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Detection of Field Defects in Primary Open Angle Glaucoma Patients Using Humphrey's Automated Perimetry – Clinical Study

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Abstract: *Glaucoma is progressive, chronic optic neuropathy characterized by acquired atrophy of optic nerve and loss of retinal ganglion cells and axons. Today, glaucoma is a leading cause of irreversible blindness throughout the world. The main challenge in glaucoma facing our country is that nearly 90% of glaucoma is undetected. Although a number of competing technologies are currently available to assess loss of Nerve fibre and optic disc cupping and it may be years before all those become practically applicable in clinical practice. Today visual field analysis and assessment irrespective of Inherent subjectivity error's in perimetry remains the most popular technique to assess the functional visual loss in patient of glaucoma.*

Keywords: Glucoma,chronic disease, irreversibleblindness

1.Introduction

Primary open angle glaucoma patients have both pressure dependent as well as pressure independent factors affecting the
optic Nerve and Causing the Ischemic and Metabolic Insult leading to Death of retinal Ganglionic cells.

The incidences of visual field defects are much more in primary open angle Glaucoma patients.

In this study we are going to subject these Primary open angle
Glaucoma patients with significant IOP and altered cup disc ratio to the standard Automated perimetry.

Automated static perimetry is the current gold standard for visual field testing in Glaucoma[1].

Humphrey Field Analyzer is inbuilt automated static perimeter.

Early and characteristic Glaucomatous field defects occur in central visual field. Hence central visual field recording is important.

In this study we subject these POAG patients to Central visual field testing.

2.PHYSIOLOGY OF AQUEOUS HUMOR

Glaucoma deals primarily with the consequences of elevated intraocular pressure. The Physiological factors which control IOP constitute the dynamics of aqueous flow. Present model of Glaucoma proposes that the level of IOP is too high for the continued health of the optic nerve and this leads to cupping and atrophy of optical disc and concomitant visual field loss.

$$Po=F/C + PV$$

Po=IOP in the undisturbed eye in mm of Hg

F = rate of Aqueous humor formation in micro

liter/minute

C = Facility of outflow in micro liter/minute/mm of Hg

Pv = episcleral pressure in mm of Hg

The study of Aqueous humor dynamics can be considered under 3 major headings.

1) Aqueous humor formation
2) Aqueous humor out flow
3) Episcleral venous pressure

Aqueous Humour Formation

Aqueous humor is a relatively cell free, protein fluid that is formed by the ciliary epithelium of ciliary Body in the posterior chamber[2].

The anatomy of the structures involved in the formation of Aqueous formation is as follows:

Anatomy of ciliary body

The ciliary body is the portion of uveal tract that lies between iris and Choroid. On cross section the Ciliary Body has the shape of right angle triangle. It is attached to anterior side of Ciliary Body leaving narrow width of ciliary face visible on Gonioscopy between peripheral Iris and the sclera Spur. The Ciliary Body is composed of

1) Ciliary Muscle
2) Vascular Tissue
3) Epithelium

Ultra structure of ciliary process

Each ciliary process is composed of three basic components :

1. Capillaries 2.Stromach 3.Epithelium

1. Network of Capillaries *:* Occupy the centre of each process and are composed of

a) Very thin endothelium with fenestrae or false pores

b) Basement membrane surrounding the endothelium

2.Stromach: Surrounds capillary network and separates it from theepithelial layer. Stroma is composed of ground substance, collagen fibrils and occasional wandering cells.

3.Two Layers of epithelium Surround the stromach with apical surfaces of the two cell layers in opposition to each other.

Pigmented Epithelium: Comprises the outer layer adjacent to stroma. The cells are cuboidal and characterized by numerous melanin granules in the cytoplasm and atypical basement membrane on stromal side.

Non pigmented epithelium : Makes up inner layer, adjacent to aqueous into the posterior chamber. The cells of the layer are columnar and have characteristic features.

MECHANISM OF AQUEOUS HUMOR FORMATION

1) Active Secretion

2) Ultra filtration

3) Diffusion

The ciliary processes are responsible for the production of aqueous humor. The aqueous is formed largely as a result of active secretion of electrolytes into posterior chamber by the Non-pigmented Epithelial cells of ciliary body.

The formation of aqueous humor is complex process that involves active transport of substances from the plasma to posterior chamber by combination of ultra filtration, diffusional exchange and active transport of substances out of the ciliary processes[3].

RATE OF AQUEOUS HUMOR FORMATION

The rate of aqueous humor formation is found to be 2.0 to 3.0 ul/mt.

The flow is measured by two different techniques.

1.Pressure dependent methods: That utilize volumetric analysis of the eye

a) Tonography

b) Suction cup technique

c) Perfusion methods

2. Tracer methods : That monitor the rate of aqueous appearance and disappearance of various substances from the eye.

a) Photogrammetry

b) Radiolabelled Isotopes

c) Flourescein

d) Para amino hippurate and iodide methods

AQUEOUS HUMOR OUTFLOW

The goldmann equation can be rearranged to give a simplified view of the factors that determine the ease with which aqueous humor leaves the eye by conventional outflow[4].

$$C = \frac{F}{Po - Pv}$$

C = Facility of outflow ml/min/mmHg

F = aqueous humor production ml/min

Po= IOP in the undisturbed eye

Pv= Episcleral Venous pressure

The factor C is often expressed as its reciprocal R which is resistance to the outflow (mmHg x min x ml- l)

ANATOMY OF OUTFLOW SYSTEM

The major pathway from the anterior chamber to the episcleral system includes the trabecular meshwork, schlemm's canal and collector channels.

Trabecular Meshwork: The tissue consists of a connective tissue core surrounded by endothelium and divided into 3 portions.

a)Uveal Meshwork : Inner layers of trabecular Meshwork that border the A.C

b)Corneo sclera meshwork : This portion extends from the sclera spur to the anterior wall of the sclera sulcus and consists of sheets of trabeculae that are perforated by elliptical openings.

c)Juxta cannalicular tissue :- The outer most portion of the meshwork (adjacent to schlemm's canal) consists of a layer of connective tissue lined on either side by endothelium.

PHYSIOLOGY OF THE OUTFLOW SYSTEM

There are number of potential pathways for aqueous humor to leave the eye. They are

1) Trabeculo canalicular flow

2) Uveoscleral flow

3) Transcorneal

4) Postiridial route

Conventional or Canalicular system accounts for 83 % - 96 % of aqueous outflow.

Unconventional or extra canalicular system or secondary pathways accounts for 5-15% of aqueous outflow.

METHODS OF MEASURING FACILITY OF OUTFLOW

There are 3 common methods used to measure facility of aqueous outflow

a)Tonography

b)Perfusion Methods

c)Suction cup

EPISCLERAL VENOUS PRESSURE

Aqueous humor leaving the eye by Trabecular canalicular outflow eventually passes into the venous system. The pressure in the veins that receive the aqueous humor is referred to as episcleral pressure[5]. The normal episcleral venous pressure is in the range of 8 to 11.5 mm Hg.

4.ANALYSIS OF THE STUDY

Central visual field examination of 50 patients of POAG was done with Humphery field analyzer (HFA-720)

POAG Group constitute 50 patients of primary open angle glaucoma (POAG)

A total of 96 visual fields (for 100 eyes) were done. Visual Fields were not recorded for 4 eyes in POAG Group as they were having glaucomatous optic atrophy[6].

TABLE – 1

S.NO.	Diagnosis	No. of Patients
1	POAG Group	50
	Total	**50**

TABLE –2 SEX INCIDENCE

S.NO.	GENDER	POAG PTS	
		No.	Percentage
1.	MALES	28	56%
2.	FEMALES	22	44%
	TOTAL	**50**	

56% of POAG Patients are males

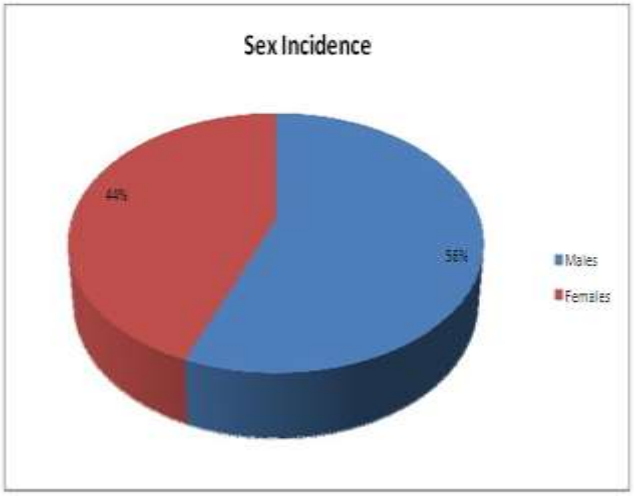
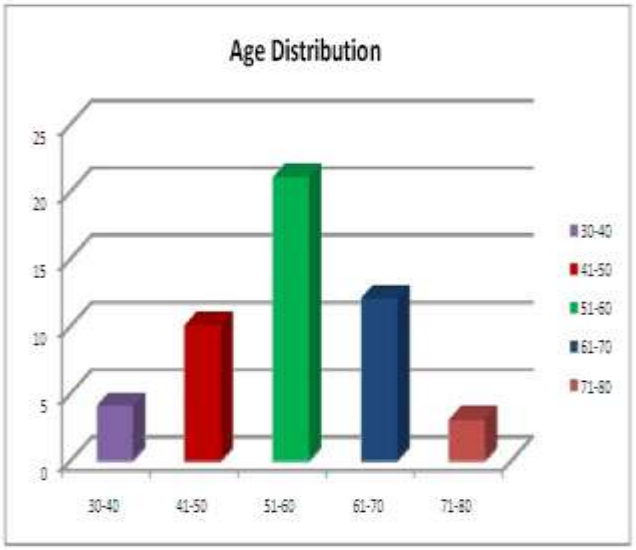


TABLE – 3 AGE DISTRIBUTION

S.NO.	AGE (YRS)	POAG PTS	
		No	Percentage
1.	30-40	4	8%
2.	41-50	10	20%
3.	51-60	21	42%
4.	61-70	12	24%
5.	71-80	3	6%
	Total	**50**	



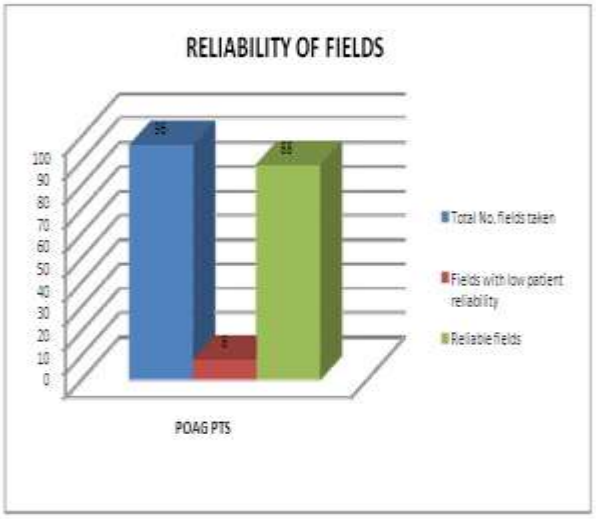
S.NO.	G.H.T.	POAG PTS	
		No	Percentage
1.	Within normal limits	10	11.36%
2.	Border line	5	5.68%
3.	Outside normal limits	70	79.54%
4.	Generalized reduction of sensitivity	3	3.40%
	Total fields	**88**	

GHT outside normal limits in 79.54% in the present study

TABLE – 4 RELIABILITY OF FIELDS

	POAG PTS
Total No. of fields taken	96
Fields with low patient reliability	8
Reliable fields	**88**

Reliability of fields was 91.66% in the present study.



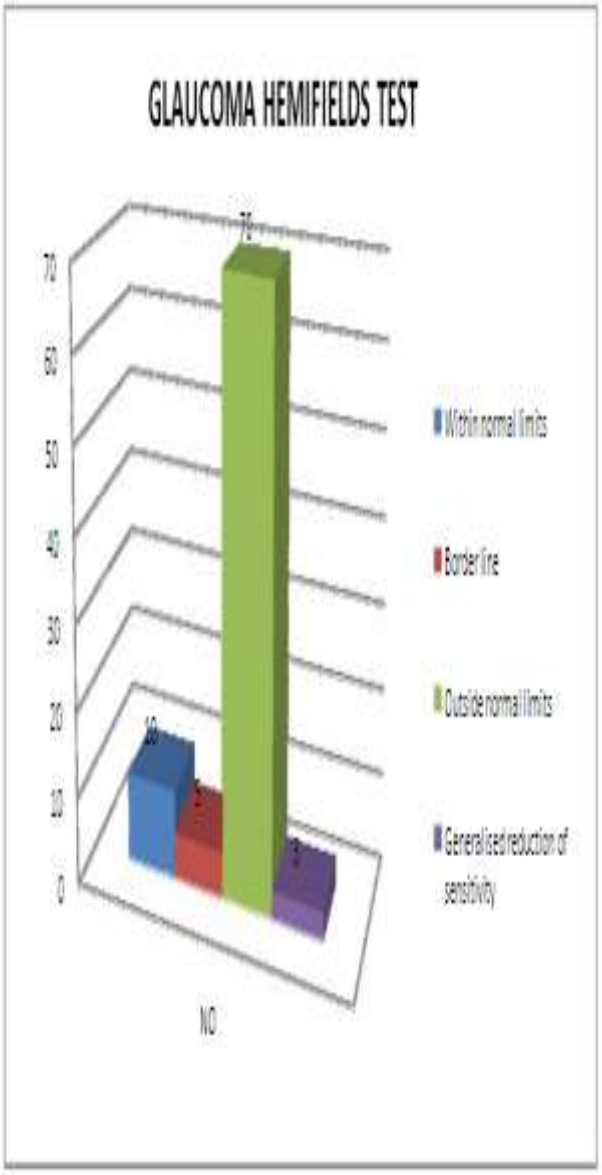


TABLE – 5 GLAUCOMA HEMIFIELD TEST

TABLE – 6 INTERPRETATION OF FIELD DEFECTS BY HFA

S.No.	INTERPRETATION	POAG PTS	
		No	Percentage
1.	Within normal limits	10	11.36%
2.	Statistically significant decrease in visual thresholds in Bjerrum's area	24	27.27%
3.	Arcuate scotoma	21	23.86%
4.	Double arcuate scotoma	15	17.04%
5.	Decreased threshold in nasal area	6	6.81%
6.	Tubula fields	11	12.5%
7	Central scotoma	1	1.13%
	Total fields	**88**	

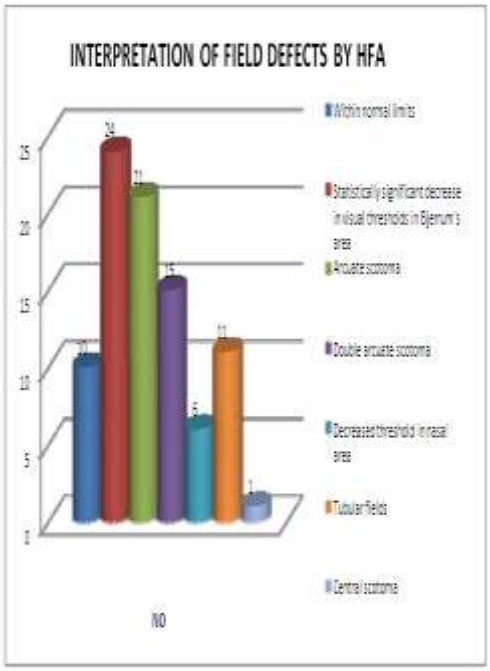


TABLE – 7: FIELD DEFECTS

S.NO	FIELD DEFECT	POAG PTS	
		No	Percentage
1.	Early	24	27.27%
2.	Definitive	42	47.72%
3.	Advanced	12	13.63%
4.	Within normal limits	10	11.36%
	Total fields	**88**	

Definitive field defects were present in 47.72% of POAG Group

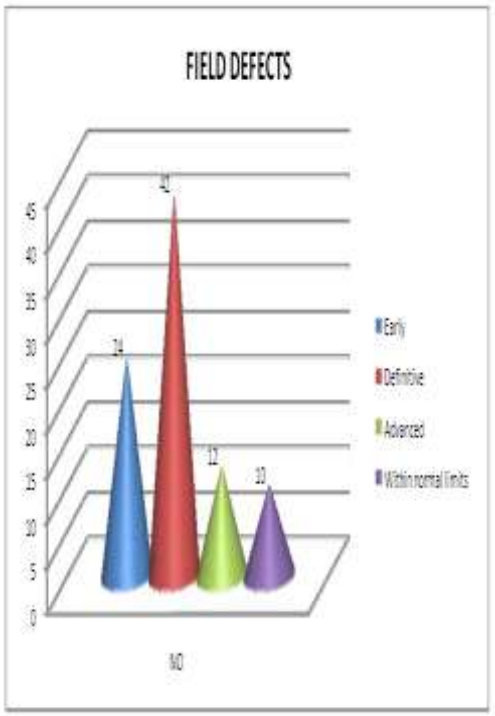


TABLE – 8TEST DURATION

S.No.	Time	Total		POAG PTS	
		No	Percentage	No	Percentage
1.	4-5 min	18	9.94%	8	9.09%
2.	5-6 min	35	19.33%	16	18.18%
3.	6-7 min	52	28.72%	26	29.54%
4.	7-8 min	44	24.30%	20	22.72%
5.	8-9 min	32	17.67%	18	20.45%
	Total fields	**181**		**88**	

5.Discussion

The present study "DETECTION OF FIELD DEFECTS IN PRIMARY OPEN ANGLE GLAUCOMA PATIENTS USIN HUMPHREY'S AUTOMATED PERIMETRY" was conducted in Government General Hospital kakinada November 2010 to September 2012 and 50 patients of POAG were selected from those attending the Glaucoma clinic. They were subjected to visual field analysis (central 24-2) by HFA - 720 after the preliminary tests were done.

In the present study, 56% were males & 44% were females in POAG group and in several studies males had a higher prevalence of POAG. Other investigators found equal prevalence of POAG on both sexes. In our study males predominated with a percentage of 56%.

Maximum prevalence of POAG was in the age group of 51-60 years (42%), in 41-50 years the prevalence is 20%, in 61-70 years the prevalence was 24% in POAG PTS.

Prevalence of POAG in general population increases with age. According to HALLOWS FC and Graham, maximum incidence of POAG is 1.3% general population in the age group of 70-74 years and 1.1% in the age group of 65-69 years.

In Framingham Eye study, incidence was found to be 4.4% in 80-85 age group and 3.7% in 70-79 age group and 1.6% in age group of 60.69 years and 1.2% in 50-60 years group. But, POAG is by no means limited to those over 40 years of age, it can occur in children and young adults as well. In our study, the maximum number of cases are in 50-60 years age group

In the present study 91.66%-of the fields were reliable

In POAG, visual field defects progress with increasing IOP and continue to progress if IOP is not controlled[7].

6.Conclusion

In this study, males presented more commonly than females in POAG group.

Average age group of presentation in POAG (Group) was 50-60 years.

Early visual field defects were found in 27.27% in POAG group.

Definitive visual field defects were found in 47.72% in POAG group. Advanced field defects were found in 13.63% in POAG group.

Most of the patients in POAG group showed definite visual field defects. Reliability of fields – 91.66% of fields were reliable in the present study.

Average time taken for central 24-2 programme, in this study, was between 6 and 7 minutes.

Humphrey field analyzer has been found to be effective in detecting early glaucoma field defects.

Automated perimetry gives field defects in statistically quantifiable data which is useful in comparing serial visual fields.

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