ORIGINAL ARTICLE

COLOR FIELD TEST CHARTS VS HVFA IN DETECTION VISUAL FIELD DEFECT CHRONIC PRIMARY GLAUCOMA

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ABSTRACT

Introduction: *Glaucoma is syndrome consist of glaucomatous optic neuropathy, destruction of retinal nerve fiber layer, and typical visual field defects. Color field test charts (CFTC) is a simple and generous instrument used to detect central and paracentral scotoma in neuro-ophthalmology patient. Diagnostic study will perform in this research to compare visual field defects, detecting in chronic primary glaucoma patient between CFTC and HVFA SITA 10-2 as gold standard.*

Methods: *Seventy two eyes from 50 patients with chronic primary glaucoma were examined visual acuity, funduscopy, color blindness, HVFA SITA 10-2 and CFTC. The results CFTC and HVFA were read by 2 ophthalmologists, and kappa agreement was done. Analysis was done to get sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), accuracy, positive and negative likelihood ratio (LR).*

Result: *The sensitivity of CFTC was 87.93%, specificity 85.71%, PPV 96.22%, NPV 63.16%, accuracy 87.5%, positive LR 6.15 and negative LR 0.14 in detecting visual field defect chronic primary glaucoma patient compared to HVFA SITA 10-2. Area Under Curve (AUC) in this research was 0.86 (95% CI 0.751-0.985, $p<0.001$). Sensitivity, PPV, and accuracy was higher in MD >-12dB compared to <-12dB. There was strong correlation between it in location of defect (Cramer's correlation; $V=0.679$, $p<0.001$), although the large of visual field defect was significantly different between 2 instruments ($p<0.05$).*

Conclusion: *Color field test charts is comparable to HVFA SITA 10-2 in detecting visual field defect chronic primary glaucoma moderate and advance stage.*

Keywords: *Visual field defect, HVFA SITA 10-2 and Color field test charts*

INTRODUCTION

Glaucoma is a syndrome consist of glaucomatous optic neuropathy, destruction of retinal nerve fiber layer, and typical visual field defects.[1] Nowadays glaucoma is the leading cause of permanent visual impairment worldwide and there are almost 60,5 million people suffer from glaucoma.[2] Prevalence of blindness in Indonesia is 1,5% and 13,4% is because of glaucoma.[3] Blindness caused by glaucoma can be prevented by early detection and appropriate treatment, but the patient usually came to the health center in the advance stage. This condition make the importance of personal examination instrument to detect sign of glaucoma, one of them is visual field defect.[4,5]

Color field test charts (CFTC) is an instrument for detecting central and paracentral scotoma in neuro-ophthalmology patient who have N II abnormalities and chiasm compression. Mutlukan (1991) use CFTC to detect visual field defect in neuro- ophthalmology, which 92% sensitivity and 96% specificity compared to Bjerrum screen testing.[6,7] Another study showed that sensitivity of CFCT in detecting visual field defect and decreasing color desaturation were 54% and the specificity was 96% compared to Friedmann field test in onchocerciasis patients who got ivermectin.[8] The way to use CFCT is simple and easy, so that it can be used to screen and personal assessment.

This research performed diagnostic study of CFCT compared to HVFA SITA10-2 as gold standard in detection visual field defect in chronic primary glaucoma moderate and advance stage.

METHODS

This is a diagnostic study which performed in ophthalmology outpatient department dr. Kariadi general hospital, Semarang on November 2018-January 2019. The sample is 72 eyes from 50 chronic primary glaucoma patients who fulfill inclusion and exclusion criteria.

The inclusion criteria were subjects with Best Corrected Visual Acuity (BCVA) ≥1/60, having reliable HVFA SITA 10-2 the last 6th months, moderate (mean deviation (MD) -6 to -12 dB) and advance stage (MD>-12 dB) chronic primary glaucoma using Zeiss Humphrey and agree to join the research including to this study. Subjects who have color blindness, having N II abnormality except glaucoma, retinal abnormality (central retinal venous obstruction, retinitis pigmentosa, chorioretinitis and degenerative myopia), and macular abnormality (macular hole, age related macular degeneration, diabetic macular edema) was excluded. Each subject underwent same examination (visual acuity, funduscopy, color blindness, HVFA SITA 10-2 and CFTC examination). The data results were made into table, and calculated sensitivity, specificity, PPV, NPV, accuracy, positive and negative LR.

This research was got ethical clearance from Health Research Ethics Commission of dr. Kariadi general hospital accordance to WHO 2011 standards.

RESULTS

The results were demographic data, visual acuity, diagnosis, MD, HVFA dan CFTC. Two ophthalmologists read the result and the Kappa agreement of CFTC was 0.964 and HVFA was 0.863 ($p<0.05$) which means substantial agreement.

Demographic data was showed in the table 1. Almost of the subjects were male (68%),

≥ 60 years old, diagnosed as open angle glaucoma, and optotype visual acuity (75%). Most of subjects were diagnosed as primary open angle glaucoma, consists of JOAG, NTG and POAG. In male group there were JOAG 4 subjects, NTG 3 subjects, POAG 21 subjects, and PACG 6 subjects. In female group there were JOAG 1 subject, NTG 2 subjects, POAG 6 subjects and PACG 7 subjects.

Based on the data in table 2, the sensitivity was 87.93%, specificity 85.71%, PPV 96.22%, NPV 63.16%, accuracy 87.5%, positive LR 6.15, and negative LR 0.14. The sensitivity higher in MD >-12 (94.87%) compared MD -6 to -12dB (54.54%). Accuracy and PPV were higher too in MD >-12dB respectively 72% became 95.74% and 75% became 100%.

Table 1. Demographic data

Variable	Total (n)	Percentage (%)
Gender		
Male	34	68
Female	16	32
Age		
< 40 yo	5	10
40 - 49 yo	8	16
50 - 59 yo	15	30
≥ 60 yo	22	44
Diagnose		
JOAG	5	10
NTG	5	10
POAG	27	54
PACG	13	26
Visual acuity		
1/60 - 3/60	13	18.06
4/60 - 6/60	5	6.94
6/40 - 6/18	22	30.56
> 6/18	32	44.44

Table 2. Sensitivity, specificity, PPV, NPV, accuracy, positive and negative LR CFTC vs HVFA SITA 10-2

HVFA CFTC	Defect (+)	Defect (-)	Total
Defect (+)	51	2	53
Defect (-)	7	12	19
Total	58	14	72

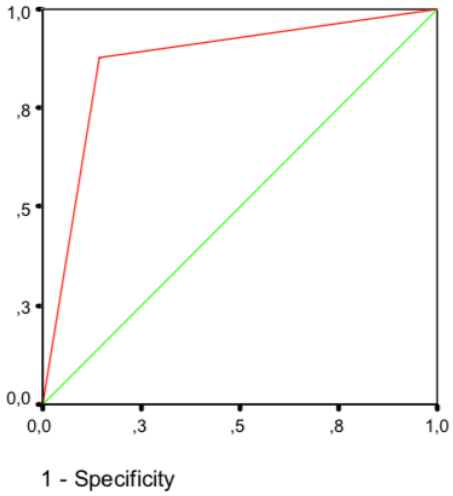

Figure 1. Graphic of ROC

According to figure 1, *Area Under the Curve* (AUC) was 0.86 (95 CI 0.751- 0.985, p< 0.001) which means the ability CFCT in detecting visual field defect compared to gold standard was good.

Fifty one eyes showed visual field defects in both examination (CFTC and HVFA SITA 10-2) and we analyzed the large of defect. Normality test showed the data distribution wasn't homogenous (Shapiro- Wilk, p<0.05). Mann Whitney test was done to determined difference mean of large defect, and the result was p=0.021 (p<0.05), which means there were significant difference between CFTC and HVFA SITA 10-2.

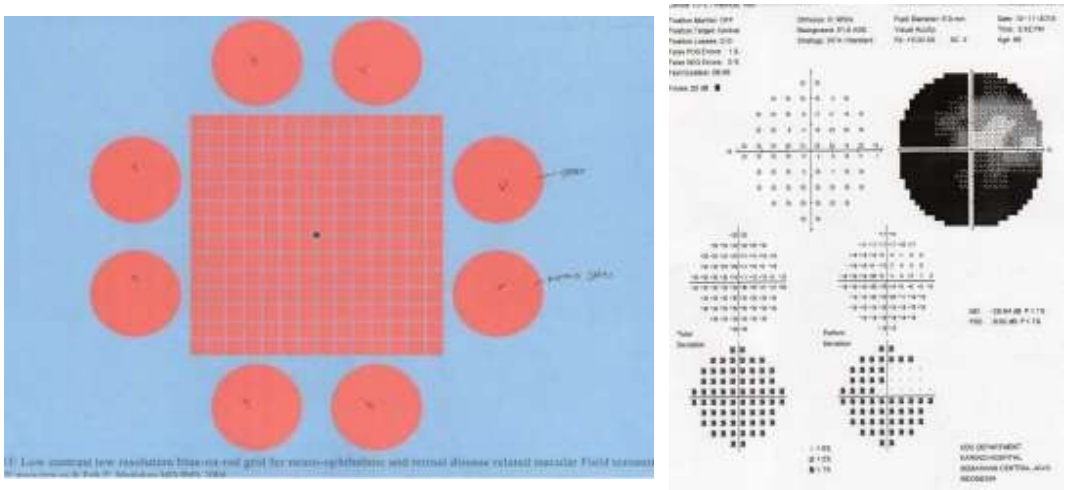

Fig 2. Example of examination CFTC and HVFA SITA 10-2, PACG patient

Table 3. Conformity visual field defect area between CFTC and HVFA SITA 10-2

HVFA / CFTC	Superior	Inferior	Equivocal	Total
Superior	26	1	0	27
Inferior	3	17	0	20
Equivocal	3	0	1	4
Total	32	18	1	51

Visual field defect was divided into 3 groups, superior, inferior and *equivocal* showed in table 3. That data was analyzed using Cramer's correlation and the result was V=0.679, $p<0.001$ which means there were strong correlation location of visual field defect between two instruments.

DISCUSSION

Demographic data in this research showed that majority patients (68%) are male. About 56% male patients tended to have open angle glaucoma (JOAG, NTG, and POAG) rather than female (18%) who tended to get PACG. This prevalence suitable to Kapetanakis (2015) that majority POAG patients were male rather than female (1.30, 95% CI 1.22-1.41).[9] Another study found that female was 2-4 times higher to have PACG than male. This related to the anatomical structure, where female have smaller anterior segment and shorter axial length.[1,2]

Age is one of the risk factor of glaucoma. The prevalence of glaucoma in this research was increasing due to aging, 1.6 times more in patients > 40 years old, 2 folds in the next decade, and 4 times in patients 60 years old and over. In Rotterdam and Barbados Eye Study, the prevalence of POAG was 7% in patients over 40 years old and increased 3-8 times in 70 years old. Tham et al (2014) found that prevalence of POAG increased 1.73 times in each decade additions.[1,2] Age is also one of the risk factor in primary closed angle glaucoma.[1,2,10] The results of this study are consistent to previous study.

Almost subject (54%) in this study were primary open angle glaucoma. Today there are almost 8.4 million people were blind caused of primary glaucoma (4.5 million POAG patients and 3.9 million PACG patients).[10] Chan et al (2013) showed that prevalence of glaucoma in Asia was 3.54% which primary open angle glaucoma (2.34%, 95% CI 0.96- 4.55) more than closed angle glaucoma (0.73%, 95% CI 0.18-1.96).[11] This study has suitability to previous study.

Central visual acuity in subject almost (75%) ophthotype although suffer from glaucoma moderate and advance stage. Glaucoma is a disease with central visual acuity relatively good

until advance stage because the papillomacular bundle, which play a role in central visual acuity still good.[12] This result of the study suitable to pathophysiology visual field defect in glaucoma that peripherally and damaging central visual field at the end stage.

Sensitivity and specificity CFTC in this study over than 80% with AUC was 0.86 showed good accuracy.[13] Humphrey Visual Field Analyzer has 90.3% sensitivity and 91% specificity in detecting visual field defect glaucoma patients.[14] It could be concluded that CFTC have good sensitivity and specificity in detecting visual field defect in primary glaucoma patients.

The sensitivity was higher in severe glaucoma that showed by MD value, 54.54% (MD -6 to -12dB) and 94.87% (MD >-12dB). The accuracy of CFTC was higher to MD, 72% (MD -6 to - 12dB) and 95.74% (MD >-12dB). Mean deviation is one of parameter that used to classify glaucoma. Suh W (2014) got that RNFL destruction was related to MD, especially in advance glaucoma. Kanamori et al (2003) concluded that there was significant relation between RNFL and MD. This showed that more MD value, wider RNFL destruction so that visual field defect sharper and easier to be detected using CFTC.[15,16]

Analysis of large of visual field defect in CFTC was significantly different to HVFA SITA 10-2 because CFTC simpler, manual and more macroscopic. In another side, HVFA is gold standard visual field defect examination which using computerized system and of course have higher sensitivity and specificity.

This study analyzed location of defect between 2 instruments using superior and inferior division because in that segment are the most changes occurred due to glaucoma. Fernandez et al (1993) got the neuroretinal rim destruction because of glaucoma began in inferotemporal disc (superior visual field) and then superotemporal (inferior visual field).[17] This is related to supporting cell configuration and changing caused by increasing intra ocular pressure. Superior and inferior area of papil N II have larger pores with less glial cell correlated to beginning destruction of axonal retinal ganglion cell which goes to lamina cribrosa. This condition causes first glaucoma's destruction in superior and inferior visual field.[10,18] Significant correlation in location visual field defect ($p<0.05$) in this study showed that CFTC could detect functional destruction of retinal nerve fibers layer consistent to HVFA SITA 10-2.[19]

This study showed that CFTC has good sensitivity and specificity, over than 80% to detect visual field defect in chronic primary glaucoma moderate and advance stage.[20] This instrument is simple, easy to use and economic so that can be considered as alternative instrument to examine visual field defect glaucoma patient, for self monitoring in house or eye health medical center which don't have HVFA.

Limitation of the study is there was not completed with data of optic nerve OCT and RNFL as objective comparison thinning location nerve fiber and functional disturbance in both instruments. Data of optic nerve OCT and RNFL compared to visual field defect using CFTC and HVFA expected to strengthen correlation between location structural and functional disturbance optic nerve and retinal nerve fiber retinal caused by glaucoma. Further study that including objective data will give strength result and better correlation.

This is a new study using CFTC to detect visual field defect in glaucoma patient, which previously only used to neuro-ophthalmology patients. The results showed that CFTC can be as alternative instrument used in field.

CONCLUSION

Color field test charts is comparable to HVFA SITA 10-2 in detecting visual field defect chronic primary glaucoma moderate and advance stage.

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