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Effect of a patient educational video on visual field test reliability

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Abstract

Purpose: Standard automated perimetry (SAP) is the gold standard for detecting and monitoring visual field (VF) defects in glaucoma, but frequent re-testing due to unreliable results increase the burden on this frequently used service. This study aims to assess the reliability of the Humphrey visual field (HVF) test in glaucoma-suspect patients with no previous SAP experience and to determine the effect of a VF test educational video on reliability.
Study design: The study was conducted as a full cycle audit.
Methods: The audit cycle was carried out in four phases: pre-intervention audit, intervention, monitoring, and post-intervention audit. The pre-intervention audit was carried out from January 2020 to May 2020 and the post-intervention audit was carried out from September 2020 to December 2020. The intervention was in the form of a VF test educational video. A post-video assessment pertaining to the contents of the video was given to patients in the intervention group to complete after they watched the video. The results were then tabulated and analysed.
Results: The pre-intervention audit showed that only 66.7% of glaucoma-suspect patients with no previous SAP experience had reliable HVF tests. Post-intervention, HVF reliability improved to 87.5% of patients. Based on the reliability parameters, the main reason for the HVF test being classified as unreliable in both the pre- and post-intervention was fixation loss greater than 20% in 36 (90%) and 11 (73.3%) patients, respectively. There were 76.9% of patients with unreliable fields who had < 4 correct answers on the post-video assessment; all patients who had > 4 correct answers had reliable HVF results.

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Conclusion: HVF reliability performance in glaucoma-suspect patients improved with the introduction of a pre-test educational video. It is a simple and inexpensive method which may reduce the need for repeat HVF tests for those with unreliable tests.

Keywords: glaucoma suspect, standard automated perimetry, visual field test reliability

Keberkesanan video pendidikan terhadap prestasi kebolehpercayaan ujian medan penglihatan

Abstrak

Pengenalan: Perimetri automatik ialah ujian piawaian emas untuk mengesan dan memantau kecacatan medan penglihatan Humphrey Visual Field (HVF) dalam penyakit glaukoma, tetapi keperluan ujian ini untuk diulang kerana keputusan yang kurang memuaskan akan meningkatkan beban perkhidmatan di klinik. Kajian ini bertujuan untuk menilai kebolehpercayaan ujian medan penglihatan di kalangan pesakit yang disyaki glaucoma yang tiada pengalaman menjalani ujian perimetri. Kajian juga bertujuan menentukan keberkesanan video pendidikan terhadap kebolehpercayaan hasil ujian ini.
Reka bentuk kajian: Kajian audit pra dan pasca intervensi.
Kaedah: Kitaran audit telah dijalankan dalam empat fasa bermula dengan audit pra-intervensi, diikuti dengan fasa intervensi dan pemantauan. Akhir sekali, fasa pasca intervensi dijalankan. Audit pra-intervensi telah dijalankan dari Januari 2020 hingga Mei 2020 dan audit pasca intervensi dijalankan dari September 2020 hingga Disember 2020. Intervensi adalah dalam bentuk video pendidikan ujian medan penglihatan. Penilaian siaran video yang berkaitan dengan kandungan video telah diberikan kepada pesakit dalam kumpulan intervensi untuk dilengkapkan selepas mereka menonton video tersebut.
Keputusan: Audit pra-intervensi menunjukkan bahawa hanya 66.7% pesakit disyaki glaukoma tanpa pengalaman ujian perimetri mempunyai ujian HVF yang memuaskan. Selepas intervensi, angka ini meningkat kepada 87.5% pesakit.
Berdasarkan parameter kebolehpercayaan, sebab utama ujian HVF tidak memuaskan dalam kedua-dua kumpulan pra dan pasca intervensi ialah kehilangan arah penglihatan 'fixation loss' (FL) lebih daripada 20% iaitu 36 (90%) dalam kumpulan pra-intervensi dan 11 (73.3%) dalam kumpulan pasca intervensi. 76.9% pesakit yang mempunyai HVF kurang memuaskan mendapat skor <4 dalam penilaian video, padahal semua pesakit yang medapat skor >4 menghasilkan HVF yang memuaskan.

Kesimpulan: Prestasi kebolehpercayaan HVF di kalangan pesakit yang disyaki glaukoma bertambah baik dengan pengenalan video pendidikan pra-ujian. Ia adalah kaedah yang mudah dan murah yang mampu mengurangkan keperluan untuk ujian HVF berulang bagi mereka yang mempunyai ujian HVF yang tidak memuaskan.

Kata kunci: glaucoma syak, kebolehpercayaan ujian medan penglihatan, ujian medan penglihatan

Introduction

Glaucoma is a progressive optic neuropathy with characteristic changes in the optic nerve head and corresponding visual field (VF) loss. It is a debilitating disease and the leading cause of global irreversible blindness.[1–3] Its insidious onset is often associated with diagnostic delay.

Management of glaucoma aims to maintain maximal functional vision by reducing its rate of progression; reduction of intraocular pressure is the only modifiable risk factor to prevent glaucoma progression.[4,5] To date, no single test or combination of tests has been identified as optimal in screening for glaucoma.[6] However, a combination of VF testing, assessment of optic disc and retinal nerve fibre layer, and tonometry may be used.[7]

Standard automated perimetry (SAP) is the gold standard for detecting and monitoring VF defects in glaucoma, but abnormal reliability parameters will render the test inaccurate. An unreliable test result cannot be used for clinical decision making and hence requires repeated testing. To tackle this issue, multiple studies have been conducted in an effort to identify possible factors that influence VF test reliability and ways to improve it.[8–11] Humphrey visual field (HVF) analyser (Carl Zeiss Meditec, Dublin CA, USA) is a commonly used static automated perimetry to measure VF.

A study conducted by Sherafat *et al.* looked into the reliability of VF test results with the introduction of a patient training video.[10] Although the results seemed promising, their patient group included various ocular pathologies and 82% of them were not HVF-naïve. Furthermore, test performance by technicians was also not standardized.

An audit is part of continuous quality improvement process that focuses on specific aspects of health care and clinical practice with the aim to highlight discrepancies between standards and actual practice in order to identify the changes needed to improve the quality of care. They consist of measuring a clinical outcome or process against well-defined standards set on the principles of evidence-based medicine. A full cycle audit identifies and implements changes to improve the clinical outcomes and re-audits the clinical practice to see whether the outcomes have changed for the better.

The main aim of this study was to assess whether the introduction of an educational video prior to testing improved the reliability of HVF tests in glaucoma-suspect patients with no previous SAP experience.

Methods

This audit was conducted in the Ophthalmology Clinic, Selayang Hospital. Only glaucoma suspects with no prior SAP tests were included. Inclusion criteria were patients aged 18 and above who underwent automated VF testing for the first time. Based on the National Clinical Practice Guideline for Glaucoma published in 2018, glaucoma suspects are individuals with suspicious glaucomatous optic disc appearance regardless of intraocular pressure and/or risk factors that increase the likelihood of developing glaucoma.[7] Risk factors include older age, positive family history of glaucoma, obstructive sleep apnoea syndrome, and diabetes mellitus. These patients were thoroughly examined in the Ophthalmology Clinic and subsequently scheduled for a HVF test.

Exclusion criteria included presence of ocular diseases affecting central vision, such as macular scarring, age-related macular degeneration, and diabetic maculopathy, and presence of dementia, stroke, severe arthritis, hearing loss, or any other systemic conditions that result in physical difficulties to perform a reliable VF test.

The study was conducted in accordance with the Declaration of Helsinki and adhered to Good Clinical Practice guidelines. Approval for the study was obtained from the local Medical Research and Ethics committee (NMRR-19-3527-51947). All patients provided written informed consent prior to enrolment.

The 24-2 SITA Fast strategy was used for screening glaucoma suspects. Data from the first eye was collected, which was routinely fixed as the right eye. However, when vision in the right eye was poor and the patient was unable to perform the HVF test, the left eye was used as the first eye. Once the test was completed, the results were printed out and reviewed.

A standard set by the manufacturers of the SITA test was used, with a cut-off of less than 20% for fixation loss (FL) rate and less than 15%for false-positive (FP) response rate to define a VF test as reliable.[12] The false-negative (FN) response cut-off rate was initially set at 33%. However, it was no longer considered while flagging a test result as unreliable, as FN rate estimates are elevated in glaucomatous VF tests, even in highly attentive patients. A study conducted by Katz *et al.* found that 81% of normal study participants were reliable on their first C30–2 full threshold VF test.[11] Sherafat *et al.* also reported a of reliability of 80.3% for the first attempt of a VF test.[10]

The audit cycle was carried out as part of a continuous quality improvement exercise. It consisted of four phases, starting with the pre-intervention audit to collect data that was then analysed against set standards, followed by the interven-

tion and monitoring phase. Subsequently, a post-intervention audit was conducted. The patients in each phase comprised different groups of people.

The pre-intervention audit was carried out from January 2020 to May 2020. Demographic data, best-corrected visual acuity (BCVA) with Snellen chart, and HVF test results of all glaucoma-suspect patients with no previous SAP experience were collected and analysed. Demographic data collected included age, ethnicity, gender, and education level. In this phase, we identified the possible factors affecting VF test reliability and explored methods to overcome these issues.

The intervention phase was conducted in July 2020 on a new group of patients. The purpose of the intervention was to enhance the patient's understanding regarding the VF test they were about to undergo. All patients were individually shown a standard educational video explaining the procedures involved in a VF test. The educational video was produced in house in both English and Malay with a total duration of 4.5 minutes. The patients then completed a post-video assessment containing seven questions that evaluated the patient's understanding of the video contents prior to performing the VF test. After watching the educational video, patients still received instructions from the technician monitoring the VF test as per usual practice. The VF test was conducted within 30 minutes of watching the complete video.

During the monitoring phase in August 2020, the reliability of HVF results were reviewed and analysed. It served as an adaptation period for technicians supervising the test to ensure that new patients were shown the educational video prior to performing the HVF test. Reminders were sent via a messaging application to the technicians' handphone devices at the beginning of each week prior to the patients' VF appointment.

A final post-intervention audit was conducted from September 2020 to December 2020 to reassess the reliability of VF tests in glaucoma-suspect patients who had no prior VF tests. Results were tabulated and compared against the earlier audit.

Results

A total of 473 HVF test were performed by patients with no prior SAP experience in 2020. From January to May 2020, 120 HVF tests were performed by glaucoma-suspect patients from a total of 163 tests. Meanwhile, 147 HVF test were performed by glaucoma-suspect patients from a total of 191 tests from September to December 2020. In the post-intervention audit, the first 120 consecutive patients were recruited for direct comparison.

A summary of sociodemographic data for the pre-intervention and post-intervention audits is provided in Table 1, which shows no significant difference between the population groups in the pre- and post-intervention audits in terms of age, gender, ethnicity, and education level. BCVA was also not significantly different between the

Table 1. Sociodemographic data of patients

	Pre-intervention audit, *n* (%)	**Post-intervention audit, *n* (%)**	***p*-value**
Age (years)			0.713
21-40	15 (12.5)	16 (13.3)	
41-60	47 (39.1)	48 (40)	
61-80	58 (48.3)	56 (46.7)	
Gender			0.439
Male	63 (52.5)	57 (47.5)	
Female	57 (47.5)	63 (52.5)	
Race			0.569
Malay	51 (42.5)	57 (47.5)	
Chinese	50 (41.7)	42 (35.0)	
Indian	19 (15.3)	21 (17.5)	
Education level			0.273
Primary school	33 (27.5)	36 (30.0)	
Secondary school	49 (40.8)	57 (47.5)	
Tertiary education	38 (31.7)	27 (22.5)	

two groups, as shown in Table 2. There was a significant improvement in reliability noted after the intervention, from 66.7% to 87.5%. Figure 1 shows the reliability of HVF test results from the pre- and post-intervention audits. Based on the pre-intervention audit, 40 patients (33.3%) had unreliable HVF test results compared to only 15 patients (12.5%) post-intervention.

Reasons for the HVF being classified as unreliable in the pre-intervention audit were FL greater than 20% in 36 patients, and both FL greater than 20% and FP response rate greater than 15% in 4 patients. Meanwhile, in the post-intervention audit, FL was greater than 20% in 11 patients, FP response rate was greater than 15% in 2 subjects, and both FL greater than 20% and FP response rate were greater than 15% in 2 patients.

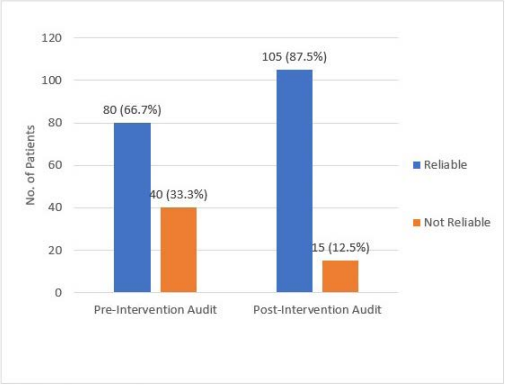
The overall performance and reliability parameters of the HVF test results are summarized in Table 3. The duration of VF test is shown in Table 4. Although the mean duration of HVF test was shorter in the post-intervention audit, the difference was not statistically significant. A summary of the post-video assessment results and the reliability of these VF tests are shown in Figure 2.

Binary logistic regression was used to further analyse age, race, gender, education level, and BCVA of patients to determine the factors affecting HVF test reliability. The results from the pre-intervention audit revealed that only education level was

Table 2. BCVA of patients in pre-intervention audit and post-intervention audit

BCVA	Pre-intervention audit, *n* (%)	Post-intervention audit, *n* (%)	*p*-value
> 6/9	93 (77.5)	77 (64.2)	0.075
6/12–6/18	21 (17.5)	33 (27.5)	
6/24–6/36	6 (5.0)	10 (8.3)	

BCVA: best-corrected visual acuity



*HVF: Humphrey visual field

Fig. 1. Reliability of HVF test results.

Table 3. Overall performance

Performance	Pre-intervention audit	Post-intervention audit	▲▼
Patients with poor reliability parameters (n = 120)			
FL > 20%	36 (30.0%)	11 (9.2%)	▼ 22.5%
FP > 15%	0	2 (1.7%)	▲ 1.7%
FL > 20% and FP > 15%	4 (3.3%)	2 (1.7%)	▼ 1.6%
Patients with good reliability parameters (n = 120)			
FL < 20% and FP < 15%	80 (66.7%)	105 (87.5%)	▲ 20.8%
Mean (SD) of reliability parameters			
FL	18.4 (1.68)	12.8 (1.17)	▼5.6
FP	3.6 (7.72)	3.7 (5.17)	▲0.1

FL: fixation loss; FP: false positive

Table 4. Comparison of Humphrey visual field test duration pre-intervention and post-intervention

	Pre-intervention audit	**Post-intervention audit**	***p*-value**
	Mean (SD)		
Duration (min)	5.1 (1.43)	4.2 (1.29)	0.792

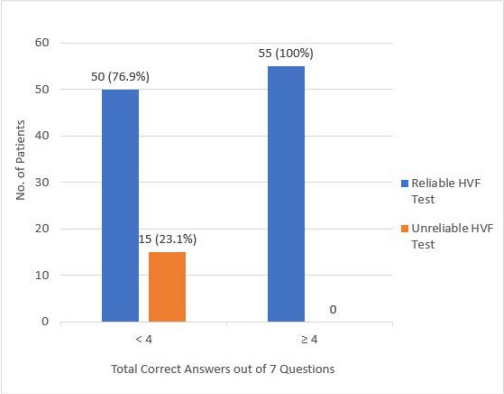


Fig. 2. Post-video assessment results from post-intervention audit. HVF: Humphrey visual field

associated with HVF test reliability ($p \leq 0.05$). The post-intervention audit showed that none of the factors above was significantly associated with HVF test reliability. These results are represented in Table 5 and Table 6.

Table 5. Factors affecting Humphrey visual field reliability in pre-intervention audit (*n* = 120)

Variables	**β**	**95% CI**	***p*-value**
Age group (years)	0.177	0.977, 1.457	0.083
Ethnicity			
Malay (Ref)			
Chinese	-1.109	0.109, 0.995	0.049
Indian	-0.196	0.208, 3.243	0.779
Gender			
Male (Ref)			
Female	-0.753	0.180, 1.232	0.125
Education Level			
Primary (Ref)			
Secondary	**2.251***	1.580, 57.079	*0.014*
Tertiary	**3.313***	3.662, 20.621	*0.001*
BCVA			
> 6/9 (Ref)			
6/12–6/18	0.625	0.594, 5.877	0.285
6/24–6/36	-1.593	0.019, 2.175	0.188

Hosmer and Lemeshow test p-value = 0.969
β: β-coefficient; 95% CI: 95% confidence interval; BCVA: best-corrected visual acuity

Table 6. Factors affecting Humphrey visual field reliability in post-intervention audit (*n* = 120)

Variables	β	95% CI	*p*-value
Age group (years)	-0.067	0.805, 1.087	0.385
Race			
Malay (Ref)			
Chinese	0.279	0.318, 5.499	0.701
Indian	-0.252	0.211, 5.704	0.913
Gender			
Male (Ref)			
Female	-0.252	0.223, 2.712	0.693
Education Level			
Primary (Ref)			
Secondary	0.636	0.304, 11.708	0.495
Tertiary	0.828	0.343, 15.270	0.932
BCVA			
> 6/9 (Ref)			
6/12 – 6/18	-0.546	0.130, 2.578	0.474
6/24 – 6/36	-1.014	0.028, 4.617	0.435

Hosmer and Lemeshow test p-value = 0.363

β: β-coefficient; 95% CI: 95% confidence interval; BCVA: best-corrected visual acuity

Discussion

This study shows that there was a significant improvement in VF test reliability post-intervention among glaucoma-suspect patients with no previous SAP experience. Results from this audit showed that the VF test educational video improved HVF performance reliability from 66.7% of patients pre-intervention to 87.5% post-intervention. This has also been demonstrated in a previous study conducted by Sherafat *et al.* which noted significant improvement of patients' VF test reliability after watching an educational video.[10]

The introduction of a standardised information video provides patients with information regarding the key points of the VF test and further reinforces the technician's instructions. The video contains clear explanations on how to perform the VF test correctly, which entails emphasising the importance of maintaining fixation and resisting the tendency to be "trigger happy" with responses. Furthermore, the video clarifies some of the uncertainties that may arise during the first VF test,

such as reminding the patient that, although they should maintain fixation, they are allowed to blink during the test, that the stimulus varies in brightness, and that they are allowed to pause if needed.

The SITA Fast algorithm was used for glaucoma screening of all patients in this study. Pierre-Filho *et al.* found there was no difference in sensitivities and specificities between SITA Standard and SITA Fast in perimetrically inexperienced individuals.[13] Although SITA Standard is a more precise testing algorithm than SITA Fast at lower VF sensitivities, it is unlikely to make a sizeable difference to improving the time to detect VF progression.[14] In this audit, the mean duration of the HVF test was similar to the average individual test time using SITA Fast, which is 5.0 minutes.[15]

The reliability parameters FL, FP, and FN were analysed; the percentage of FL was lower post-intervention. A previous study by Peracha *et al.* found that the majority of unreliable fields were due to FL.[16] FN was not used to flag a test as unreliable in this study as increased FN is strongly associated with glaucomatous VF status.[17] However, it is worth noting that even small frequencies of FN errors can lead to the inaccurate classification of a VF test as being glaucomatous.[18]

Patients were given a post-video assessment after viewing the VF educational video to evaluate their understanding of the test. There were 54.2% of patients who scored less than four answers correctly out of a total of seven questions. However, all patients who scored more than four answers correctly had reliable HVF tests. Based on this finding, it is possible that better understanding yields more reliable HVF results. Visualization and imagery have been noted to improve learning skills and transfer of knowledge.[19,20] Meanwhile, other studies have reported that adequate and careful patient instruction plays a major role in yielding reliable VF tests.[21,22]

Based on the results from the pre-intervention audit, only education level was associated with HVF test reliability ($p \leq 0.05$). On the other hand, the post-intervention audit revealed that none of the factors such as age, gender, ethnicity, education level, and BCVA was significantly associated with HVF test reliability. With the introduction of the educational video, education level was no longer a significant factor affecting reliability. This finding indicates that the VF educational video is beneficial for all patients regardless of their education level. Tan *et al.* reported that age, education level, and number of previous VF tests are major factors affecting the reliability of VF testing.[23] Another study by Bittner *et al.* found that level of vision loss was not significantly associated with HVF reliability.[24]

This study had several limitations. The technician's instructions were not standardised, as it is not representative of a typical hospital eye service clinic. All patients generally had their VF test done in the morning (8 am to 1 pm) but the waiting time was not considered in our analysis. The patient's performance might be affected by fatigue if the waiting time is longer. Despite the promising results obtained from this audit, patients who are repeating the VF test at a later interval

may not benefit as much from the patient educational video. Further studies can be conducted to establish the long-term effectiveness of the educational video. The effectiveness of the educational video in patients who are not VF-naïve would also be insightful.

Conclusion

HVF performance reliability in glaucoma-suspect patients undergoing VF tests for the first time improved with the introduction of an educational video prior to testing. It is a simple and inexpensive way of using available clinic time to enforce key points of the HVF test and may reduce the number of repeat tests due to unreliable results.

Declarations

Ethics approval and consent to participate
The study was conducted in accordance with the Declaration of Helsinki and adhered to Good Clinical Practice guidelines. Approval for the study was obtained from the local Medical Research and Ethics Committee (NMRR-19-3527-51947). All patients provided written informed consent.

Competing interests
None to declare.

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