measurements had the best AUC in their study.[50] Sung et al. tested the sensitivity and specificity of the normative classification of Cirrus HD-OCT and found that the sensitivity (64%) and specificity (100%) of the average RNFL measurement of Cirrus HD-OCT was better than the sensitivity (40%) and specificity (96.7%) of the Stratus OCT.[51] There are no reports yet on the diagnostic performance of the other SDOCT devices as well as the ONH and the macular measurements of SDOCT devices.

Even though there appears to be no improvement in the diagnostic accuracy of the SDOCT over TDOCT in diagnosing glaucoma, there are still some potential benefits of the newer technology apart from faster scan acquisition time and improved resolution. The increased number of scans obtained by SDOCT may allow for the development of better registration algorithms which might have a superior performance in longitudinal RNFL assessment and for judging progression. This aspect will need to be evaluated in future studies.

Detection of glaucomatous progression

Glaucoma is a slowly progressing optic neuropathy characterized by the loss of retinal ganglion cells and their axons. Therefore, the detection of glaucomatous progression is a critical aspect of glaucoma management. The identification of glaucomatous changes, such as progressive thinning of the RNFL, not only can help clinicians in confirming the initial diagnosis but, more importantly, can alert them that further treatment may be required to prevent visual impairment due to glaucoma.

Imaging instruments offer the advantage of providing large amount of reproducible data that can be used to

develop analysis strategies for detecting change over time. Ideally, imaging instruments should be able to detect clinically relevant changes at the level of the disc or the RNFL that are greater than the variability of the measurements. With imaging instruments, multiple scans are obtained at each imaging session, so that measurement variability can be calculated, both globally and regionally.

It is, therefore, possible to identify regions of the optic disc and RNFL that have changed significantly (greater than the variability of the measurements) overtime.

In addition, because it is important to document that the change is repeatable, these instruments have the potential to automatically identify regions of the optic disc and RNFL that show significant and consistent change over several consecutive imaging sessions, therefore confirming that change has occurred.

Recent reports have suggested that imaging technologies have the potential to detect glaucomatous structural changes. Studies with HRT, GDx, and Stratus OCT, for example, have shown that on average the decrease in rim area or RNFL thickness occurs at a faster rate in eyes progressing overtime compared to non-progressing eyes, with the assessment of progression based on stereophotography or visual fields.[6,9,52,53]

However, for the method to be useful in clinical practice, it is important for change to be detected in eyes of individual patients. For this purpose, most imaging technologies now incorporate specific software that allows for clinicians to detect significant change in a single eye with adequate follow-up. Preliminary studies have shown that these methods are capable of detecting change in glaucomatous eyes or eyes of glaucoma suspects.[52,54]

It is important to note that agreement between various methods of analysis, such as progression by stereophotography or visual fields, and progression by imaging techniques is generally poor and further studies are needed to determine whether a longer follow-up will yield a better agreement between methods.[2,4,5,9]] It will also be important to better characterize what constitutes a clinically significant change in glaucoma.

Below is a brief description of the methods used by HRT, GDx, and Stratus OCT for detecting glaucomatous progression.

HRT Topographic Change Analysis: The topographic change analysis (TCA) is currently the primary method for assessing glaucomatous change using the HRT.[3-5, 8,55-58] By accounting for the effect of scan variability and location of topograph height measurements, TCA describes significant and repeatable changes in picture elements (so-called superpixels, i.e., 4 × 4 pixels) over the topographic map, with red demonstrating depression and green demonstrating elevation compared to baseline. TCA change summary parameters can be used to describe size and location of regions of change.

Fig. 5 shows an example of a TCA printout of an eye that has shown significant change over time, indicative of increased optic disc cupping and neuroretinal rim thinning. The change, indicated by the presence in the 2007 scan of red superpixels within the optic disc margins at the infero-temporal region, appears to occur inside the disc margins and by definition is repeatable in follow-up scans. In addition, the graph shows change overtime beginning in 2008 with an increase in the total size and volume change of the superpixel cluster. For convenience, TCA results are also presented in the HRT "Follow-up Report" [Fig. 1a].

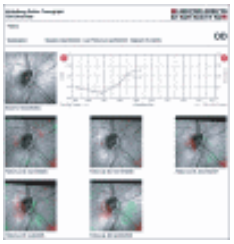

Figure 5

Topographic change analysis overview of the right eye. The presence of red pixels inside the disc at three consecutive follow-up exams is indicative of glaucomatous progression. In addition, the graph shows change overtime beginning in 2008 with an increase ...

GDx-Guided Progression Analysis: The GDx VCC-guided progression analysis (GPA) software evaluates and compares SLP images acquired during follow-up

and labels progression as "Possible Progression" (shown in yellow) if significant decrease in RNFL thickness is detected once, "Likely Progression" (shown in red) if significant reduction is detected in at least two consecutive exams, and "Possible Increase" (shown in purple) if an increase in RNFL thickness is detected. Two types of analysis are available, depending on whether one or three scans are obtained at each visit. The "fast mode" compares the two last images with the two baselines; change is identified as significant if it meets a predetermined criteria based on an independent group of eyes. In contrast, the "extended mode" uses a mean of three images at each visit, measures the variability of the mean image, and identifies significant change that is greater than the variability measured for that individual eye.

An example of the GDx GPA extended mode analysis is shown in Fig. 6. The GDx GPA uses two different statistical analyses to determine significant change, and provides the results in three different maps, each focusing on a specific pattern of damage. The "Image Progression Map" represents a fundus image with color-coded areas, flags as significant a cluster of at least 150 adjacent pixels showing changes in RNFL measurements compared to the two individual baselines. In this example, possible change is identified as red pixels in the superior nasal region. According to the manufacturer, the image progression map was designed to be more sensitive to narrow, focal RNFL loss.

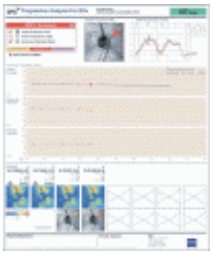

Figure 6

GPA progression analysis for GDx of the right eye. The image progression map shows a region of "Likely Progression" in the supero-nasal quadrant. The rate of change is shown below, and it is significant for the parameter "TSNIT ...

The "TSNIT Progression Graph" shows RNFL thickness measurements around the optic disc (TSNIT stands for the sectors around the optic disc, T for temporal, S for superior, N for nasal, and I for inferior) where the current exam (red line) is plotted over the baseline exams (gray lines). The GDx calculation

circle is divided in 64 segments; and requires significant change in at least four adjacent segments to be flagged as progression. In this example, likely possible change is identified in the superior nasal regions.

The third-image-based map is the "Summary Parameters Charts", in which three parameters are plotted: the TSNIT average, the superior average, and the inferior average. These parameters are displayed from all included images in chronological order, and a regression line is drawn if the last one shows "Likely Progression" and there is a significant linear trend (P < 5%). In these cases, the corresponding rate of change (given in ìm/year with 95% confidence interval) and a P value is also provided. The "Summary Parameters Charts" was designed to be more sensitive to diffuse change. In the example provided, a significant change can be observed in the supero-nasal region in the Image Progression Map (flagged as "Likely Progression") and a negative linear trend is also found (-1.1 ± 0.3 ìm/year).

Stratus OCT-Guided Progression Analysis: The commercially available Stratus OCT now includes Guided Progression Analysis (GPA) (software version 6.0) which evaluates and compares Stratus OCT scans acquired during follow-up and reports a summary analysis for progression in an individual eye after automated consideration of expected test-retest variability. An example of this type of analysis is shown in Fig. 7. All selected scan patterns are visualized in different colors in a double hump profile for visual comparison among scans (left). The corresponding rate of change (given in ìm/year with 95% CI), and a P-value is provided. In the case shown, although a negative rate of change of -0.414 ± 3.1 ìm/year was found, this was not statistically significant (P > 5%). The report also provides the signal strength values, a measure of image quality for

each follow-up scan along with the average, superior, inferior RNFL thickness measurements.

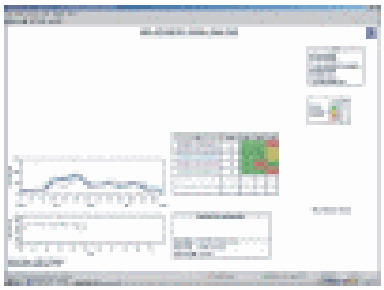

Figure 7

Stratus OCT GPA advanced serial analysis of the left eye. The rate of change of the average RNFL thickness, shown at the bottom left, is statistically not significant. Abbreviation: RNFL: retinal nerve fiber layers.

Anterior chamber angle imaging

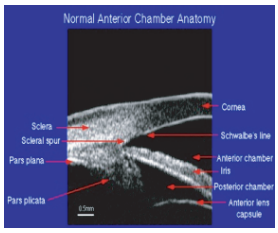

Figure 8

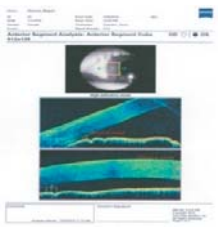

Figure 9

UBM (Fig-8) of the anterior segment shows normal anterior chamber angle structures. AS-OCT(Fig-9) normal angle structures. UBM is superior to AS-OCT for evaluation of anterior chamber angle.

Color Doppler imaging of retrobulbar circulation

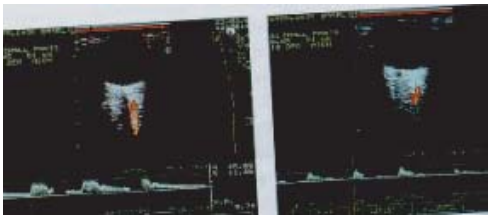

Figure 10 (a & b)

Color Doppler imaging of ophthalmic artery(Fig. 10a) shows normal blood flow velocity and (Fig. 10 b) shows reduced blood flow velocity in glaucoma

Conclusions :

Imaging instruments show promise for improving the documentation and detection of optic disc and RNFL changes for clinical management of glaucoma. Each instrument is in a different stage of development with important software improvements anticipated, particularly for detecting change overtime. Sophisticated computer intensive techniques have been reported that show promise for improving detection of structural change overtime. With increased computing capabilities now available, these and other techniques may become standard tools in imaging instruments in the near future.

It is important to remember that the quality of the scan and severity of glaucoma can influence the diagnostic accuracy of all imaging instrument results. Predictably, the diagnostic accuracy of even the most sophisticated analyses of optic disc and RNFL data may be limited if poor quality scans are used, and will be much higher in eyes with advanced glaucoma than in eyes with early disease. It is, therefore, essential the clinicians understand the strengths and limitations of each instrument and interpret the data accordingly. Moreover, it is important to use good quality images in conjunction with a complete clinical examination and assessment of visual function for patient management decisions.

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Recent updates in diagnosis of Glaucoma

M M Hossain[1]

Abstract :

Recently early glaucoma can be diagnosed by some advanced perimetry, like; Short wave length automated perimetry(SWAP), Frequency doubling technology perimetry(FDTP), & Flicker defined form perimetry (FDF) by Heidelberg Edge Perimetry (HEP) and imaging technologies like; OCT, HRT, GDxVcc & RTA; anterior segment imaging: UBM & AS-OCT and CDI of retrobulbar circulation

Introduction :

In the past glaucoma was usually diagnosed mainly by measuring IOP, clinical signs & symptoms (if any), gonioscopy, ophthalmoscopy and standard automated perimetry (SAP). But early glaucoma could not be diagnosed by SAP. Recently, some newer technologies have evolved which can diagnose glaucoma in the early stage. These are: Short wave- length automated perimetry (SWAP), Frequency doubling technology perimetry(FDTP), Flicker defined form perimetry (FDF) by Heidelberg Edge Perimeter which can detect functional status of RNFL and some imaging techniques like; OCT, HRT, GDxVCC can measure retinal nerve fiber layer (RNFL) & optic nerve head(ONH) defects . Color Doppler imaging(CDI) can measure blood flow velocity of retrobular circulation. Ultra sound biomicroscopy (UBM) & Anterior segment OCT (AS-OCT) can image anterior segment of the eye to assess anterior chamber angle.

Discussion :

Weber designed the first Applanation tonometer in 1867, Goldmann constructed the modern applanation tonometer in 1954, but only 27 years ago Ehlers et al[1] presented their study that showed the correlation between central corneal thickness (CCT) and intraocular pressure (IOP) applanation tonometric measurement. The number of publications about central corneal thickness measurements has risen exponentially over the past few years,[2] but do we use this information? The implementation of this inverse correlation between CCT and IOP on the glaucoma/ocular hypertension (OHT) patients has a great impact on our knowledge, understanding, classification, and treatment of glaucoma. This means that many OHT patients should be reclassified as normal; from 30% as Argus[3] found or even up to 65% according to Herndon et al.[4] Of the normal tension glaucoma (NTG) patients a similar proportion can be reclassified; 31% according to Copt et al.[5] But this is only the beginning. All the data concerning prevalence of OHT, NTG, and primary open angle glaucoma (POAG) must be revised as well as all the data concerning natural history and typical morphological changes of OHT and NTG.

One of the most important consequences should be that corneal pachymetry is a must when conducting a study with OHT or NTG patients, otherwise the population study is false and the results are not valid. Nevertheless, most publications dealing with OHT and NTG patients do not put these criteria to use, and we continue to gather inaccurate information.

The Ocular Hypertension Treatment Study[6] has to readjust its eligibility assessment— include CCT pachymetry—otherwise the results of this important study will be doubted. Visual field examination and interpretation is one of the pillars of ophthalmological diagnoses. Bengtsson et al[7] introduced in 1997 the Swedish

interactive threshold algorithm (SITA), a static perimetry operating system/ software package. SITA

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standard presents a reduced number of stimuli by an average of 25% and test time reduction up to 50%.[7-9] SITA has greater patient acceptance than full threshold strategy.[10-11] The mean sensitivity is about 1 dB higher than in a full threshold program and the age dependent decrease of mean sensitivity is 25% smaller.[12-13] The intersubject variance is 30% smaller.[9-13] In glaucoma patients the SITA standard shows a larger number of significantly

depressed points.[14] Perimetry is still the gold standard for most ophthalmologists for glaucoma monitoring. Should we be satisfied with a blurred presentation of visual field instead of a clear and sharp presentation only because of greater patient acceptance? All the deviations of sensitivity in comparison with full threshold strategy are the result of the algorithm behind SITA, as well as thelower intersubject variance that is flattened by an algorithm, and not because of shorter examination time. It can be deduced, if we look at a similar strategy, that tendency oriented perimetry (TOP), has similar drawbacks.[15]

HRT Printouts

In Fig. 1a, a typical HRT "Follow-up Report" is divided into three parts to summarize cup, rim, and RNFL measurements for each eye, and asymmetry between eyes. Green checks indicate that the measurements are "within normal limits", yellow exclamation points indicate measures are "borderline", and red "x"s indicate measurements "outside normal limits". All stereometric parameters require a user-drawn contour line to set a reference plane. Details of each section of the printout are provided below.

(a, b) HRT "Follow-up Report" (a) with results from the topographic change analysis (top) and the Moorfields Regression Analysis (middle). RNFL thickness measurements and inter-eye asymmetry are provided in the bottom section of the printout. ...

Information on image quality is reported at the top of the HRT Follow-up printout as color-coded text with the standard deviation (SD) in parentheses. In Fig. 1a, the quality of both right eye (OD) and left eye (OS) scans are "very good" (indicated in green at the top of the page), with SDs of 11 ìm and 14 ìm, respectively. Standard deviations of greater than 50 ìm are considered as "poor quality" topographies, and the values are outlined in red to denote that the results should not be used or at least should be interpreted with caution.

The stereometric measurements of the cup are presented in the first section. In this example, linear cup/disc ratio and cup shape measurements of both eyes are within normal range, with symmetry of the linear cup/disc ratio indicated as "borderline". The HRT images presented next to the cup summarize visually the topographic change analysis when there are sufficient follow-up scans available to complete the analysis (See "Topographic Change Analysis" in the "Detection of Glaucomatous Progression" section for additional details). In brief, pseudo-colors are used to indicate areas that are significantly elevated and areas that are significantly depressed (green and red colors, respectively) on consecutive follow-up examinations compared to baseline topographies.

In the center of the printout, overall neuroretinal rim area and rim volume measurements are presented and compared to the normative database. In this example, with the exception of OS rim area, which is "borderline", the OD, OS, and asymmetry measurements are "within normal limits" (green checks). The HRT optic nerve head images presented next to the rim measurements visually summarize the results of the MRA which divides the ONH into six areas and compares rim area measurements of the examination to regression analysis results of rim area in normal eyes after adjusting for disc size and age. For the right eye of this example, the MRA is "within normal limits" overall (green checks in the middle of the image) and in each sector. In contrast, several

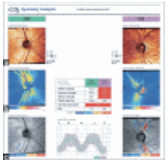
sectors of the disc of the left eye are "outside normal limits", as indicated by the red "x"s. Moreover, the MRA result is labeled with text "outside normal limits" as at least one sector is "outside normal limits".

The bottom section of the printout shows the RNFL height variation contour and mean RNFL thickness values and the degree of asymmetry all "within normal limits". The RNFL profile graphs on either side of the RNFL measurements map the RNFL measures along the optic disc margin of the baseline and current exam. In this example, the OS RNFL profile dips into the "outside normal limits" area in the temporal superior region.

GDx Printout

The GDx VCC symmetry analysis printout is divided into three sections [Fig. 2]. In this example, the scans are of good quality with "Q" values presented next to the "fundus image" for the right and left eyes being 9 and 8, respectively. The nerve fiber layer map is shown in pseudo-colors for the right and the left eyes (center), with brighter colors indicating a thicker RNFL. The deviation map compares RNFL thickness results to the instruments' normative database (bottom).

In the example provided, the OS RNFL is particularly thin and "outside normal limits" in the supero-temporal and infero-temporal regions, as evidenced by the red pattern in the left deviation map. The RNFL thickness pattern for the two eyes is visualized, and a symmetry analysis is provided at the bottom of the printout. Several important RNFL thickness parameters, such as the temporal superior nasal inferior temporal (TSNIT) average and the nerve fiber indicator (NFI), also are displayed with pseudo-colors used to flag parameters "borderline" (blue and yellow) or "outside normal limits" (red).



GDx VCC symmetry analysis printout displaying a fundus image of the optic nerve (a), the nerve fiber layer map in pseudo-colors (b), and the deviation map (c). VCC: variable corneal compensator

Strengths and limitations

The major strength of the SLP relies in the ability to obtain reproducible measurements of the RNFL thickness without pupil dilation, a reference plane or magnification correction. Some of the limitations with previous versions of the device, such as the variable corneal birefringence or the occurrence of ARPs have been overcome with the introduction of the GDx VCC and the software enhanced GDx ECC, respectively. However, ARPs are still present even when using GDx ECC in some patients, and this must, therefore, be considered a limitation of the SLP technology. In addition, the newer GDx instruments are not backward compatible with older instruments, so that RNFL measures acquired with different GDx instruments are not comparable.

maximum of 10) for the Fast RNFL thickness protocol is provided. For this scan, the signal strength is "8" indicating good quality.

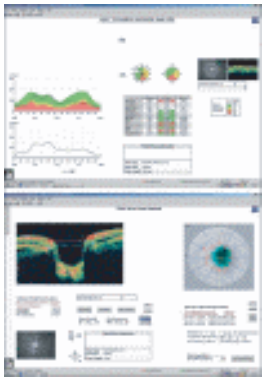


Figure 3

(a, b) Stratus OCT RNFL thickness average analysis (a) and optic nerve head analysis (b) of the left eye. RNFL: retinal nerve fiber layer

The Stratus OCT optic nerve head analysis is shown in Fig. 3b for a good quality (signal strength Time Domain Optical Coherence Tomography

Optical coherence tomography (OCT) is an imaging method analogous to ultrasound B mode imaging, except that light instead of sound is used to acquire high-resolution images of ocular structures. By applying the principles of low coherence interferometry to light backscattered from ocular structures, OCT provides cross-sectional images of the macula, the peripapillary retina, and the optic nerve head. The final image is artificially color-coded by the OCT software. High reflective tissue, such as the RNFL, appears green and yellow whereas less reflective tissue has darker colors such as black and blue. TDOCT is the term now widely used to distinguish Stratus OCT from the newer SDOCT technology (see "Spectral Domain Optical Coherence Tomography" section below for more details). With TDOCT, the different echo time delays produced by the back reflected light are measured separately. The first TDOCT was introduced over a decade ago. The commercially available time domain Stratus OCT (Carl Zeiss Meditec, Dublin, CA, USA) provides better resolution (8-10 ìm), increased number of A-scans, and reduced need for pupil dilation compared to previous OCT instruments.

Several studies have reported good reproducibility of RNFL thickness measurements using Stratus OCT in normal and glaucomatous eyes and good diagnostic ability for glaucoma detection.[27-32] In addition, studies performed using previous and current versions of the OCT have demonstrated its ability to detect RNFL thickness damage in glaucomatous eyes in agreement with red-free RNFL photographs and visual fields.[33-35]

Spectral Domain Optical Coherence Tomography

Until recently, clinically available TDOCT instruments have used a technique to obtain images wherein the different echo time delays produced by the back reflected light were measured separately leading to slow acquisition time and limited data gathering. With the introduction of SDOCT, it has become possible to image ocular structures with better resolution and with a much faster scan rate. These instruments are known as "Spectral" or "Fourier domain" because echo time delays of light are measured by taking the Fourier transform of the interference spectrum of the light signal. Because OCT with Fourier domain detection can measure all light echoes from different delays simultaneously, it has a dramatic speed compared with TDOCT.[16-24] Compared to TDOCT which collects 400 axial measurements per second with an axial resolution of around 10 ìm, the scan rate of SDOCT is at least 20,000 axial measurements per second with an axial resolution of 5 ìm. Shorter image acquisition time leading to less eye motion artifacts, acquisition of large number of data points to allow three-dimensional imaging and scan registration from session to session, and higher resolution with more precise segmentation of retinal layers are some of the advantages of SDOCT over TDOCT.

There are several SDOCT devices commercially available at this point in time, each with several unique advantages. For example, the RTVue (Optovue Inc., Fremont, CA) offers the ganglion cell complex (GCC) protocol, which is designed to measure the inner retinal thickness to include the nerve fiber layer, ganglion cell layer, and the inner plexiform layer, collectively called the GCC, believed to be the primary region of affection in glaucoma. The Cirrus HD-OCT (Carl Zeiss Meditec Inc., Dublin, CA) includes the optic disk cube 200 × 200 protocol that provides automated alignment of the scan circle around the optic disc, allowing manual centering of the measurement cube on the optic disc center after image acquisition in cases of decentration due to eye movements. The Spectralis OCT (Heidelberg Engineering, Dossenheim, Germany) incorporates a real time eye tracking system that couples CSLO and SDOCT scanners to adjust for eye movements and to ensure that the same location of the retina is scanned over time. This method allows B-scans to be re-sampled to improve the SNR ratio. The Topcon 3D OCT-1000 (Topcon, Paramus, NJ) has the advantage of combining a nonmydriatic fundus camera with the imaging capabilities of SDOCT technology.

In general, all SDOCT devices incorporate

sophisticated software for image acquisition and data analysis that provides real-time image quality information to the operator, and compares measurements to normative databases with color-coded results as red ("outside normal limits"), green ("within normal limits"), and yellow ("borderline"). It is important to note that these systems are evolving rapidly, and it is likely that numerous software enhancements will be made available in the near future.

Figs. Figs.4a4a–c are printouts from the RTVue, Cirrus HD-OCT, and Spectralis OCT, respectively. RTVue printout [Fig. 4a] provides the color-coded GCC, and the optic nerve head maps with their respective parameters in a tabular form. Image quality is summarized as the "signal strength index" (SSI) with scans above 45 considered good quality. The optic nerve head protocol provides the optic nerve head parameters as well as the RNFL parameters similar to the Stratus OCT optic nerve head and RNFL maps. The GCC protocol, in addition to the inner retinal thickness at the macula, also provides two other parameters called global loss volume (GLV) and focal loss volume (FLV). GLV measures the average amount of GCC loss over the entire GCC map, and FLV measures the average amount of focal loss over the entire GCC map, much like the total and pattern deviation maps in the visual fields.

Figure 4

(a-c) Printouts from the commercially available spectral domain optical coherence tomography devices. (a) RTVue, (b) Cirrus HD-OCT, and (c) Spectralis OCT

The Cirrus HD-OCT printout [Fig. 4b] is of the optic disc cube protocol, which is a three-dimensional scan of a 6 × 6 mm[2] area centered in the optic disc. Image quality is measured by signal strength with values six or above considered good quality. The printout provides summary information in several sections including the RNFL thickness map and RNFL thickness deviation (analogous to the GDx Nerve Fiber Layer and Deviation Maps), and RNFL TSNIT normative data (with presentation of information similar to that of the Stratus OCT).

The Spectralis OCT RNFL thickness printout provides the RNFL scan and profile corresponding to a circle of 3.4 mm diameter centered on the optic disc, as shown in Fig. 4c. The RNFL thickness around the optic disc is measured in six sectors corresponding to the sectors generated by the HRT MRA and GPS. A SNR of 15 dB or higher is considered good quality.

Studies have shown the SDOCT devices to have excellent intrasession repeatability for RNFL,[19-21] ONH, and macular measurements [22-24] Leung et al. also found that the intervisit variability of Cirrus HD-OCT was significantly lower than that of Stratus OCT.[25]

There have been few studies to date evaluating the diagnostic performance of these devices. Leung et al.[25] evaluated RNFL measurements of Cirrus HD-OCT and found that the average (AUC, 0.962), superior (AUC, 0.963), and inferior (0.949) quadrant RNFL thickness measurements had the best discriminating ability to differentiate normal eyes from eyes with glaucomatous visual field defects. They also found that the diagnostic performance of Cirrus HD-OCT was similar to that of Stratus OCT.[25] Sehi et al. evaluated the RNFL measurements of RTVue, and they too found that the diagnostic ability of RTVue was similar to Stratus OCT; inferior (0.95), average (0.87), and superior (0.79) quadrant RNFL measurements had the best

AUC in their study.[26] Sung et al. tested the sensitivity and specificity of the normative classification of Cirrus HD-OCT and found that the sensitivity (64%) and specificity (100%) of the average RNFL measurement of Cirrus HD-OCT was better than the sensitivity (40%) and specificity (96.7%) of the Stratus OCT.[27] There are no reports yet on the diagnostic performance of the other SDOCT devices as well as

the ONH and the macular measurements of SDOCT devices.

Even though there appears to be no improvement in the diagnostic accuracy of the SDOCT over TDOCT in diagnosing glaucoma, there are still some potential benefits of the newer technology apart from faster scan acquisition time and improved resolution. The increased number of scans obtained by SDOCT may allow for the development of better registration algorithms which might have a superior performance in longitudinal RNFL assessment and for judging progression. This aspect will need to be evaluated in future studies.

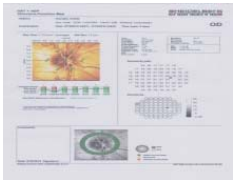


Fig-5: S-F Correlation

Structure-Function(S-F) correlation between HRT & Flicker defined form (FDF) Perimetry in a normal person. HRT & FDF correlation shows normal RNFL thickness & normal visual field respectively(Fig.5).

Anterior chamber angle imaging :

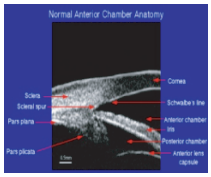


Figure 6

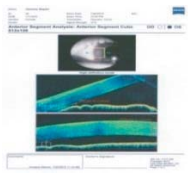


Figure 7

UBM (Fig-6) of the anterior segment shows normal anterior chamber angle structures. AS-OCT(Fig-7) normal angle structures. UBM is superior to AS-OCT for evaluation of anterior chamber angle.

Color Doppler imaging of retrobulbar circulation

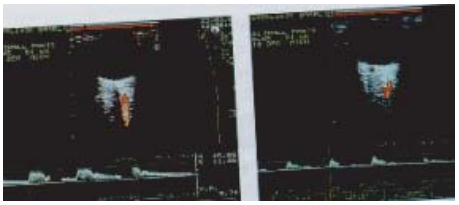


Figure 8 (a & b)

Color Doppler imaging of ophthalmic artery (Fig. 8a) shows normal blood flow velocity and (Fig. 8 b) shows reduced blood flow velocity in glaucomatous

Conclusions :

Diagnosis of early glaucoma depends on early detection of retinal nerve fiber layer defects & corresponding visual field defects. SWAP, FDTP, FDF perimetry can detect glaucomatous visual field defects earlier. OCT, GDxVCC, HRT, RTA can detect RNFL defects & ONH changes earlier. UBM & AS-OCT can assess anterior chamber angle . CDI can detect blood flow velocity in ophthalmic & posterior ciliary arteries.

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Review Article

Imaging Technique: Diagnosis of Glaucoma and Bangladesh Perspective

Y Khan[1]

Summary :

Imaging techniques related with glaucoma diagnosis are HRT (Heidelberg Retinal Tomography), GDxVCC, (Scanning Laser polarimetry) and OCT (Optical coherence Tomography). HRT were first developed in the year 1992, HRT II in 1999 and now HRT III. GDx –VCC developed in the year 2002 and Stratus OCT in the year 2001. Although clinical examination and fundus photography remain the "gold standard" for assessing glaucomatous optic disc and RNFL change, they are limited by the need for pupil dilation and subjective, qualitative assessment. In contrast to clinical examination and photography, computer-based imaging techniques provide real-time, quantitative information on the optic disc and RNFL. For these reasons, in clinical practices, imaging techniques are considered standard for documenting optic nerve head and RNFL.The future of these imaging devices is hopefully bright for diagnosis of glaucoma. Till today, in Bangladesh we are not accustomed to GDx –VCC, though our neighboring countries like India, Pakistan, Thailand and Singapore have been to GDx –VCC for last several years, which is the most friendly imaging device to glaucoma patients. To go with the development of newer device in ophthalmic practice, the Ophthalmologist of our country must be familiar with these imaging techniques.

Key Words : HRT, GDx-VCC, OCT

Introduction :

Glaucoma causes loss of the retinal nerve fiber layer (RNFL). RNFL assessment is extremely necessary for early detection and monitoring the progression of glaucoma. Now a days, in Bangladesh, diagnosis of glaucoma is mostly based on IOP measurement and optic disc evaluation, which is not sufficient enough. Visual fields are the next most widely used tests to diagnose glaucoma. They are highly subjective having low sensitivity and specificity and able to detect field changes only after about 40% of RNFL damage has already occurred . Measurement of RNFL overcomes these limitations to a great extent. In our country RNFL measurement is done by clinical assessment, red-free filters in direct ophthalmoscopes, ONH and RNFL photography- which is now considered the gold standard in the diagnosis of glaucoma. Its value to see the progression of glaucoma is not truly convincing, as this is also subjective. Now a days everyone is concerned about early detection of the disease process so that a diagnosis can be made before appearance of any irreversible change. The upcoming technologies and newer diagnostic modalities may enable us to make a pre- perimetric diagnosis of glaucoma. Three new modalities of RNFL assessment are- 1. HRT (Heidelberg Retinal Tomography). 2. GDxVCC(Scanning Laser polarimetry) 3. OCT (Optical coherence Tomography) and so considered new imaging devices for diagnosis of glaucoma. It is utilized in conjunction with careful clinical examination and visual function testing. The HRT, GDx-VCC and OCT provide reproducible, real-time, quantitative information on the optic disc and RNFL. Recent advances have improved their ability to detect and monitor glaucomatous damage over time. These can differentiate between normal and glaucoma eyes and show promise for detecting change over time. It is important that the clinician should understand the strengths and limitations of each technique. If the ophthalmologist are acquainted with these imaging devices, it may help the diagnosis as well as follow-up of glaucoma patient. In contrast to clinical examination and photography, computer-based imaging instruments are thought to be much helpful.

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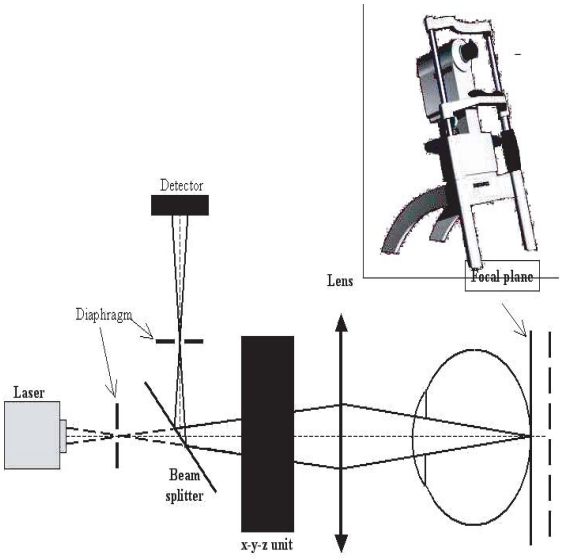
Table -1

Imaging technique

Sl. No.	Basic Principle	Name of imaging instrument and their changes	Manufacture company
1.	Confocal scanning laser ophthalmoscopy (CSLO)	Heidelberg retina tomography 1. HRT 2. HRT II 3. HRT III	Heidelberg Engineering, Dossenheim, Germany
2.	Scanning laser polarimetry (SLP)	Nerve fibre analyzer 4. NFA 5. NFA II 6. GDX FCC 7. GDX- VCC	Laser diagnostic Technologies, San Diego, CA
3.	Optical coherence tomography OCT	Optical coherence tomograph8. OCT 9. Stratus OCT	Zeiss Meditec, Dublin, CA

Principles of operation of Imaging technique :

There are three commercially available confocal Scanning laser ophthalmoscopes (CSOL) for imaging the posterior segment of the eye- The Heidelberg Retina Tomograph (HRT). HRT instruments from Heidelberg Engineering, Dossenheim, Germany. The HRT II, a diode laser (670nm wavelength) to sequentially scan the retinal surface in the x and y directions at multiple focal planes using confocal Scanning principles, is designed specifically for imaging in glaucoma.



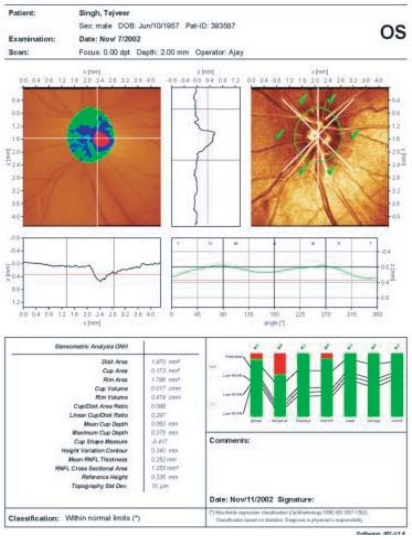


Figure-1 : HRT II machine and confocal scanning Laser system and printout

Scanning laser polarimetry (GDx-VCC) provides objective and quantitative measurement of the RNFL by measuring the change in polarization (retardation) that occurs when light illuminates birefringent tissue, such as the RNFL.

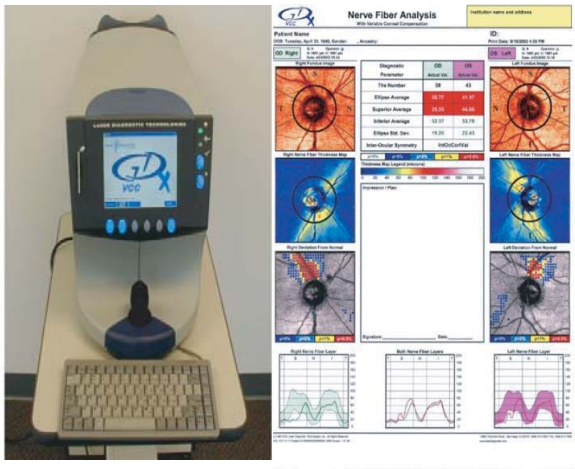


Figure-2: GDx-VCC Machine and Printout.

Optical coherence tomography (OCT) uses optical technology that is analogous to ultrasound B mode imaging, but it utilizes light instead of sound to acquire high resolution images of ocular structures using the principles of low coherence interferometry.

Figure-3: Abnormal OCT-RNFL Scan

Table -2

Cpomparative evalutation of HRT II, GDx-VCC and OCT3

All three machines are non –Contact, rapid, scanning time few seconds

	HRT II	GDx VCC	OCT3
Light Source	670nm Diode	780nm Diode	830nm Diode
Resulation	30	-	8-10
Pupillary dilation	N	N	Y
Sensitivity specificity	96%84%	89%98%	95%89%
Normative database	112 normals	540 normals & 262 glaucoma patients	328 normals

Image quality :

Image quality is important for better evalution. Several imaging instruments currently provide automated image quality assessment and feedback to the operator during or immediately after image acquisition. The HRT II quality control system automatically determines three good quality scans. Regarding GDx-VCC, feedback on image quality is available immediately after image acquisition..The OCT and Stratus OCT currently do not provide real-time feedback on image quality.

Detecting Early Glaucoma :

The large variability in the number of optic nerve axons in healthy eyes, ranging from 750,000 to 1,500,000 results in considerable overlap in RNFL thickness and optic disc topography measurements of healthy and glaucomatous eyes. Sensitivities and specificities ranging from 58% to 84% and 65% to 96%, respectively[1] .In studies that included early to moderate glaucoma defined using visual field criteria, sensitivities of discriminant functions of GDx-VCC parameters had the best diagnostic accuracy; at a high fixed specificity of 90%, sensitivity ranged from 33% to 81%, while area under the ROC curve range from 0.79 to 0.94. The areas under the ROC curves have been reported to range from 0.79 to 0.94, depending on the parameter and characteristics of the population evaluated[2].

Strengths and Limitations :

HRT has high sensitivity and specificity thus allowing it to have a very high precision in early diagnosis and allowing us to pick up pre-perimetric glaucoma and detect early progression. A strength of the HRT is its analysis of the optic disc, a structure with characteristics likely more familiar to the ophthal-mologist than the retinal nerve fiber layer. RNFL thickness measurements obtained with the GDx VCC can better discriminate between healthy and glaucoma eyes and are more strongly associated with visual field indices[3-4]. For each GDX-VCC scan, an age-matched comparison is made to the normative

database and any significant deviations from normal limits are flagged as abnormal with a p value. Strengths of the OCT include its ability to measure peripapillary RNFL thickness without the need for a reference plane or magnification correction, macular thickness and the ONH parameters in eyes with glaucoma.

Clinical Studies :

There are numerous studies in literature showing that all three machines have high reproducibility. The para meters are measured by, HRT II, GDx –VCC and OCT3 show good correlation with visual field indices on standard white on white automated perimetry (SAP). They also possess high sensitivity and specificity for differentiating normal eyes from glaucomatous eyes even in early stages of glaucoma. All these have the provision for serial analysis of the scans to detect changes in ONH or RNFL over a period of time. Various studies evaluating the role of HRT, GDx VCC and OCT generated RNFL and optic nerve head Parameters have valuable role in identifying glaucoma suspects and differentiating them from normal eyes. But it should be kept in mind that there is considerable overlap amongst the normal and early glaucoma eyes. Therefore, the exact role of these imaging modalities in preperimetric diagnosis still remains undefined. And till to day, there are not well defined guidelines that can enable an ophthalmologist to choose whether a patient requires initiation of treatment or simply a follow-up still under devide.

Bangladesh Perspective :

Bangladesh having a population of 160 million should have several HRT, GDx -VCC and OCT. Our neighboring countries like India, Pakistan, Thailand, Singapore etc. have imaging devices running for last several years. Dhaka, being central and capital city of Bangladesh having a dense population of about 15 million needs to have multiple HRT, GDx- VCC and OCT facilities in ophthalmic care centres for diagnosis of glaucoma. Unfortunately there is no GDx-VCC in Bangladesh. only one HRT machine has been installed recently at National Institute of Ophthalmology, Dhaka. GDx–VCC have 540 normals and 262 glaucoma patients normative database covering Asian, African, American and Caucasians. GDx –VCC is a friendly imaging device to glaucoma patient Ophthalmogist of Bangladesh should be familiar with HRT and GDx-VCC and should have knowledge regarding evaluation of their printouts. Fortunately, in Dhaka there are three OCT machine for both glaucoma and retina patients. All these imaging devices must be available all major cities of Bangladesh and ophthalmologists should be acquainted with these techniques.

Summary for the Clinician :

HRT II image quality control system modifies scanning parameters during image acquisitions and provides feedback on image quality to the operator. HRT clinical printouts include identification of regions and measurements that are outside the range of normal values. HRT measurements are influenced by fluctuations in IOP. Users should consider possible IOP related change when assessing progression. Improvements with the commercially available GDx-VCC are likely to enhance its utility in clinical practice. GDx- VCC clinical printouts include identification of regions and measurements that are outside the range of normal RNFL thickness values. GDx- VCC corneal compensation should be reassessed after laser refractive procedures, or other conditions that may cause a change in corneal architecture. Stratus OCT is able to assess peripapillary RNFL thickness, optic nerve head topography and macular thickness using the same instruments. Stratus OCT RNFL thickness printouts include identification of regions that are outside normal limits. Pupillary dilation is needed to obtain good quality stratus OCT images in some eyes.

Conclusion :

Optic nerve imaging techniques provide objective measurements of the RNFL in glaucoma. Each instrument is now standing at different stages of their development. As the reproducibility of imaging instruments is good, these techniques are particularly well suited for detecting small, subtle changes in the

optic disc and RNFL. It is important that the clinician understand the strength and limitation of each , so that the best quality information will be used for glaucoma management.

Acknowledgement : I specially thank Dr. Ritu Gardia, senior resident, Dr. R P Centre for ophthalmic sciences, All India Institute of Medical Sciences, New Delhi, India for her support regarding ptintout of HRT, GDx-VCC and OCT.

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Review Article

Medical Management is not the only Option in End Stage Glaucoma

M S I Prodhan[1]

Abstract

End stage glaucoma is a term used to describe glaucoma that has reached a stage of extreme or near total vosion loss: however there is no universally accepted formal definition. One definition implies very constricted visual field, less than 10^0 in diameter; others define as a visual acuity of 6/60 or worse. Patient of end stage glaucoma is refered as legally blind when affected bilaterally. End stage glaucoma should be evaluated and managed differently because patient with end stage glaucoma has a high risk of further disease progression. Therefore, the preservation of this already seriously threatened vision is of major importance. Treatment decisions must be made more quickly.

In end stage glaucoma monitiring or follow up is more frequent Antiglaucoma drugs should such type of drug which maintains intraocular pressure constantly, so no fluctuation e,g. prostaglandin analogue. Surgical treatment may be used when antiglaucoma medications become ineffective. Patients with rapidly progressive glaucomatous optic neuropathy where quality of life would suffer unless rapid intraocular pressure lowering occurs to the desired target level need surgical treatment. More stringent early control of intraocular pressure may avoid the development of end stage glaucoma. End stage glaucoma: fortunately the end may be far off. Medical management is not the only option in end stage glaucoma. Trabeculectomy with anti-metabolite such as Mitomycin-C or 5FU is the ideal surgery for end stage glaucoma.

Key word : End stage glaucoma, medical treatment, surgical treatment.

Introduction

Glaucoma is a blinding disease. It is called silent killer of eye. As glaucoma is usually a symptomless disease patient doesn't attend to the doctor in early stage of desease. They usually present to ophthalmologist at advanced stage (end stage). So screening programme should be strengthening for early diagnosis & thereby we can prevent glaucoma related blindness. End stage glaucoma is a term used to describe glaucoma that has reached a stage of extreme or near total vosion loss: however there is no universally accepted formal definition[1]. One definition implies very constricted visual field, less than 10^0 in diameter; others define as a visual acuity of 6/60 or worse. Clinically cup disk ratio is 0.9:1 or more, neuroretinal rim is vry thin. OCT shows much thining of nerve fibre layer of peripapillary region. Patient of end stage glaucoma is refered as legally blind when affected bilaterally. End stage glaucoma should be evaluated and managed differently because patient with end stage glaucoma has a high risk of further disease progression[2]. Even though viual loss slowly progress, most patients with end stage glaucoma retains funtional vision for a long period when intraocular pressure is being held below 15 mmHg[3]. Therefore, the preservation of this already seriously threatened vision is of major importance. Regarding management of end stage glaucoma there are two schools of thought, some surgeon prefer continuing medical treatment but others are infavour of surgical treatment. Sometimes surgery may reduce the existing vision but not always.

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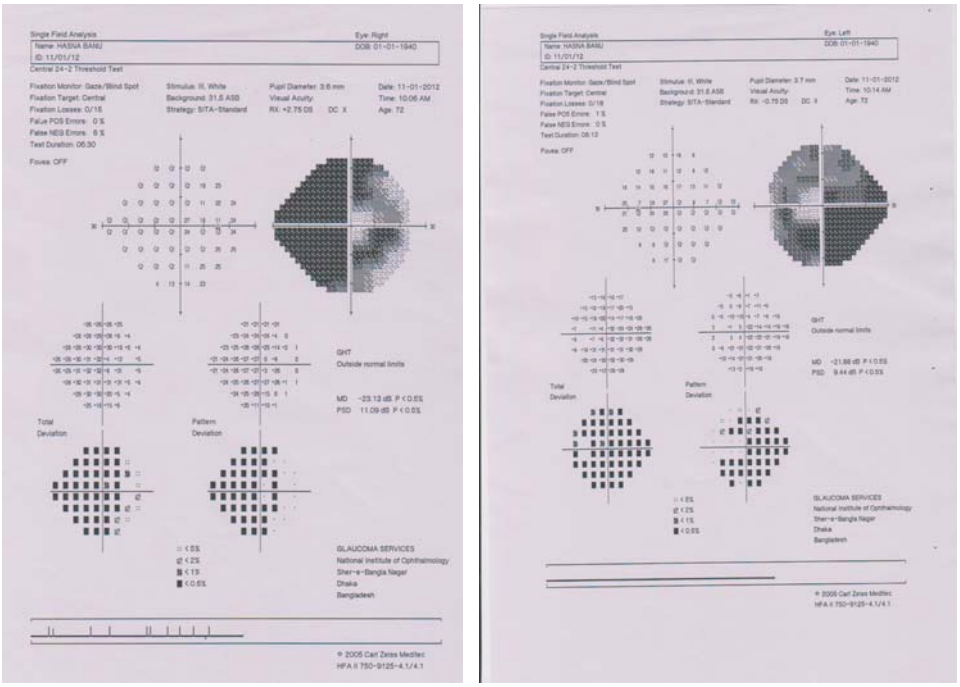
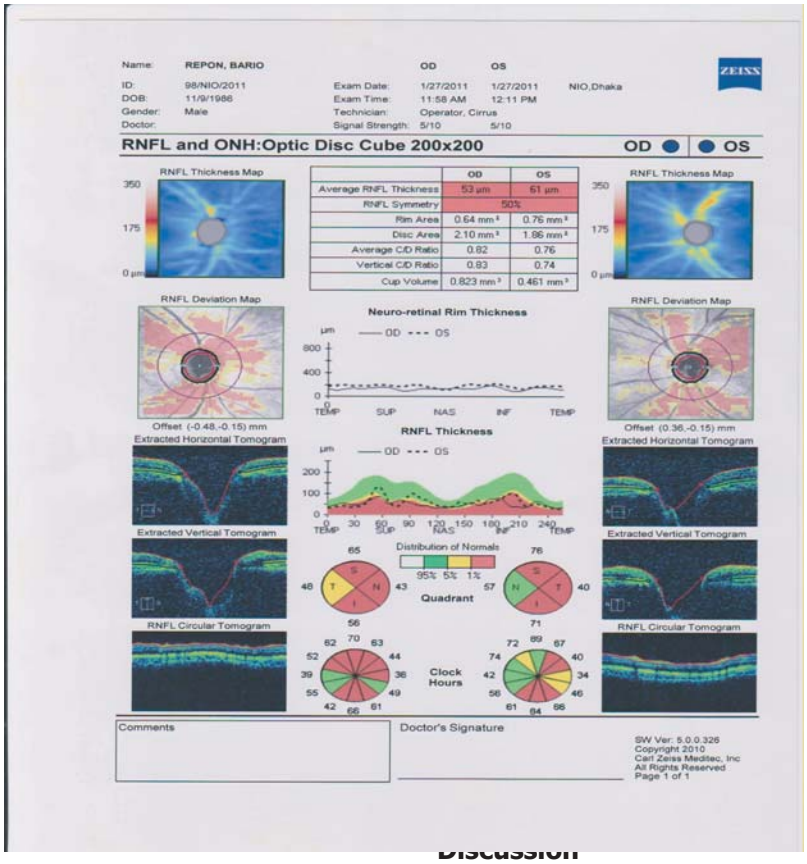


Fig: 1. Tubular field in end stage glaucoma



	OD	OS
Average RNFL Thickness	53 µm	61 µm
RNFL Symmetry	50%	
Rim Area	0.64 mm²	0.76 mm²
Disc Area	2.10 mm²	1.86 mm²
Average C/D Ratio	0.82	0.76
Vertical C/D Ratio	0.83	0.74
Cup Volume	0.823 mm³	0.461 mm³

Fig: 2. Marked thining of RNFL in end stage glaucoma

Treatment decisions about end stage glaucoma must be taken more quickly. In end stage glaucoma monitiring or follow up is more frequent.Target pressure in end stage glaucoma is lower than in earlier stage glaucoma[4]. Aggressive treatment is needed to get the pressure low.Treatment of end stage glaucoma is just like early glaucoma exept the target intraocular pressure is much lower. Counselling of patient is very important giving hope of the patient that 'Relentless progression to blindness is not the norm in treated patients".

Antiglaucoma drugs should such type of drug which maintains intraocular pressure constantly, so no fluctuation of intraocular pressure e, g. prostaglandin analogue. To aceive target intraocular pressure sometimes it is needed combination of all antiglaucoma drugs such as prostaglandin analogue, beta blocker. Alpha-2 agonist, carbonic anhydrase inhibitor. "Low visual aid"may be needed along with medical treatment. Patient should be encouraged that treatment is not futile. They may retain their visual acuity for many years and be able to perform simple tasks of daily living and enjoy reading and hobbies. Even though viual loss slowly progress, most patients with end stage glaucoma retain funtional vision for a long period when intraocular pressure is being held below 15 mmHg[4]. Immediate postoperative unexplained vision loss after surgery is a complication of end stage glaucoma. Surgery of end stage glaucoma needs confident and skilled surgeon. Trabeculectomy with anti-metabolite such as Mitomycin-C or 5FU is the ideal surgery for end stage glaucoma.

Indications of surgical treatment in end stage glaucoma:

- Surgical treatment may be used when antiglaucoma medications become ineffective.
- Patients in whom the target intraocular pressure is unlikely to be achieved with topical medications alone.
- Visual field loss is such that further progression is likely to affect the patient's quality of life.
- Patients with rapidly progressive glaucomatous optic neuropathy where quality of life would suffer unless rapid intraocular pressure lowering occurs to the desired target level.
- Patients who are poor candidates for conventional medical treatment.
- Surgical options are trabeculectomy with antimetabolite. Alternatively glaucoma drainage implants if filtration surgery failed.

Conclusion

Management of end stage glaucoma is really a matter of controversy. Medical management is not the only option in end stage glaucoma. Surgical treatment may the other effective option to save the residual vision. Trabeculectomy with anti-metabolite such as Mitomycin-C or 5FU is the ideal surgery for end stage glaucoma. Management of end stage glaucoma depends upon the patient's need, choice of the surgeon and also the patient preference[5].

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Laser PI is better in PAC-an update

M. H. Rahman[1]

Introduction :

PACG is the most visually destructive form of glaucoma. It is established that primary angle closure glaucoma (PACG) is more common in the Asian population and accounts for greater blindness than primary open angle glaucoma (POAG). Primary Angle Closure (PAC) is a stage of Angle Closure Diseases (ACD) before development of glaucoma. We can prevent development of glaucoma and blindness by Laser Peripheral Iridotomy (LPI) during the stage of PAC. This article reviews the insight into the current concepts related to the treatment of PAC with LPI.

Terminologies and Classifications

Older terminologies and classification has many problems :

1. Reflects time course and or presence of symptoms
2. Lack of specificity
3. Makes standardization of diagnosis-difficult
4. Little or no value to clinical strategies for pt care

Twenty first century consensus classification-PACG

The new classification has three stages:

1. Primary Angle Closure Suspect -PACS
2. Primary Angle Closure- PAC
   - Acute
   - Chronic
3. Primary Angle Closure Glaucoma -PACG
   - Acute
   - Chronic

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Advantages of new classification :

- Classify natural history of angle closure
- Rely on three simple factors-
  - I. IOP
  - II. Gonioscopic findings
  - III. Status of ONH and visual field
- Clinical examination alone determines the staging
- Determine prognosis and individual's need for treatment

Criteria :

PACS	Normal IOP, Optic Nerve Head and Visual Field but shallow Aanterior Chamber
PAC	1. Chronic-Variable IOP, Normal Optic Nerve Head and Visual Field but shallow Anterior Chamber and angle abnormalities (PAS, blotchy pigment over TM, glaucomphlaken etc) 2. Acute- signs of Chronic PAC, High IOP, Corneal edema, Pain, Redness and Dimness of vision
PACG	1. Chronic-Signs of Chronic PAC except High IOP, ONH damage and Visual field defects 2. Acute- Signs of Acute PAC except High IOP, ONH damage and Visual field defects

Risk factors :

- Anatomic predisposition toward Angle Closure
  1. Shallow anterior chamber
  2. Short axial length of globe
  3. Small corneal diameter
  4. Increased thickness of lens
  5. Decreased anterior chamber volume
  6. Anterior position of lens

- **General factors:**
  1. Age- average age is >60 years
  2. Race- more common in South east Asian, Chineese and Inuit
  3. Gender- F:M = 3:1
  4. Refractive error- Hyperopes are more affected
  5. Family history- First degree relatives

- Precipitating factors:
  1. Deem light
  2. Mydriasis
  3. Miosis-Reversal AC

Mechanisms of PAC :

Two mechanisms are responsible for angle closure-1) Pupillary block happening at the level of pupil and iris 2) Nonpupillary block occurring at the level of ciliary body and lens. Both mechanisms can close angle itself but component of papillary block is often present.

A) At pupil and iris level-

- Pupillary block:

  - Relative papillary block is the fundamental mechanism of PAC (Absolute pupillary block responsible for 2ndary angle closure)

  - Most common
- Prominent last iris roll
- Peripheral iris crowding

B) At ciliary body level-

- Plautae iris

C) At level of lens-

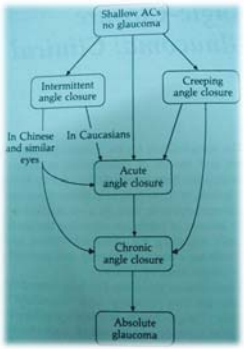
- Lens induced Angle Closure

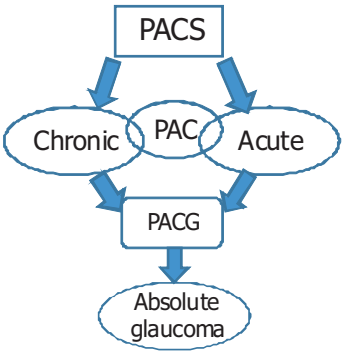
- Third category of PAC mechanism

- Abnormal lens (size) either compromises the lens– iris channel (papillary block) or mechanically pushes the peripheral iris forward into the angle

Natural History of PACG:

Older terminology Newer terminology





Diagnosis of PAC :

It based on three things-

1. Angle status(Gonioscopic findings)
2. ONH evaluation with corresponding visual field abnormalities
3. IOP

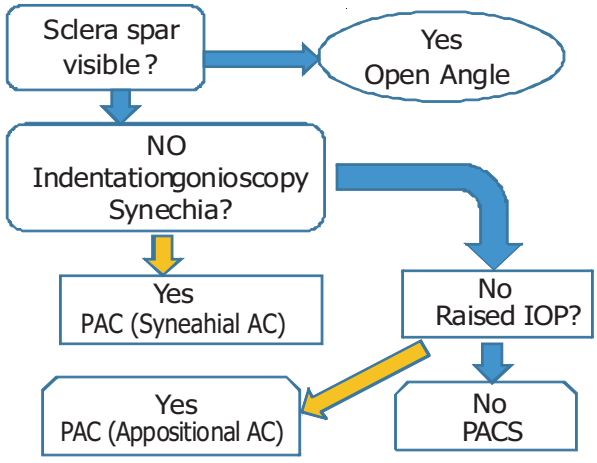
Evaluation of angle

It is the basic thing for diagnosis of PAC. Angle can be assessed by various ways-

1. Gonioscopy
   - Integral part of eye examination
   - Fundamental test for diagnosis of PAC
   - Important for treatment and Follow up also

2. Other Procedures :
   - UBM
   - Anterior segment OCT
   - Both are helpful for diagnosis

Diagnostic cascade with gonioscopy-



Treatment of PAC :

- Considerable Factors-
  - I. Nature of onset
  - II. Level of IOP
  - III. Extent of PAS
- Two basic principles:
  - Immediate control of symptoms and raised IOP
  - Change of angle configuration preventing further closure and progression to Glaucoma

A. Immediate control of symptoms and Signs:

We should think first for elimination of discomfort and ensuring patient wellbeing which can be achieved by reduction of IOP- symptomatic relieve. It is more important for symptomatic PAC that is called acute PAC. Immediate control of IOPmay be done by using following drugs-

1. Beta blockers
2. Carbonic Anhydrase Inhibitor-I/V, Oral or Topical
3. Alfa agonist
4. Pilocarpine
5. I/V mannitol

B. Change of angle configuration preventing further closure and progression to Glaucoma:

I n order to prevent further closure of angle and to prevent progression from PAC to PACG something to be done which can change the angle configuration-widening of angle.

a. Surgical Options-

I. Laser Peripheral iridotomy

II. Argon laser peripheral iridoplasty

III. Lens extraction with or without goniosynecholysis

IV. Surgical iridectomy

b. Medical option-

Topical pilocarpine

i. Yag laser peripheral iridotomy-

Indications-

1. PACS- prophylaxis
2. PAC-
   - Curative
   - Prophylaxis
3. PACG

IN PAC-

- Effectively widens Angle
- Changes the course of Angle Closure disease process
  - Prevent acute attach
  - Prevent progression to PACG
- Very low risk procedure
- Complications – rare and temporary
- Not so effective- Platue Iris Configuration and PAC with uncontrolled IOP by Antiglaucoma drugs

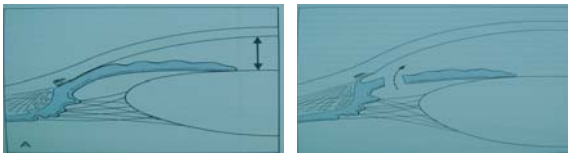


Fig- Effect of Yag PI in PAC

ii. Argon laser peripheral iridoplasty-

It is very effective way of angle widening but reserved the cases refractory to laser peripheral iridotomy.

Advantages-

- Widens angle
- Changes the course of Angle Closure process
- Low risk of complication
- Effective in Platuae Iris configuration.

Disadvantages-

- Relatively Invassive procedure

iii. Lens extraction with or without goniosynecholysis-

- Effectively widen angle
- Definitive procedure in PAC which is induced by lens
- Some controversy is there

iv. Surgical iridectomy-

It is older modalities of treatment but effective.

Advantages-
- Effectively widens AC angle
- Changes the course of AC process

Disadvantages-
- Invassive procedure
- Risk of complications

v. Topical pilocarpine-

Pilocarpine is used for more than 100 years in treatment of PACG. It is the most common drug prescribed for management of ACD. But now the use of pilocarpine is reduced after coming of Yag laser.

Advantages-
- Effectively widen appositional Angle Closure
- Easily available

Disadvantages-
- Can't changes the course of Angle Closure process
- Can't prevent progression of PAS and to PACG
- Induces subconjuntival fibrosis which reduce success of filtration surgery
- Complications–common sometimes untolarable (frontal headache)

Literature Review :

Nolan et al. (Br J Ophthalmol 2000; 84: 1255-9) reported that LPI is an effective treatment for acute PAC, resulting in widening of the filtration angle and reduction of elevated IOP. However, they stated that iridotomy alone is less effective at controlling IOP once glaucomatous optic neuropathy (PACG) associated with synechial angle closure has occurred.

Lim etal. (Ophthalmology 2004; 111:1470-4) evaluated the changes in the configuration of the drainage angle in the first year after acute PAC. They noted that in acute PAC eyes, there was a significant increase in angle width from baseline to 2 weeks after LPI but no change in angle width subsequently. The fellow eyes were shown to have widening of the angle between baseline and week 2; and from week 2 to 4 months. However, no significant change was noted in PAS in either affected or fellow eyes over the follow-up period of 12 months.

Ahmed M etal (J Coll Physicians Surg Pak 2006 Dec; 16(12):764-7) showed that-YAG laser iridotomy offers effective, long lasting, first line treatment for the management of PAC and Laser iridotomy widens drainage angle and reduces IOP, once synechial angle closure occurs in more than one quadrant.

Ang LP et al (Ophthalmology 2000 Nov; 107(11): 2092-6) showed that LPI is safe and effective in preventing acute angle closure in fellow eyes.

Tarongoy P etal (Surv Ophthalmol. 2009 Mar-Apr; 54(2): 211-25) showed that
- Laser peripheral iridotomy equalizes the anterior and posterior pressures and widens the filtration angle by reducing the effect of pupillary block.
- Argon laser peripheral iridoplasty contracts the iris stroma to reduce angle crowding and is helpful for some affected eyes.
- Lensectomy dramatically widens the angle and eliminates pupillary block.

Bian AL et al (Zhonghua Yan Ke Za Zhi 2009 Dec; 45(12): 1099-104) told us most of PAC eyes after LPI are free of acute attack of angle closure and PAC eyes should be given close and regular follow-up in a long-term to monitor the IOP control and progression.

World Glaucoma Consensus recommends -
- Laser PI should be performed in all stages of Angle Closure Diseases as soon as feasible

- Argon Laser Iridoplasty can be considered in eyes with residual AC having patent PI
- Medical treatment should not be used as substitute for Laser PI

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RNFL Analysis by OCT

M M Hossain[1]

Introduction :

Glaucoma imaging technologies work by detecting thinning of the retinal nerve fiber layer (RNFL), as with ocular coherence tomography (OCT) and scanning laser polarimetry (GDx VCC, Carl Zeiss Meditec Inc.), or through topographic evaluation of the optic nerve and peripapillary retina, as with confocal scanning laser ophthalmoscopy (Heidelberg Retina Tomograph-3, Heidelberg Engineering). This article focuses on using OCT to enhance your glaucoma work-up and management, while recognizing its limitations. In general, OCT's role in glaucoma management cannot be translated to other technologies such as GDx VCC or HRT-3. The inherent differences in the way that these devices measure structural changes secondary to glaucoma require looking at the devices individually to determine their effectiveness for the various stages of glaucoma. So, for simplicity, this article discusses only OCT.

OCT is a dynamic imaging device that generates a high-resolution, in vivo cross sectional view of the retina that enables accurate measurement of the RNFL thickness.[1] It is well known that thinning of the RNFL can occur before visual field defects manifest, and that progressive RNFL thinning is a hallmark of advancing glaucoma.[2] So, OCT RNFL analysis has great potential for early detection and management of the disease.

Two different OCT technologies are currently commercially available: time-domain OCT (TD-OCT: Stratus OCT, Carl Zeiss Meditec) and spectral-domain OCT (SD-OCT). There are clear clinical advantages to using SD-OCT over the older TD-OCT technology:

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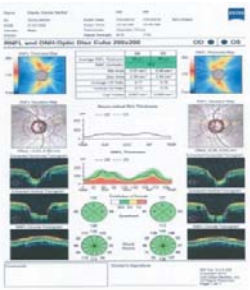
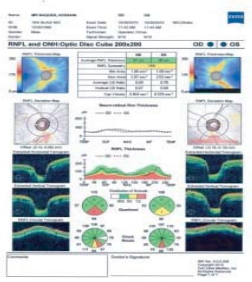
improved resolution of the retinal layers, repeatability, and faster scans. However, much of the clinical research that verifies OCT's ability to detect glaucoma is based upon the Stratus OCT. Additionally, the Stratus OCT is still widely used in clinical practice, so it is worthwhile to consider its clinical attributes.[3]



OCT- RNFL (Normal Eye)



OCT-RNFL(Glaucomatous Eye)

Discussion :

For diagnostic purposes, the Stratus OCT has been proven to differentiate most normal eyes from glaucomatous eyes Therefore, the Stratus OCT can be an important management tool for glaucoma suspects and ocular hypertensives. For patients with known glaucoma, the Stratus OCT can be used to monitor glaucomatous RNFL loss over time, but with some caveats.

Recent studies have shown that the Stratus OCT is capable of recognizing glaucomatous RNFL progression.[1,3,4] Despite this, we know that the Stratus OCT is incapable of measuring the same peripapillary location on consecutive scans. This is due to subjective peripapillary ring placement and slow scan speed, which has a deleterious effect on repeatability because of eye movement. So, when you compare follow-up RNFL scans with your baseline values, you must consider that the changes in RNFL thickness may be secondary to variability in the measurements. In general, when integrating OCT

RNFL analysis into your glaucoma management decisions, you must be able to recognize errant OCT findings that do not fit the overall clinical picture.

A more sophisticated way to track RNFL thickness changes over time is to utilize the guided progression analysis software (GPA Advanced Serial Analysis) for the Stratus OCT. The OCT GPA software performs a trend-based analysis of serial RNFL measurements and looks for changes in RNFL thickness compared to the baseline scan.[4] A recent study has shown that the OCT GPA is capable of detecting significant RNFL thinning, both locally (quadrants) and globally (average thickness).[4]

OCT GPA can also determine the rate of RNFL thinning, which could impact how aggressively you treat your patients. Glaucoma patients with RNFL progression that was detected by OCT GPA did not always show progression of their visual field defects.4 At present, it is unclear what the impact is on functional vision loss if RNFL progression is detected by OCT GPA.

As OCT continues to be tested in clinical studies for its use in glaucoma management, there are indications that it may outperform other imaging modalities, such as confocal scanning laser polarimetry and scanning laser polarimetry.[5-8] A recent study showed that visual field defects correlated better with RNFL thinning detected by SD-OCT compared to scanning laser polarimetry.[6] In another study, SD-OCT was found to have better diagnostic sensitivity for detecting glaucoma than HRT.[5]

The profound advantages of SD-OCT over TD-OCT have further solidified OCT's role in glaucoma imaging, making it more relevant now than ever before. There are multiple SD-OCTs commercially available, and each one continues to undergo clinical studies to validate its role in glaucoma management. This review focuses on two new SD-OCT units: Cirrus HD-OCT (Carl Zeiss Meditec) and Spectralis SD-OCT (Heidelberg Engineering).

While Spectralis OCT and Cirrus HD-OCT are both SD-OCT devices, they take a different approach to data acquisition. Cirrus HD-OCT measures RNFL thickness within a cubed area, allowing point-by-point evaluation of nearly all areas within it. The Optic Disk Cube 200 x 200 protocol is a 6mm square grid composed of 200 horizontal scan lines that each render 200 A-scans.9 The Cirrus HD-OCT automatically generates a 3.46mm diameter peripapillary calculation circle utilizing the acquired cube data, identifies the optic disc center, and positions the ring accordingly.

In comparison, the Spectralis OCT RNFL imaging protocol requires manual centration of its 3.45mm peripapillary ring. This process is made easier with the TruTrack software that stabilizes the scan image and eliminates the need to "chase" the optic nerve head while trying to center the ring. The Spectralis OCT utilizes confocal scanning laser ophthalmoscopy to employ its TruTrack system, which allows for retina recognition.

Discussion (Contd.) :

This feature allows the OCT to lock in on the retina so that even if the patient's eye is moving, the image is stable. This improves cross-section resolution by filtering out image noise. Also, it allows for unprecedented repeatability of scans (within 1µm), which is crucial when comparing follow-up RNFL scans.[10]

However, unlike the Cirrus HD-OCT, which has OCT GPA software available, the Spectralis OCT does not currently have any means to decipher statistically significant changes with serial RNFL thickness readings.

Ideally, we should be able to detect the earliest signs of glaucoma to ensure proper oversight of this lifelong disease and for timely medical intervention to prevent functional vision loss. RNFL imaging devices offer a means to objectively detect early glaucoma in some patients who have subtle or subclinical changes. If a reliable scan (i.e., good scan quality and centered ring placement) is obtained, then the OCT is able to detect

RNFL thinning in early glaucoma patients, making it a valuable diagnostic tool.[11]

OCT can be used to differentiate suspicious optic nerves that have abnormal structural characteristics (i.e., large cupping, thin neuroretinal rims, optic disc tilt, peripapillary atrophy) that are not secondary to glaucoma. For instance, a tilted or obliquely inserted optic disc often obscures the appearance of the neuroretinal rim and cup-to-disc ratio, to the point that a healthy optic nerve may appear glaucomatous.

Using OCT to verify normal RNFL thickness will help prevent a misdiagnosis of glaucoma. OCT is capable of detecting RNFL thinning in glaucomatous eyes with tilted discs, and has good correlation with the severity of visual field loss.[12] (One study found that patients with tilted disc syndrome, who did not have glaucoma, tended to have thinning of the superior RNFL compared to normals. So, be cautious when using OCT to analyze the superior neuroretinal rim in tilted discs.[13])

Conclusions :

Although OCT provides valuable information about RNFL thickness, it is not essential for making a diagnosis of glaucoma. So, for diagnostic purposes, OCT at this time cannot replace a detailed optic nerve and RNFL evaluation with a fundus lens. However, it can add credibility to subtle clinical findings and is an important tool in any glaucoma practice.

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BGS Website

Bangladesh Glaucoma Society Website has been created as www.bgsbd.net. The website will be officially opened in the 3rd Annual National Conference of Bangladesh Glaucoma Society to be held on 12 January, 2013 at Ruposhi Bangla Hotel, Dhaka. Prof. Syed Modasser Ali adviser to the Hon'ble Prime Minister for the ministry of Health & Family & Social Welfare will open the website in the conference.

5th World Glaucoma Congress

The WGC 2013 congress will take place from July 17th to July 20th, 2013 at the Vancouver Convention Centre, 1055 Canada Place, Vancouver, BC V6C 0C3, Canada.

Deadline abstract submission

February 15, 2013.

To attend the Conference interested glaucoma members are requested to contact: General Secretary, Bangladesh Glaucoma Society.

BGS President Elect got ACOIN Award

Prof. M. Nazrul Islam President Elect of Bangladesh Glaucoma Society has got the prestigious AK Das Award of the Association of Community Ophthalmologist of India (ACOIN) this year from Bangladesh. For his community service in glaucoma & eye care through Jessore Community Eye Hospital Prof. Islam got this award in ACOIN annual conference at Pune, Bombay in November 2012.

Prof. Nazrul Islam elected APGS Executive Board Member

Prof. M. Nazrul Islam president elect of Bangladesh Glaucoma Society (BGS) has been elected as a member of the executive Board of Asia Pacific Glaucoma Society (APGS) for the session of 2013-2014.

In the Annual General Meeting of APGS held at Bali, Indonesia, a nineteen member new Executive Board was formed with Prof. Ivan Goldberg (Australia) as president & Dr. S.K. Fang (Malaysia) as secretary.