European Journal of Ophthalmology / Vol. 18 no. 4, 2008 / pp. 628-632

A new visual field test in empty sella syndrome: Rarebit perimetry

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PURPOSE. *Several visual field defects can be seen in empty sella syndrome (ESS). In this study, the authors aimed to evaluate the visual field defects in patients with ESS by rarebit perimetry and to compare the results with Humphrey perimetry.*
METHODS. *Left eyes of 13 patients with ESS and left eyes of 15 age-matched normal subjects were included in the study. Visual field testing was performed by Humphrey Visual Field Analyzer II (Fastpack 30-2 strategy) and rarebit perimetry (regular test). Statistical analysis was performed by independent-samples t-test, Mann-Whitney U test, receiver operating characteristic (ROC) curves, and Pearson correlation test.*
RESULTS. *Humphrey perimetry mean deviation was –3.67 dB in control group and –6.06 dB in patients with ESS (p=0.12). Mean hit rate calculated by rarebit test was 91.8% in control group and 75.9% in cases with ESS (p=0.005). Area under ROC curve was 0.756 for Humphrey visual field test and 0.827 for rarebit hit rate (p=0.59). There was a significant correlation between rarebit hit rate and Humphrey visual field test mean deviation (r=0.755, p<0.001).*
CONCLUSIONS. *Rarebit perimetry correlates significantly with Humphrey perimeter in detecting visual field defects related with ESS and has a higher sensitivity and specificity. (Eur J Ophthalmol 2008; 18: 628-32)*

KEY WORDS. *Empty sella syndrome, Humphrey visual field, Rarebit perimetry*

Accepted: January 16, 2008

INTRODUCTION

Empty sella syndrome (ESS) is the herniation of suprasellar arachnoid space into the sella turcica resulting in compression of the pituitary gland. Its pathogenesis has not been clearly identified but a defect in diaphragma sella is a major risk factor (1). Several ophthalmic manifestations and visual field defects can be seen in ESS. The mechanical and ischemic effects related with the herniation of the optic apparatus (optic nerve, optic chiasm, and optic tract) are the main reasons for visual field defects. The visual field defects described in ESS are bitemporal hemianopsia, unilateral temporal defect, arcuate scotoma, central or paracentral scotoma, binasal defect, and enlargement in blind spot (2, 3).

Most visual field tests use varying stimulus characteristics and compare the results with empiric norms (4). However, the role of these tests to detect early or low degree neural defect has not been clear. It has been shown that 1/3 to 1/2 of retinal ganglion cells have to be lost before visual field defect can be seen on perimetry (5).
Rarebit perimetry is a new visual field test thought to be more sensitive to neural damage (4). It depends on the recognition of two microdots with high contrast exposed simultaneously for 200 ms at different test locations with a separation equal to 4°. All probes should be seen with a normal neural matrix but there can be some physiologic misses like angioscotoma or age-related losses of retinocortical channels (4). With partial matrix depletion, some probes should be missed depending on the severity

Presented as a poster at the 8th EUNOS Meeting; Istanbul; 2007

1120-6721/628-05$25.00/0

of damage (4). In rarebit regular test central 30° is evaluated with 30 circular test areas. These test areas are 5° in diameter. Five passes are mostly enough and all test areas are tested twice in each pass. Only 10% of presentations contain one dot or none at all and are used for control purposes. At the end of the test, the hit rate (sum of probes seen/sum of probes shown) (%) is plotted for each test area and for the field quadrants. A normal patient will have a hit rate near 100%. In this study, we aimed to compare the visual field defects obtained by rarebit perimetry and Humphrey field analyzer in patients with ESS and normal subjects.

METHODS

Left eyes of 13 subjects aged between 21 and 53 years with the diagnosis of primary ESS were included in the study. Left eyes of 15 healthy subjects aged between 28 and 55 years served as control group. Patients with a Snellen visual acuity lower than 0.8, ametropia greater than 3 diopters, glaucoma, history of any ocular surgery, any systemic or ocular drug use, any systemic disease like diabetes mellitus, and neurologic disease were excluded from the study.

All cases underwent routine ophthalmic examination. Automated visual field testing was performed first with Humphrey Visual Field Analyzer II (Humphrey/Zeiss, San Leandro, CA). After appropriate near correction, white-on-white Fastpack 30-2 strategy was used. The test was repeated twice to all subjects and the more reliable one was used for evaluation. Tests with fixation losses, false positives, or false negatives greater than 33% were determined to be unreliable and excluded from the study. Mean deviation (MD), pattern standard deviation (PSD), corrected pattern standard deviation (CPSD), and short-term fluctuation (SF) were recorded. Mean sensitivities were calculated in upper temporal quadrant, upper nasal quadrant, inferior temporal quadrant, and inferior nasal quadrant.

After Humphrey visual field test, rarebit perimetry regular test (Rarebit version 3.0) was performed. The software is available free of charge from its developer (4). Rarebit perimetry was performed with a computer with a 15-inch liquid crystal display monitor. A total of 30 areas, covering a horizontal eccentricity of 27.5 degrees and a vertical eccentricity of 20 degrees upwards and of 22.5 degrees downwards, were evaluated. The examination was performed at a distance of 0.5 m for the 26 peripheral test locations and at a distance of 1 m for the 4 inner test locations with appropriate correction for near. The patients were told to indicate the number of dots seen by not clicking, clicking, or double clicking a mouse button. Five passes were made. Mean hit rate was recorded over all test locations and for the upper temporal, upper nasal, inferior temporal, and inferior nasal field quadrants.

Statistical analysis was performed by SPSS statistical software version 10.0. Sex distribution between groups was evaluated by Fisher exact test. All variables were tested for normality using the Shapiro-Wilk test. The significance of the differences between subjects with ESS and normal cases was determined with 1) independent samples *t*-test for the variables with a normal distribution and 2) Mann-Whitney *U* test for the variables found to deviate significantly from normal distribution. Receiver operating characteristic (ROC) curves were obtained for

TABLE I - RAREBIT PERIMETRY AND HUMPHREY VISUAL FIELD TEST RESULTS

	Control group	Empty sella syndrome	p
Rarebit hit rate			
Upper temporal quadrant (%)	93.2±4.6	72.8±18.2	0.027*
Upper nasal quadrant (%)	92.6+3.2	80.8±19.7	0.25†
Inferior temporal quadrant (%)	88.8±2.6	74.1±16.8	0.009*
Inferior nasal quadrant (%)	92.0±4.9	75.0±22.0	0.019†
Humphrey visual field			
Upper temporal quadrant (dB)	29.7±1.1	24.0±5.1	0.002*
Upper nasal quadrant (dB)	28.8±1.3	23.9±5.4	0.001†
Inferior temporal quadrant (dB)	29.8±1.0	26.4±2.9	0.007*
Inferior nasal quadrant (dB)	29.6±1.0	24.6±6.8	0.007†

*Independent samples t-test.
†Mann-Whitney U test

Humphrey visual field test MD and rarebit hit rate, and area under ROC curves were compared by MedCalc statistical program version 7.3 (Belgium). The ROC curve represents a sensitivity/specificity pair; 1.0 represents a perfect discrimination (100% sensitivity and 100% specificity) having a ROC curve passing through the upper left corner whereas 0.5 represents that there is no difference between the two distributions. The correlation between Humphrey visual field test MD and rarebit perimetry mean hit rate, and the correlation between Humphrey visual field test mean sensitivities per quadrant and rarebit hit rates per quadrant, were evaluated by Pearson correlation test. At all times, p values <0.05 were determined to be statistically significant.

RESULTS

Mean age was 40.5±9.8 years in control group and 40.0±9.4 years in subjects with ESS (p=0.91, independent samples *t*-test). Control group consisted of 2 male (13.3%) and 13 female (86.7%) subjects whereas ESS subjects consisted of 13 female (100%) subjects (p=0.28). For rarebit perimetry, mean test time was 5.4±0.1 minutes in control group and 5.7±0.7 minutes in subjects with ESS (p=0.66, independent samples *t*-test). For Humphrey visual field test, mean test time was 8.5±1.5 minutes in control group and 9.8±1.5 minutes in ESS subjects (p=0.28, independent samples *t*-test). Rarebit test time was significantly shorter compared to Humphrey visual field test time in both control group and ESS subjects (p=0.007, p<0.001, independent samples *t*-test, respectively).

Mean deviation was –3.67±1.0 dB (–5.23 dB to –2.34 dB) in control group and –6.06±3.4 dB (–13.98 dB to –1.43 dB) in patients with ESS (p=0.12, independent samples *t*-test). Pattern standard deviation was 2.25±0.9 in control group and 4.33±2.9 in patients with ESS (p=0.10, Mann-Whitney *U* test), CPSD was 1.05±1.2 in control group and 3.19±3.2 in patients with ESS (p=0.08, Mann-Whitney *U* test), and SF was 1.76±0.5 in control group and 2.24±0.9 in patients with ESS (p=0.31, independent samples *t*-test). Mean hit rate was measured to be 91.8% (88%–95%) in control group and 75.9% (39%–97%) in cases with ESS (p=0.005, independent samples *t*-test). Mean sensitivities measured by Humphrey perimetry and mean hit rates calculated by rarebit perimetry for all quadrants are given in Table I. Mean hit rate was found to be significantly decreased in upper temporal quadrant, inferior temporal quadrant, and inferior nasal quadrant in patients with ESS whereas mean sensitivity decreased significantly in all quadrants. Area under ROC was 0.827 (95% confidence interval 0.586–0.957) for rarebit hit rate and 0.756 (95% confidence interval 0.509–0.919) for Humphrey visual field test (Fig. 1). The difference between these areas was not significant (p=0.59).

There was a significant correlation between rarebit mean hit rate and Humphrey visual field test MD (r=0.755, p<0.001). There was a significant correlation between Humphrey visual field mean sensitivities and rarebit hit rate in all quadrants, as shown in Table II. Humphrey visual field pattern deviation map and rarebit perimetry of a normal subject are shown in Figures 2 and 3. Humphrey visual field pattern deviation map and rarebit perimetry of a subject with ESS are shown in Figures 4 and 5.

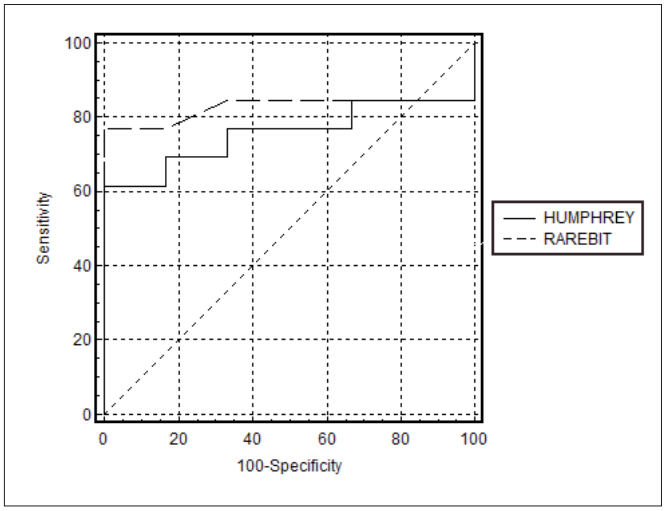

Fig. 1 - *Receiver operating characteristic (ROC) curves obtained for Humphrey field test and rarebit test.*

TABLE II - CORRELATION BETWEEN HUMPHREY VISUAL FIELD AND RAREBIT PERIMETRY

	r	p
Upper temporal quadrant	0.777	<0.001
Upper nasal quadrant	0.824	<0.001
Inferior temporal quadrant	0.521	0.027
Inferior nasal quadrant	0.894	<0.001

r = Coefficient of Pearson correlation

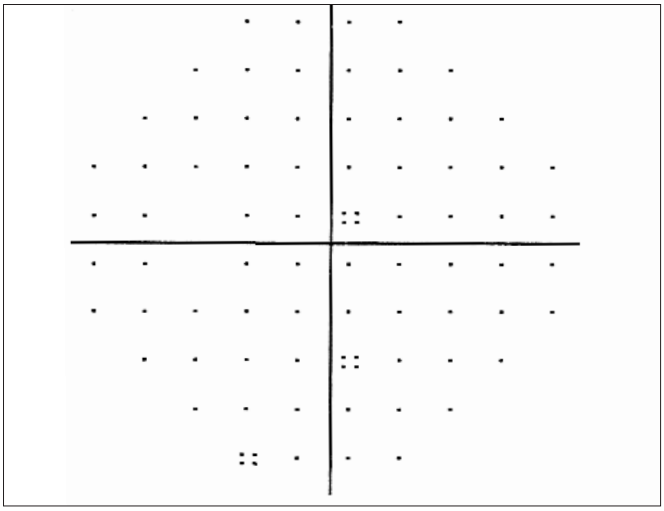

Fig. 2 - *Printout from a normal Humphrey visual field pattern deviation map.*

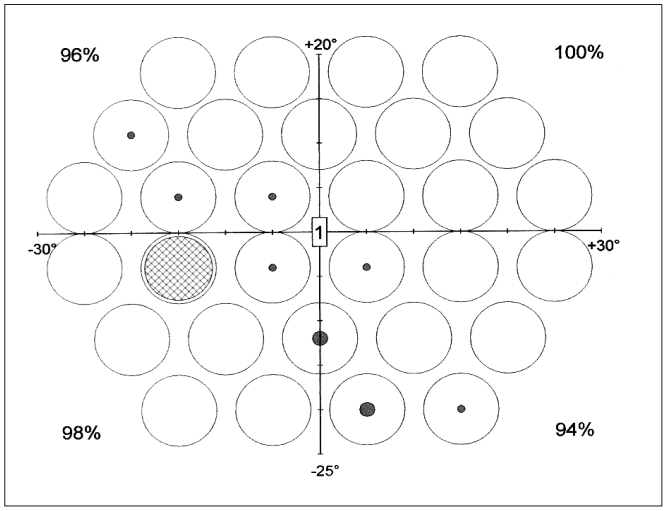

Fig. 3 - *Printout from a Rarebit perimetry from the same subject as in Figure 2. Empty circles indicate that all dots were perceived. The missed presentations are shown with an inner closed circle, as the percentage of probes shown. The blind spot is shown as a cross in the circle. The percentages show mean hit rates in quadrants.*

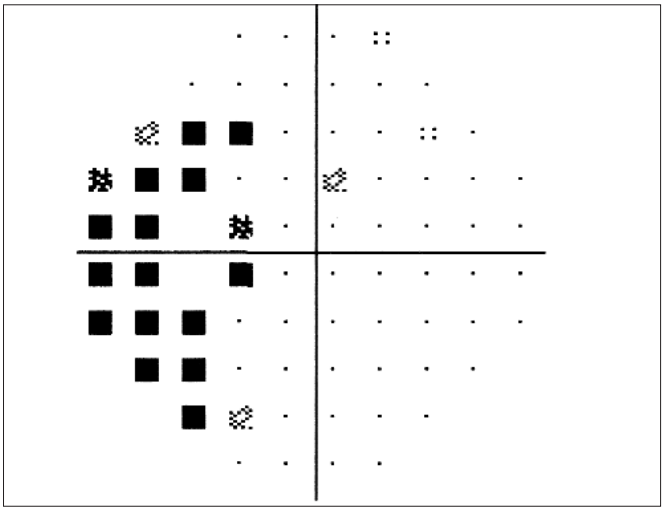

Fig. 4 - *Printout from Humphrey perimetry from a subject with empty sella syndrome. Temporal field defect is seen.*

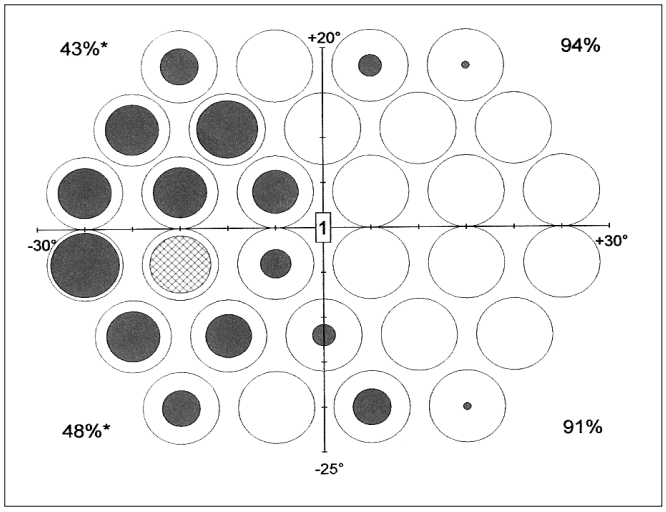

Fig. 5 - *Printout from a Rarebit perimetry from the same subject as in Figure 4. Temporal field defect is more pronounced.*

DISCUSSION

Empty sella syndrome is characterized by downward herniation of the suprasellar cistern through a defect in diaphragma sella resulting in enlargement of sella (6, 7). The suprasellar portion of optic nerve, optic chiasm, optic tractus, and anteroinferior portion of third ventricle can herniate inferiorly (6). The most commonly seen ophthalmic manifestation in ESS is dysfunction of anterior visual pathways (1). Bitemporal hemianopia, unilateral or bilateral temporal defect, arcuate scotoma, central scotoma, binasal defect, or enlargement of blind spot can be seen (1-3, 8). In our study, we found that mean hit rate showed a decline in all quadrants except upper nasal quadrant in cases with ESS.

It is known that white-on-white perimetry has low sensi-

tivity to early neural damage which can be related with relatively large test targets (5). Rarebit perimetry depends on the realization of briefly exposed microdots and it is thought to be sensitive in detecting neural visual defects (4). Frisen performed rarebit perimetry and high-pass resolution perimetry (HRP) on 27 normal cases and reported that mean hit rate decreased by 1% per decade of age (4). He also showed that HRP disclosed a mean change with age (0.022 dB per year) and the distributions of defects mapped by rarebit perimetry were similar to those mapped by HRP although the area involved was larger in rarebit perimetry. Frisen assessed the sensitivity of rarebit perimetry to damage in 10 patients with light to moderate mid-chiasmal lesions whose visual acuities ranged between 0.8 and 1.2 and reported that rarebit perimetry disclosed more widespread damage than HRP (4). Martin and Wagner (9) compared rarebit perimetry with frequency doubling perimetry in normal subjects and found that both test methods were almost completely equivalent. In our study, Humphrey visual field test and rarebit perimetry correlated with each other significantly. We could not find a statistically significant difference between Humphrey visual field MD ROC curve and rarebit perimetry ROC curve though the sensitivity and specificity of rarebit perimetry was higher.

As a result, rarebit perimetry, having a short examination time, was found to be effective in the realization of visual field defects in cases with ESS. To our knowledge, this is the first study to show that rarebit perimetry is correlated with Humphrey visual field test in the detection of visual field defects related to chiasmal lesions.

Proprietary interest: None.

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