Blue Field Entoptoscopy and VER in Preoperative Cataract Evaluation

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SUMMARY

Blue field entoptoscopy (BFE) has been described as an effective method for evaluating macular function in patients with dense cataracts. We evaluated 150 preoperative cataract patients with BFE, and found the commercially available instrument (MIRA BFE 100) to be accurate in patients with 20/400 or better preoperative acuity. There was a high percentage of false negative BFE results in patients with dense cataracts, and light flash VER testing was found to correlate better with attainable postoperative acuity in these patients.

The preoperative assessment of potential postoperative visual acuity in patients with cataracts has always been difficult, especially when the cataracts are dense enough to preclude satisfactory visualization of the posterior pole. Various subjective tests have been employed, including color or 2-point light discrimination, as well as the appreciation of various entoptic phenomena and laser-generated interference fringes. Objective tests have included pupillary reactions and electrical recordings from the retina (electroretinogram) and occipital cortex (visually-evoked cortical response). Ultrasonography has been useful in cases with elevated macular lesions or other detectable ocular pathology (e.g., cupped discs).

Most of the aforementioned tests make no pretense of being able to predict attainable postoperative Snellen acuity, but merely represent attempts at a rough gauge of macular function. Laser interferometry, while accurate in eyes with lesser degrees of media opacities, becomes increasingly less reliable as the density of the cataract increases — precisely those eyes in which it would otherwise be most useful.

Recently, blue field entoptoscopy (BFE) has been described as the best available predictive test of macular function in patients with dense cataracts, and in patients with traumatic media opacification. This subjective test evaluates another of the entoptic phenomena (which may be defined as visual perceptions of normal or abnormal structures in one’s own eye that can be seen only under various special arrangements of illumination). This is the phenomenon of the perception of leukocytes passing through one’s perifoveal retinal capillaries, and has been called the phenomenon of the flying corpuscles.

The Blue Field Entoptoscope manufactured by MIRA was developed after preliminary studies by Sinclair, Libet and Riva demonstrated that a 500-watt tungsten lamp could provide irradiance at the pupil sufficient to adequately penetrate even very dense cataracts. These authors studied a series of preoperative cataract patients with blue field entoptoscopy, and compared preoperative results with postoperative acuities. They concluded that the test was 94% accurate in identifying cataract patients with 20/40 or better postoperative acuity, and 75-90% of patients with poor macular function (20/50 or worse postoperative acuity). In particular, they felt BFE to be especially well suited to the evaluation of patients with very dense cataracts.

MATERIALS AND METHODS

We examined a series of 150 preoperative cataract patients with the MIRA blue field entoptoscope (BFE 100),...
evaluating their ability to see the "flying corpuscles," both by number and by quadrants. The presence or absence of pulsatile motion was not evaluated. After obtaining negative responses in a number of patients with very dense cataracts, we began recording visually evoked responses (VERs) to light flash stimuli in cataractous eyes having negative BFE test results. The VERs were performed without pupillary dilatation, using the Grass photostimulator lamp (S16 and S1 settings) with the lamp placed 4 feet from the patient's eye, and averaging 64 or 128 responses.

Midline monopolar recordings were obtained from 1 cm above the inion. While understanding that we were evaluating an even larger anatomic area than that addressed by BFE, and therefore a function even less directly comparable with visual acuity, we wished to see if such VER testing could nonetheless be a more reliable predictor of good potential macular function in patients with dense cataracts.

RESULTS

As may be seen in Table I, negative or equivocal preoperative BFE results were unusual in patients with relatively good preoperative acuity. Of 114 patients with 20/400 or better preoperative Snellen acuity, 99, or 86.8%,
Table IV

Equivocal BFE's

<table>
<thead>
<tr>
<th>PRE-OP VA</th>
<th>POST-OP VA</th>
<th>PATHOLOGY</th>
</tr>
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<tbody>
<tr>
<td>20/100</td>
<td>20/40</td>
<td>Illiterate &quot;E&quot;s</td>
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<tr>
<td></td>
<td></td>
<td>Macular RPE Δ's</td>
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<tr>
<td>HM</td>
<td>20/25</td>
<td>+FTA-Abs.</td>
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<tr>
<td>20/60-</td>
<td>20/40</td>
<td>SMD and CME</td>
</tr>
<tr>
<td>20/400</td>
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<td>HM</td>
<td>20/40</td>
<td>CME</td>
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</table>

TABLE IV: Pre- and postoperative acuities of patients with equivocal BFE responses.

Table V

Positive BFE’s With 20/40 or Worse Post-Op Acuity

<table>
<thead>
<tr>
<th>PRE-OP VA</th>
<th>POST-OP VA</th>
<th>PATHOLOGY</th>
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<tr>
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<td>20/50</td>
<td>CME</td>
</tr>
<tr>
<td>20/80-</td>
<td>20/50</td>
<td>Retinal Edema</td>
</tr>
<tr>
<td>CF</td>
<td>20/80+</td>
<td>Diabetic Retinopathy</td>
</tr>
</tbody>
</table>

TABLE V: Patients with positive preoperative BFE responses who did not achieve better than 20/40 postoperative acuity.

had a positive response on BFE testing, while only 3 (2.6%) were equivocal, and 12, or 10.5%, had negative responses. Two of the three patients with equivocal responses achieved only 20/40 postoperative acuity, felt to be secondary to senile macular degeneration (SMD) in both cases (Table IV). Of the 12 negative responders, 5 did not achieve postoperative acuities of better than 20/40. Two of these eyes attained 20/40 — one had SMD and the other cystoid macular edema (CME); the third saw only 20/100 due to advanced glaucomatous optic atrophy, the fourth was limited to 20/80 by SMD, and the fifth patient was lost to follow-up after five weeks (at which time acuity was 20/50). Therefore, the incidence of false negatives in patients with less dense (20/400 or better preoperative acuity) cataracts was only 6 of 114 patients, or 5.3% (Table II).

Patients with counting fingers or worse preoperative acuity could not have their potential postoperative acuity accurately predicted by BFE. Only 9 of 36 gave positive responses. Of 25 negative responders, 18, or 72.0%, achieved 20/30 or better acuity. The etiologies of the reduced acuity in the other seven eyes is listed in Table III. One of the two equivocal responders achieved 20/25 postoperative acuity, while the other was limited to 20/40 due to CME (Table IV).

VER responses to light flash stimuli were recorded in 22 patients with negative BFE responses. In 19 cases (including the patient with 20/50 acuity at five weeks post-
op who was subsequently lost to follow-up and a patient limited to 20/40 due to diabetic retinopathy), a positive VER response could be recorded, even with the S1 setting of the Grass photostimulator (Tables II and III). One VER false negative was encountered among these BFE-negative patients, in an eye that achieved 20/25 postoperative Snellen acuity. Two abnormal VER responses were recorded in this group, with neither patient achieving 20/40 (20/70 and LP).

Of the 108 patients with positive BFE results, only 3 (2.8%) failed to achieve better than 20/40 acuity post- cataract extraction (Table V). In each of these cases, postoperative events could be invoked to possibly account for the reduced acuity, leaving no unequivocal instances of false positive BFE results.

COMMENT

Our results suggest that blue field entoptoscopy, like laser interferometry, becomes progressively unreliable as a predictor of potentially good postoperative Snellen acuity as cataract density increases. The reason or reasons for this are not entirely apparent, and remain somewhat speculative. Certainly, patients with dense cataracts can see the blue light, especially at the high intensity setting of the BFE 100 instrument. There are no transmitted images which could be degraded by the impaired optics of these eyes, and irregularities within the medial opacities cannot be invoked to "explain" our results.

The theoretical basis for clinical blue field entoptoscopy rests on the fact that blue light is absorbed by the red blood cells in the perivascular capillaries, thus blocking its transmission to the photoreceptors underlying these capillaries. When a leukocyte passes through a perivascular capillary, the blue light is transmitted to the underlying photoreceptors, and the moving white blood cell ("flying corpuscle") can therefore be "seen." Perhaps very dense cataracts attenuate the intensity of the 1.8 × 10⁻² W/sq cm blue light sufficiently to make entoptic perception of leukocytes a marginal phenomenon. Nevertheless, we have found that the MIRA instrument may produce a less intense blue light than did the prototype. Alternatively, it may be that, as opposed to the normal situation in which cones underlying retinal vessels are relatively dark-adapted compared to cones elsewhere situated, the state of cone adaptation is more nearly equal when dense cataracts have reduced the ambient light transmitted to the retina to something closer to scotopic levels. If this is the case, the "sudden" onset of bright retinal illumination should affect cones underlying a leukocyte and random retinal cones more nearly equally, thus decreasing the contrast between the two and rendering entoptic perception of the "flying corpuscle" phenomenon more difficult. These explanations may all play a role, along with other, as yet unexplored factors.

In summary, our results suggest BFE, using the commercially available MIRA 100 entoptoscope, to be a useful and reliable test of macular function in cataract patients with better than 20/400 preoperative acuity. Although sharply delimited foveal lesions might be expected to yield false positive results, we encountered no unequivocal false positives in our series. Unfortunately, patients with very dense cataracts, precisely those in whom any clinical visualization of the posterior pole is impossible, do not appear to be reliably predictable by this test, showing an unacceptably high incidence of false negative results in our series. Light flash VER testing, despite the relatively large retinal area which contributes to the recorded occipital response and the comparatively complicated instrumentation required, appeared to be more reliable than MIRA BFE testing as a predictor of potentially good postoperative acuity in patients with very dense cataracts. This is attributable to the fact that most cataract patients do not have visually significant macular lesions, rather than to any ability of light flash VER testing to predict acuity. While an abnormal light flash VER recording in a cataract patient with a negative MIRA BFE 100 test result implies a poor visual prognosis, a normal flash VER recording in such a patient is no guarantee of good potential Snellen acuity. Some false positives may be expected with such VER testing, but false negatives should be very rare events indeed.

REFERENCES