Graefe's Arch Clin Exp Ophthalmol
(2002) 240:601–607

CLINICAL INVESTIGATION

DOI 10.1007/s00417-002-0506-7

David N. Zacks
C. Michael Samson
John Loewenstein
C. Stephen Foster

Electroretinograms as an indicator of disease activity in birdshot retinochoroidopathy

Received: 3 September 2001
Revised: 8 April 2002
Accepted: 22 May 2002
Published online: 10 July 2002

The authors have no proprietary interest in any of the material presented in this paper

D.N. Zacks (✉) · J. Loewenstein
Retina Service,
Massachusetts Eye and Ear Infirmary,
Harvard Medical School,
243 Charles Street, Boston,
MA 02114, USA
e-mail: david_zacks@meei.harvard.edu
Tel.: +1-617-5237900
Fax: +1-617-5733698

C.M. Samson · C.S. Foster
Immunology Service,
Massachusetts Eye and Ear Infirmary,
Harvard Medical School, Boston,
Massachusetts, USA

C.M. Samson
Uveitis Service,
New York Eye and Ear Infirmary,
New York, New York, USA

Abstract *Purpose:* To determine whether electroretinogram results can help predict the success in tapering of immunosuppressive medication in patients with birdshot retinochoroidopathy. *Methods:* Fifteen patients with birdshot retinochoroidopathy who had at least three serial electroretinograms (ERG) during the course of their disease were included in the study. Charts of patients seen at the Immunology and Uveitis Service at the Massachusetts Eye and Ear Infirmary, Boston, Massachusetts were retrospectively reviewed. Seven parameters of the ERGs were examined: dim scotopic amplitude, bright scotopic amplitude, bright scotopic implicit time, single-flash photopic amplitude, single-flash photopic implicit time, 30 Hz flicker amplitudes, and 30 Hz flicker implicit times. For each parameter the patients were divided into two groups, those with normal and those with abnormal responses at the time their immunosuppressive medication taper was initiated. The percentage of patients in each group who were able to successfully taper their immunosuppressive medication was calculated. A successful taper of medication was defined as no recurrence of disease signs or symptoms for at least 1 year after the medication was terminated. *Results:* Abnormalities in the bright scotopic response amplitudes and 30 Hz flicker implicit times were associated with recurrence of inflammation as immunosuppressive therapy was tapered. *Conclusion:* ERG can serve as a useful adjunct in helping determine when to initiate tapering of immunosuppressive therapy in patients with birdshot retinochoroidopathy.

Introduction

Birdshot retinochoroidopathy (BSRC) is a rare form of uveitis characterized by the presence of multiple depigmented spots at the level of the choroid and retinal pigment epithelium [7]. The disease is also accompanied by retinal vasculitis and vitritis, but minimal anterior segment inflammation. There is a strong association of this disease with the HLA-A29 haplotype [2, 5, 7]. Patients often present with complaints of blurry vision, floaters, photopsias, and difficulty with night vision[2]. Abnormalities usually exist in the electroretinograms (ERGs) of these patients, including decreased scotopic and photopic amplitudes as well as a prolongation of the implicit times of the electrical responses [1, 3, 9]. B-wave amplitudes are affected more than a-wave amplitudes, resulting in the negative type response often associated with inner retinal dysfunction and night blindness. In the extreme, the ERG can be so markedly diminished as to resemble the responses seen in severe retinal degenerations.

The clinical course of BSRC is often characterized by repeated cycles of inflammation. Vision loss usually results from cystoid macular edema, epiretinal membrane formation, and subretinal neovascularization [2, 8]. No

standard treatment regimen exists for patients with BSRC, and many clinicians often start treatment with topical or peribulbar steroids. Unfortunately, progression from mild to more severe disease occurs frequently, with as many as 54% of patients treated with local therapy alone experiencing a loss of at least two lines of Snellen visual acuity [2, 4, 7, 10]. This has prompted our group to institute the use of systemic treatment with cyclosporin A (CSA) or azathioprine as a first line therapy for patients with BSRC.

Several types of therapeutic dilemmas may confront the physician treating a patient with BSRC because of the recurrent nature of the disease. Patients may have resolution of their symptoms with treatment, only to have disease activity return as the immunomodulatory agents are tapered. Additionally, patients may complain of symptoms such as decreased vision, especially in dim illumination, and impaired color perception even when minimal if any inflammation is evident on clinical examination. In these situations it may be difficult to determine whether these symptoms result from occult yet potentially damaging inflammation that might require increased immunomodulation.

Few guidelines exist to help the clinician determine an appropriate schedule for the withdrawal of immunomodulatory therapy. We wondered whether one might be able to use ERG data as an indicator of disease activity, and whether this information might predict the likelihood of success of tapering the medication without recurrence of disease activity. We therefore constructed this study to test the hypothesis that abnormalities in the ERG correlate with the need for continued immunomodulation in patients with BSRC.

Patients and methods

Charts of all patients with BSRC seen in the Immunology Service of the Massachusetts Eye and Ear Infirmary between January 1995 and July 2000 were reviewed retrospectively. IRB approval was obtained for this review. All patients had the diagnosis of BSRC made based on the following criteria: the presence of typical cream-colored fundus lesions in the posterior pole, the presence of a vitritis with retinal vascular leakage on fluorescein angiography, and minimal anterior segment inflammation [7]. We obtain ERGs as part of our initial evaluation and subsequent monitoring of all patients with BSRC. As this study is attempting to correlate ERG findings as a function of the clinical course of the disease over time, only patients who had at least three serial ERGs performed were included in the study. The decision to begin tapering a patient off of immunosuppressive medication was based on the absence of active inflammation on clinical examination for a minimum of 1 year, and was independent of the patient's ERG results. A successful taper of medication was defined as no recurrence of disease signs or symptoms for at least 1 year after the medication was terminated.

Seven parameters of the ERG recordings from patients who met the above-defined criteria were analyzed: dim scotopic amplitude, bright scotopic amplitude, bright scotopic implicit time, single-flash photopic amplitude, single-flash photopic implicit time, 30 Hz flicker amplitudes, and 30 Hz flicker implicit times. For each parameter the patients were divided into two groups, those with normal and those with abnormal responses. For each parameter a chi-squared test was used to determine the significance of the dependence between the partition of the parameter to normal or abnormal values and the ability to taper a patient off of medication. The exact distribution of the chi-squared values under the null hypothesis of the random partition of the 15 patients was generated. The 95th and 99th percentiles of the null distribution were then determined. Chi-squared values greater than 3.8 showed significance at the P=0.05 level, and chi-squared values greater than 6.6 showed significance at the P=0.01 level.

Electroretinograms were performed on a UTAS-E 2000 system (LKC Technologies, Gaithersburg, Md.). The measurements were performed in accordance with the international standard protocol [6]. Implicit times were calculated by system software for the 30 Hz flicker response. Prolongations in the implicit time were defined as an increase in the implicit time over the upper limit (95% confidence interval) for the normal age-adjusted reference values (unpublished data). ERG results were interpreted by one of the authors (J.L.), who was masked as to the clinical course of the patients' disease and type of therapy being administered.

Table 1 Profile of patients with birdshot retinochoroidopathy undergoing tapering of immunosuppressive therapy (*CSA* cyclosporin A)

Patient	Sex	Age (years)	Immunosuppression	Taper successful?	Final visual acuity	
					OD	OS
1	Male	52	CSA	Yes	20/15	20/20
2	Male	41	CSA, azathioprine	No	20/25	20/25
3	Male	58	CSA, azathioprine	No	20/32	20/20
4	Female	49	CSA	No	20/20	20/20
5	Female	61	CSA	No	20/30	20/25
6	Female	67	CSA	No	20/25	20/25
7	Female	57	CSA	No	20/32	20/40
8	Female	38	CSA	Yes	20/20	20/20
9	Female	31	CSA	No	20/25	20/20
10	Male	45	CSA	Yes	20/40	20/40
11	Female	29	CSA	No	20/20	20/25
12	Male	51	CSA, azathioprine	No	20/80	20/25
13	Male	69	CSA, retinal S-antigen	Yes	20/20	20/20
14	Female	58	CSA, azathioprine	No	20/60	20/60
15	Male	66	CSA	No	20/40	20/30

Table 2 Values for each of the seven ERG parameters obtained at the time taper of immunosuppressive medication was initiated. Values in parentheses indicate the normal range for age-adjusted controls

Patient	Dim scotopic	Bright scotopic		Bright photopic		30 Hz flicker	
	Amplitude (μV)	Amplitude (μV)	Implicit time (ms)	Amplitude (μV)	Implicit time (ms)	Amplitude (μV)	Implicit time (ms)
1	OD 245 (92–251) OS 284	OD 380 (288–591) OS 388	OD 48.5 (42.6–52.5) OS 46.5	OD 92 (55–150) OS 90	OD 30 (27–32) OS 32	OD 45 (34–113) OS 76	OD 27.2 (22.8–28.7) OS 26.7
2	OD 83 (106–264) OS 108	OD 269 (298–602) OS 256	OD 47 (42.6–52.5) OS 47	OD 59 (61–157) OS 51	OD 32 (27–32) OS 32.5	OD 26 (39–118) OS 23	OD 31 (25–30) OS 31
3	OD NR OS NR	OD 46 (277–581) OS 44	OD 49 (43–53) OS 49.5	OD 31 (48–144) OS 16	OD 35 (27–32) OS 37	OD 16 (29–109) OS 12	OD 36 (25–31) OS 35
4	OD 134 (94–252) OS 119	OD 268 (289–593) OS 290	OD 48.5 (43–53) OS 48.5	OD 92 (55–151) OS 81	OD 36 (27–32) OS 36	OD 76 (35–114) OS 85	OD 34 (25–31) OS 35
5	OD 87 (77–235) OS 87	OD 221 (276–580) OS 180	OD 50.5 (43–53) OS 49	OD 64 (47–143) OS 51	OD 34.5 (27–32) OS 34	OD 61 (29–108) OS 49	OD 34.8 (23–29) OS 34.5
6	OD 133 (64–222) OS 133	OD 332 (266–569) OS 312	OD 55.5 (43–53) OS 55	OD 84 (41–137) OS 79	OD 35 (27–32) OS 33	OD 63 (24–103) OS 51	OD 33 (25–31) OS 32
7	OD 61 (79–237) OS 50	OD 119 (277–581) OS 120	OD 51.5 (43–53) OS 53	OD 25 (48–144) OS 25	OD 33.5 (27–32) OS 34	OD 12 (29–109) OS 10	OD 35.4 (25–31) OS 35.7
8	OD 165 (116–275) OS 176	OD 396 (306–609) OS 418	OD 45.5 (43–53) OS 44.5	OD 115 (66–161) OS 105	OD 30 (27–32) OS 29	OD 71 (43–122) OS 84	OD 29.7 (25–31) OS 28.1
9	OD 151 (125–283) OS 169	OD 303 (312–616) OS 365	OD 36 (43–53) OS 34	OD 53 (70–165) OS 56	OD 31.5 (27–32) OS 31.5	OD 47 (46–125) OS 59	OD 29.4 (25–30) OS 27
10	OD 35 (104–263) OS 25	OD 195 (297–600) OS 79	OD 67 (43–53) OS 67	OD 25 (60–156) OS 8	OD 36 (27–32) OS 36.5	OD 21 (38–118) OS 12	OD 35.8 (25–31) OS 33.8
11	OD 244 (130–288) OS 272	OD 406 (316–620) OS 392	OD 46.5 (43–53) OS 45	OD 151 (72–168) OS 154	OD 34 (27–32) OS 33.5	OD 95 (47–127) OS 80	OD 31.3 (24–30) OS 33
12	OD 57 (91–249) OS 101	OD 120 (286–590) OS 196	OD 40 (43–53) OS 38	OD 45 (54–149) OS 54	OD 33 (27–32) OS 31.5	OD 18 (34–118) OS 36	OD 35 (25–31) OS 30.1
13	OD 192 (64–222) OS 181	OD 305 (266–569) OS 301	OD 46 (43–53) OS 48	OD 55 (41–137) OS 51	OD 32 (27–32) OS 29.5	OD 52 (24–103) OS 52	OD 27.6 (23–28) OS 27.5
14	OD NR OS NR	OD 55 (277–581) OS 47	OD 53 (43–53) OS 52	OD 21 (48–144) OS 19.5	OD 30.5 (27–32) OS 31	OD 19 (29–109) OS 21	OD 41.5 (25–31) OS 37.2
15	OD 26.5 (100–276) OS 41.2	OD 106 (350–700) OS 188	OD 48 (43–53) OS 47.5	OD 37 (41–137) OS 33	OD 31 (27–32) OS 31	OD 15 (50–125) OS 29.4	OD 34 (25–32) OS 30

Results

Fifteen patients met our study inclusion criteria (Table 1). All these patients were positive for the HLA-A29 antigen. The values for each of the seven ERG parameters are shown in Table 2. The ERG parameter that showed the most significant correlation with an inability to taper medication was the 30 Hz flicker implicit times (P=0.01) (Table 3). Only 1 of 11 patients with prolonged 30 Hz flicker implicit times could be successfully tapered off medication. Of the four patients with normal implicit times, three achieved a successful taper. The degree of implicit time prolongation in patients varied from 1% to 31% above the upper limit of normal for the age-adjusted reference values. For most patients the extent of prolongation decreased as a function of the amount of immunosuppressive medication received, but any prolongation was still correlated with unsuccessful tapering off medication.

Decreased bright scotopic response amplitudes also mirrored the predictive value of the 30 Hz flicker implicit time (P=0.05), with only one of nine patients having a decreased amplitude achieving a successful taper. The intra-patient variability in the amplitude measurements varied more than the implicit times, even for similar degrees of disease activity (data not shown).

Case 1

Patient 8 was a patient in whom the 30 Hz flicker implicit time correlated well with success in tapering of immunosuppressive medication. Patient 8 was a 38-year-old woman who also presented to our service with a sudden onset of blurry vision and photopsias and visual acuities of 20/20 OD and 20/20 OS. The anterior segment examination disclosed no anterior chamber cells, but 1+ vitreous cells were seen. Examination of the retina showed depigmented lesions scattered throughout the midperiphery at the level of the retinal pigment epithelium in both eyes. The diagnosis of BSRC was made, and the patient was started on CSA therapy at a dose of 200 mg/day. This dose was raised to 500 mg/day over a 6-month period in response to worsening inflammation and symptoms. Seven months after the immunosuppressive therapy was started, all seven parameters of the ERG, and particularly the 30 Hz flicker implicit times, were normal (Table 2, Fig. 1). The patient's CSA dose was decreased to 300 mg/day and she was maintained at that dose for the next 6 months. Repeat ERG testing at that time again showed normal responses. The patient's CSA dose was slowly tapered over the following 12 months. During the course of this taper the patient experienced several episodes of increased floaters and worsening photopsias. Electroretinograms measured during these episodes of worsening symptoms revealed normal bright scotopic

Table 3 Chi-squared analysis of the correlation between different ERG parameters and the ability to taper a patient off of immunosuppressive medication. A value greater than 3.8 is significant at P=0.05 and a value greater than 6.6 is significant at P=0.01

	Number of patients			Chi-squared
	Tapered	Not tapered	Total	
Dim scotopic amplitude				
Normal	2	5	7	
Abnormal	2	6	8	0.02435
Bright scotopic amplitude				
Normal	3	2	5	
Abnormal	1	9	10	4.2613
Bright scotopic implicit time				
Normal	3	8	11	
Abnormal	1	3	4	0.0077
Single-flash photopic amplitude				
Normal	3	4	7	
Abnormal	1	7	8	1.7593
Single-flash photopic implicit time				
Normal	3	4	7	
Abnormal	1	7	8	1.7593
30 Hz flicker amplitude				
Normal	3	5	8	
Abnormal	1	6	7	1.0288
30 Hz flicker implicit time				
Normal	3	1	4	
Abnormal	1	10	11	6.616

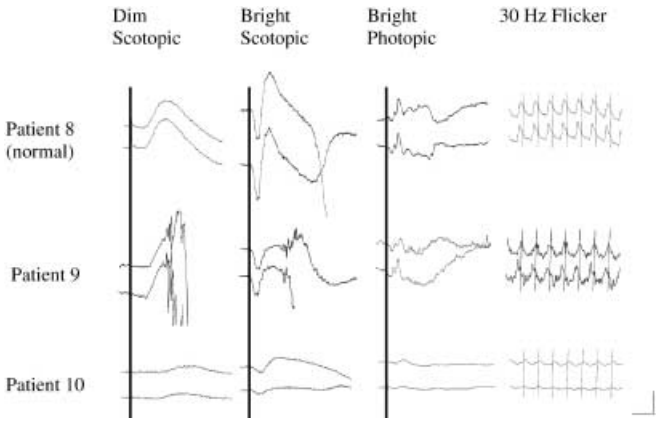

Fig. 1 Full-field ERGs for patients 8, 9, and 10 showing each patient's response to single-flash dim scotopic, bright scotopic, and bright photopic stimuli. For each patient the *upper curve* is from the right eye and the *lower curve* is for the left eye. Also shown are the responses to 30 Hz flicker stimulation. An *upward deflection* represents cornea positivity. Stimulus onset is designated by the *solid vertical lines* in the single flash responses and by *vertical shock artifacts* in the 30 Hz flicker responses. The *calibration bar* in the lower right hand corner is 50 ms along the horizontal axis and 100 μV along the vertical axis. Age-adjusted values for the normal range for patient's response are given in Table 2

amplitudes and 30 Hz flicker implicit times, suggesting that the symptoms were not due to recurring inflammation. Tapering of the medicine was continued despite the symptoms, and the patient was successfully taken off the medication. No recurrence of symptoms or clinically evident inflammation has occurred in 1 year of follow-up since medication has been terminated.

Case 2

In contrast to patient 8, one patient (patient 9) failed her taper despite a normal implicit time. This patient was a 31-year-old woman who presented to our service with recent onset of blurry vision and photopsias and with visual acuities of 20/25 OD and 20/30 OS. The anterior segment examination disclosed 1/2+ anterior chamber cells and 1/2+ anterior vitreous cells. Examination of the retina disclosed depigmented lesions scattered throughout the midperiphery at the level of the retinal pigment epithelium in both eyes. HLA-A29 testing was positive. The diagnosis of BSRC was made, and CSA therapy was begun at a dose of 200 mg/day. The dose was increased to 400 mg/day over a 1-month period. Initial ERG testing showed decreased rod and cone amplitudes and a prolongation of the 30 Hz flicker stimulus implicit time by 27.0% in OD and 5.3% in OS. The implicit time in the left eye was normal when tested 6 months after therapy was initiated. At that time the patient had no new retinal lesions in either eye, and vitreal cells were substantially fewer in number than prior to treatment. The patient's CSA therapy was continued. After 9 months of therapy, the patient had no evidence of intraocular inflammation on clinical examination, and the retinal lesions appeared inactive. After 18 months of CSA therapy the implicit time in the right eye also became normal (Figure 1). Examination at that time also showed no active inflammation, and therefore the dose of CSA was decreased to 300 mg/day. Over the next 3 months the CSA dose was tapered to 100 mg/day, but after 3 months at this dose the patient experienced worsening floaters and photopsias. The clinical examination disclosed 1+ vitreous cells and new hypopigmented retinal lesions. ERG recording at that time showed an implicit time that was prolonged by 7.5% in the patient's right eye and was normal in the left eye. The patient's CSA dose was increased to 400 mg/day and this resulted in a decrease of her symptoms and in her inflammation. The patient is currently still at this higher dose of CSA and is awaiting repeat ERG testing.

Case 3

The one patient (patient 10) whose prolonged implicit times did not correlate with an unsuccessful taper was a 45-year-old man who was referred to our service 13 years after he was initially diagnosed with BSRC. Previous therapy included topical steroid drops, sub-Tenon's injection of steroids and oral prednisone. On presentation to our service the patient's visual acuities were 20/40 in each eye. Anterior segment examination disclosed mild posterior subcapsular cataracts. The patient's intraocular pressures were normal. The vitreous contained 1+ cells, and the retina exhibited multiple depigmented spots at the level of the retinal pigment epithelium, distributed throughout the midperiphery in both eyes. Initial ERG measurements showed implicit times prolonged by 16.6% and 10.1% in the right and left eye, respectively. Both rod- and cone-mediated response amplitudes were decreased by over 70% from the lower limit of the normal age-adjusted values (Figure 1). The patient was started on CSA, but this was discontinued after 2 months because the patient was asymptomatic, there was no evidence of active inflammation and the patient was reluctant to continue medication. The patient had no recurrence of his symptoms or of the retinal or choroidal lesions. His clinical examination remained stable and was still significant only for multiple large areas of retinal pigment epithelial atrophy. His ERG remained abnormal, showing prolonged implicit times and decreased rod and cone function.

Discussion

Management of the patient with BSRC can be very frustrating, with disease recurrences and the paucity of markers of disease activity contributing to the confusion surrounding adjustment of medication regimens. We believe that our analysis supports the idea that serial ERG measurements are useful in the care of patients with BSRC. Particularly, we find that the bright scotopic amplitudes and the 30 Hz flicker implicit times provide useful markers of disease activity and can serve as a predictor of recurrence of inflammation if immunomodulatory therapy is tapered prior to normalization of those parameters. During the course of the medication taper these ERG parameters are helpful in monitoring for renewed inflammation that may require increased medication.

The contrast between patient 8 and patient 9 (case descriptions above) highlights these points. In patient 8 the normal implicit times correlated with the successful taper, despite the occasional recurrence of subjective patient symptoms. In patient 9, however, the taper proceeded well when the implicit time was normal, but failed when the implicit time became prolonged. The implicit time became prolonged in only one eye, but this still correlated with a need for increased medication. It is interesting to note that patient 9 did have a decreased single-flash photopic response amplitude at the time the taper was started, but this parameter of the ERG measurement

was not found to be significantly correlated with failure of medication withdrawal.

Unilateral prolongation of the implicit times was seen in two other patients (patients 12 and 15), both of whom experienced recurrent inflammation as the immunosuppressive medication was decreased. As with patient 9, the inflammation in these two patients rebounded in both eyes and not just the eye with the prolonged implicit time. This reinforces the concept that BSRC is a bilateral disease, or, more strongly stated, a systemic autoimmune disease that requires systemic immune system modulation in order to abrogate the inflammation and preserve retinal function.

The reason the ERG is a sensitive indicator of disease activity is speculative, but this test may help assess the functional integrity of the retina, which may be compromised during active inflammation. Of course, marked destruction of the retina due to chronic inflammation will make ERG measurements irrelevant, as was seen in patient 10 (case 1). This patient was able to stop immunosuppressive medication despite a decreased bright scotopic amplitude and a prolonged implicit time. He had a long history of BSRC, and the disease may have caused too much permanent retinal damage to allow normalization of electrical signals with CSA therapy. This suggests that using the ERG as a marker of disease activity would probably be most useful in patients with substantial amounts of preserved retinal function.

The high correlation of certain ERG parameters with successful or unsuccessful taper of medications suggests several ways in which the ERG may be helpful to the clinician in guiding therapy for patients with BSRC. We suggest that baseline electroretinograms be obtained on all patients meeting the clinical criteria for BSRC. Therapy is then initiated and medication doses adjusted until there is resolution of clinically apparent inflammation. We believe it is highly desirable to continue therapy until one sees, if possible, normalization of the ERG, particularly the bright scotopic amplitudes and 30 Hz flicker implicit times, in both eyes before beginning any attempt at tapering the immunosuppressive medications. Finally, the patient may be monitored with ERG recordings at regular intervals during the course of the taper, and if the bright scotopic amplitude decreases or the 30 Hz flicker implicit time becomes prolonged, then the immunosuppressive therapy should probably be increased. The frequency with which one monitors implicit times during the course of the taper may vary depending on the patient's symptoms. Patients with long-standing inflammation resulting in widespread destruction of retinal elements will not fit well into this paradigm of sequential ERG testing.

It is not uncommon for patients to require many months of immunosuppressive therapy before successful tapering of such therapy can begin [4]. Our experience correlates well with this finding, and patients whose medication is tapered prematurely very often have rebound inflammation. Even if the disease appears only minimally active on clinical examination, our findings suggest that inflammation is likely to return if the bright scotopic amplitude is decreased or if the 30 Hz flicker implicit time remains prolonged.

The majority of our patients were treated with CSA as the sole immunosuppressive agent, although some had a second agent included in their regimen. It is possible that the type of immunosuppressive agent could have an effect on the rate at which ERG normalization occurred, and that patients treated with other types of medication could have a better chance of a successful taper earlier in the course of treatment.

Our sample size was too small to allow us to address several important issues. First, we could not attach a statistical significance to the number of patients who had normal ERG parameters at the start of their medication taper and were successfully taken off the immunosuppressants. Stated another way, our data help us to predict when a taper will be unsuccessful, but not when a taper will be successful. Secondly, we do not know how long a patient should be maintained on an immunosuppressive medication, once the ERG has normalized, before a taper is initiated. Additionally, the small sample size allowed us to perform only a univariate analysis of the data. Thus, a caveat should be attached to the *P* values provided in Table 3 in that significance may be somewhat exaggerated due to the possibility of multiple-testing error. Even accounting for this, however, the significance of the 30 Hz flicker implicit time would still remainnear the 0.05 level. Finally, we could not find any predictors of which patients will have an improvement in their ERG profiles and a normalization of their ERG. Hopefully, the answer to these questions will become more evident as we prospectively follow additional BSRC patients using the guidelines suggested above.

Acknowledgements The authors wish to thank Shelley Zacks, PhD, Professor of Mathematical Sciences, State University of New York at Binghamton, Binghamton, New York for assistance in statistical analysis of the data.

References

1. Fuerst DJ, Tessler HH, Fishman GA, et al (1984) Birdshot retinochoroidopathy. Arch Ophthalmol 102: 214–219

2. Gasch AT, Smith JA, Whitcup SM (1999) Birdshot retinochoroidopathy. Br J Ophthalmol 83(2): 241–249

3. Hirose T, Katsumi O, Pruett RC, et al (1991) Retinal function in birdshot retinochoroidopathy. Acta Ophthalmol 69:327–337

4. Jabs DA, Rosenbaum JT, Foster CS, et al (2000) Guidelines for the use of immunosuppressive drugs in patients with ocular inflammatory disorders: recommendations of an expert panel. Am J Ophthalmol 130:492–513
5. LeHoang P, Ozdemir N, Benhamou A, et al (1992) HLA-A29.2 subtype associated with birdshot retinochoroidopathy. Am J Ophthalmol 113:33–35
6. Marmour M (1995) An updated standard for clinical electroretinography. Arch Ophthalmol 113:1375–1376
7. Nussenblatt RB, Whitcup SM, Palestine AG (1996) Uveitis. Fundamentals and clinical practice, 2nd edn. Mosby, St Louis, pp 325–333
8. Priem HA, Oosterhuis JA (1988) Birdshot chorioretinopathy: clinical characteristics and evolution. Br J Ophthalmol 72:646–659
9. Priem HA, de Rouck A, de Laey JJ, Bird AC (1988) Electrophysiologic studies in birdshot chorioretinopathy. Am J Ophthalmol 106:430–436
10. Vitale AT, Rodriguez A, Foster CS (1994) Low-dose cyclosporine therapy in the treatment of birdshot retinochoroidopathy. Ophthalmology 101:822–831