Significance of Electro diagnostic Tests in a Rare Case of Vision Loss Following Silicone Oil Removal

Silikon Yağı Çıkarılmasını Takiben Görme Kaybı Oluşan Nadir Bir Olguda Elektro Diyognostik Testlerin Önemi

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ABSTRACT

Purpose: To report the significance of Multifocal Electroretinogram (mf ERG) in predicting visual outcome before silicone oil injection and removal.

Methods: Case report.

Results: A 67-year-old man presented to our hospital complaining of flashes in left eye. Indirect ophthalmoscopic examination revealed giant retinal tear with posterior breaks and multiple horse shoe tears 360^0 with posterior vitreous detachment in left eye. Underwent pars plana vitrectomy, membrane peeling, endolaser with silicone oil injection in left eye. Posterior subcapsular cataract developed in left eye after 3 months post-operative period and underwent phacoemulsification with intraocular lens implantation and silicone oil removal. Immediately after surgery his best corrected vision dropped from 6/18 to 5/60 with a central dark blue hue. Extensive workup revealed decreased foveal sensitivity in Humphrey's Field Analyser and loss of macular peak in mf ERG.

Conclusion: mf ERG may be used as an indicator to estimate prognostic visual outcome after silicone oil removal.

Key words: Silicone oil, multifocal electroretinogram, gaint retinal tear.

ÖZ

Amaç: Silikon yağı verilmesi ve çıkarılmasında görme sonuçlarının tahmininde multifokal elektroretinagramın (mfERG) öneminin bildirilmesi.

Metod: Olgu sunumu.

Sonuçlar: Sol gözünde uçuşmalar şikayeti ile hastanemize müracaat eden 67 yaşında erkek bir hasta takdim edilmiştir. İndirekt oftalmoskopide, sol gözünde arka vitre dekolmanı ile dev retinal yırtık, 360° çok sayıda at nalı yırtık saptanmıştır. Sol gözüne pars plana vitrektomi, membran soyulması, endolazer ve silikon yağı enjeksiyonu yapılmıştır. Postoperatif 3. aydan sonra sol gözde subkapsüler katarakt gelişmiş ve fakoemilsifikasyon, introöküler lens implantasyonu ve silikon yağı çıkarılması ameliyatı yapılmıştır. Hemen ameliyattan sonra en iyi düzeltilmiş görme derecesi 6/18'den 5/60'a düşmüş ve yoğun araştırmalar sonucu foveal duyarlılığın Humprey görme alanı testi ve mfERG makular pikin kaybı saptanmıştır.

Sonuç: mfERG, silikon yağı alınmasından sonra tahmini görmenin belirleneceği bir indikatör olarak kullanılabilir.

Anahtar kelimeler: Silikon yağı, multifokal elektroretinogram, dev retina yırtığı.

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INTRODUCTION

Silicone oil is being used with increased frequency in ophthalmology for retinal tamponade during vitreous surgery[1]. The indications are complicated retinal detachment due to proliferative vitreoretinopathy (PVR) or viral retinitis, giant retinal tears, trauma, and severe proliferative diabetic retinopathy[2]. New possible indications are now retinal detachment due to macular hole in high myopic eye, chronic and persistent macular hole, colobomatous retinal detachment and chronic uveitis with hypotony[2]. Silicone oil is a group of hydrophobic polymeric and monomeric compound with silicone-oxygen bonds and named organosiloxane[1]. Silicone oil has hydrocarbon radicals and acts as radical side chains[1].The viscosity of silicone oil is expressed in centistokes(cs) and determined by its molecular weight and length of linear chain[1]. The currently available silicone oils are ranging from 1000cs to 5000cs of viscosity[1]. The specific gravity of silicone oil is 0.97, which is slightly less than aqueous and vitreous fluid which makes the silicone oil float in aqueous fluid[1]. Though it is now possible to reattach most detached retinas with silicone oil, there are well known complications such as cataract, glaucoma, corneal opacification, and a certain risk of redetachment during the silicone oil removal in second sitting[2]. Other associated complications with silicone oil removal are keratopathy, persistent hypotony, and elevated intra ocular pressure (IOP) [3,4]. However unexplained vision loss following silicone oil removal is a rare complication and only few cases were reported earlier. This unexplained vision loss was diagnosed by multifocal electroretinogram (ERG).

The electroretinogram (ERG) is a diagnostic test that measures the electrical activity generated by neural and non-neuronal cells in the retina in response to a light stimulus. The electrical response is a result of a retinal potential generated by light-induced changes in the flux of trans retinal ions, primarily sodium and potassium. Most often, ERGs are obtained using electrodes embedded in a corneal contact lens, which measure a summation of retinal electrical activity at the corneal surface. The International Society for Clinical Electrophysiology of Vision (ISCEV) introduced minimum standards for the ERG in 1989[5]. The ERG can provide important diagnostic information on a variety of retinal disorders including, but not limited to congenital stationary night blindness, Leber congenital amaurosis, and cancer-associated retinopathy[5]. Moreover, an ERG can also be used to monitor disease progression or evaluating for retinal toxicity with various drugs or from a retained intraocular foreign body. The a-wave amplitude of ERG is measured from baseline to the trough of the a-wave[5]. This wave reflects the hyperpolarization of the photoreceptors due to closure of sodium ion channels in the outer segment membrane. The b-wave amplitude is generally measured from the trough of the a-wave to the peak of the b-wave. This wave is the most common component of the ERG used in clinical and experimental analysis of human retinal function. The bipolar cell depolarization increases the level of extracellular potassium, subsequently generating a transretinal current. It is this trans retinal current that depolarizes the rapidly oriented Muller cells and generates the corneal positive deflection[5]. The c-wave is a reflection of the resulting change in the trans epithelial potential due to the hyperpolarization at the apical membrane of the retinal pigment epithelium (RPE) cells and the hyperpolarization of the distal portion of the Muller cells. The c-wave generally peaks within 2 to 10 seconds following a light stimulus, depending on flash intensity and duration.

As the regular ERG gives the global retinal function, it is now been replaced by Multifocal ERG (mfERG). Multifocal ERG is a new technique that allows analysis of local ERG responses to assess focal retinal function. Recording is done with dilated pupils with subject placed in ordinary room light for 15 minutes before testing. The overall stimulus pattern should subtend a visual angle of 20-30^0 on either side of fixation. Duration of recording varies from 4-8 minutes depending on whether 61 or 103 elements are used. The typical waveform of the primary mfERG is a biphasic wave. The initial negative deflection is called N1, which is followed by a positive deflection P1 and a second negative deflection called N2. The cellular origins of these responses are still under study, but the N1 may be from photoreceptors while P1 may have contributions from the inner retinal cells. The amplitude and latency measurements of N1 and P1 follow the same convention as for the 'a and b' waves of routine flash ERG.

We are presenting a case of unexplained visual loss after silicone oil removal which is diagnosed and analyzed with the help of mf ERG.

CASE REPORT

A 67 years old male visited our hospital with complaints of flashes of light in left eye since one week. On ocular examination, his best corrected vision (BCVA) was 6/12 in right eye and 6/6 in the left eye. Intraocular pressure (IOP) was 14 and 15 mm of Hg in right and left eyes respectively. Anterior segment was normal in both eyes. Lens showed grade 2 and grade 3 nuclear sclerosis in left and right eyes respectively. Indirect ophthalmoscopy showed giant retinal tear with posterior breaks and multiple horse shoe tears 360^0 with posterior vitreous detachment in left eye. As laserpexy, cryopexy, scleral buckling and perfluorocarbon gas tamponade were deferred in this case, patient was advised to go for pars plana vitrectomy, membrane peeling and endolaser with silicone oil (viscosity of 2000 cs) injection under local anaesthesia (LA) in the left eye. He was operated the following day. Patient was discharged with topical antibiotics and steroid combination on tapering regimen. Patient's postoperative

BCVA after 1 week was 6/12 in left eye and IOP was 16mm of Hg. After 3 months, patient developed posterior subcapsular cataract in left eye and BCVA was found to be 6/18. He underwent phacoemulsification with Acrysof IQ (ALCON) IOL implantation along with intraocular silicone oil removal in left eye. Immediate postoperative day, patient was complaining of bluish haze in central visual field with BCVA of 5/60 in left eye and funduscopic examination showed healthy disc and flat retina with macula looking normal. OCT and FFA showed no abnormality. Even after one month postoperatively, there was no improvement in BCVA. Humphrey's field analyser (HFA) 30-2 SITA Standard showed reduced foveal sensitivity in LE. This initiated us to go for electrophysiological tests. The patient underwent mfERG the following week which revealed substantial decrease in central macular function in left eye when compared to right eye. Figure 1 shows a reasonable peak in macula and in Figure 2 reveals a drop of amplitude in macula.

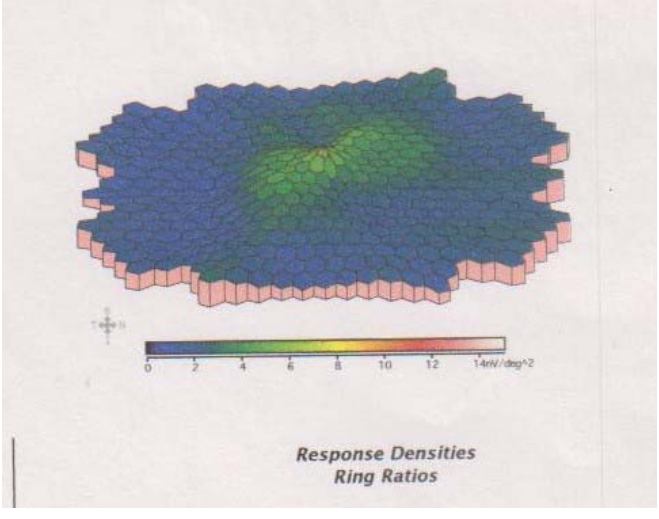

Fig 1: *A reasonable peak in amplitude at Macula in RE.*

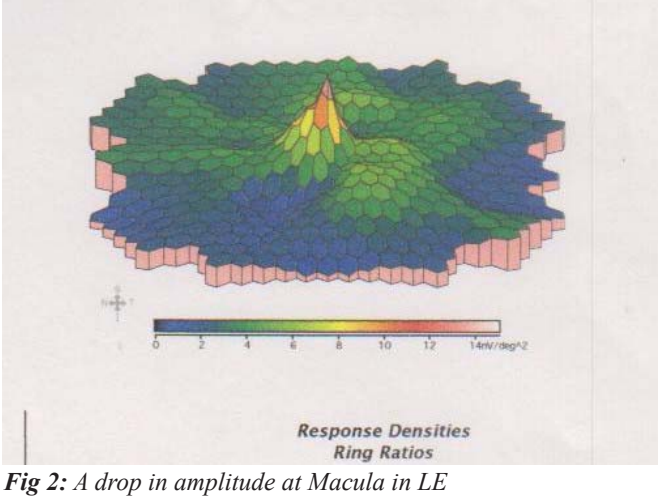

Fig 2: *A drop in amplitude at Macula in LE*

Discussion: This unexplained vision loss after silicone oil removal is a complication that is seen to occur in rare cases as reported earlier[6]. The temporal proximity between silicone oil removal and sudden visual loss is likely to suggest causative association between the two. The reason for the same has not yet been explained, but is postulated to bear a relation to various physiochemical changes surrounding the event.

It has been experimentally proven that Muller cells buffer the extracellular potassium ion concentration by siphoning excess K+ ions into the vitreous[7-9]. In the absence of vitreous, there is an increased buffering K+ ions between the oil and the retina. Removal of oil is known to cause a sudden physiochemical alteration in the aqueous milieu (potassium, glucose, depolarising transmitter molecules, and pH) and an impaired buffering of K+ ions. Winter et al[10] have reported an increase of K+ ions in the retina as a result of the above leading to excitotoxicity and consequent neuronal cell damage. An alteration in blood perfusion to the retina at the time of silicone oil removal is yet another postulated theory for the diminution of visual acuity.

Removal of oil may lead to direct exposure of retina to the harmful effects of soluble growth factors and free radicals. Silicone oil when present in the eye acts as a physical barrier to these substances. Its removal may allow more widespread dispersal and possibly damage to the macula as a result of its accumulation at this site.

In the case reported here, OCT revealed no retinal pathology. The Humphrey's field analyzer recordings showed decreased foveal sensitivity in left eye when compared to right eye. Multifocal ERG showed substantially reduced central macula function in the left eye compared to the right eye.

The amplitude and latency of 1st ring average of 'b wave'was found to be 58 nV/degree^2 and 49 ms in right eye and 33.33 nV/degree^2 and 59 ms in left eye. The amplitude and latency of 2nd ring average of 'b wave'was found to be 26 nV/degree^2 and 49 ms in right eye and 17 nV/degree^2 and 58 ms in left eye. The Peripheral ring amplitudes and latency time did not reveal much difference between the eyes as shown in Table 1. There is a clear evidence that left eye showed a considerable drop in the amplitude in the macula when compared to right eye. Normal amplitude values[11] of 'b wave'at that age is 89.36 nV/degree^2 and in this case it is found to 33 nV/ degree^2 only. This explains that silicone oil tamponade effect caused the reduction in macular function as preoperative visual acuity was good in this patient.

One should also note that the macular function in RE is less when compared to normal values at that age. This gives us an insight that even RE can be affected in future if the eye has to be treated with silicone oil. Hence for all patients who have undergone silicone oil injection, mfERG should

Table 1: *Ring averages for Latency and Amplitude for both eyes.*				
	RIGHT EYE		**LEFT EYE**	
	Latencies (milliseconds)	**Values(nV/degrees²)**	**Latencies (milliseconds)**	**Values(nV/degrees²)**
1st Ring	49	58	59	33
2nd Ring	49	26	58	17
3rd Ring	46	14	47	13
4th Ring	49	12	46	10
5th Ring	47	10	47	7
6th Ring	51	8	47	7

be done before the injection and removal of silicone oil as a preliminary routine procedure. This will give us an idea about the possible postoperative outcome following silicone oil removal.

REFERENCES / KAYNAKLAR

1- Barca F, Caporossi T, Rizzo S. Silicone oil: different physical proprieties and clinical applications. BioMed research international. 2014 Jun 11;2014.

2- Falkner CI, Binder S, Kruger A. Outcome after silicone oil removal. British journal of ophthalmology. 2001 Nov 1;85(11):1324-7.

3- Casswell AG, Gregor ZJ. Silicone oil removal. II. Operative and postoperative complications. British journal of ophthalmology. 1987 Dec 1;71(12):898-902.

4- Moisseiev E, Ohana O, Gershovitch L, Barak A. Visual prognosis and complications following silicone oil removal. European journal of ophthalmology. 2012 Dec;23(2):236-41.

5- Bach M, Brigell MG, Hawlina M, Holder GE, Johnson MA, McCulloch DL, Meigen T, Viswanathan S. ISCEV standard for clinical pattern electroretinography (PERG): 2012 update. Documenta Ophthalmologica. 2013 Feb 1;126(1):1-7.

6- Cazabon S, Groenewald C, Pearce IA, Wong D. Visual loss following removal of intraocular silicone oil. British journal of ophthalmology. 2005 Jul 1;89(7):799-802.

7- Newman EA. Distribution of potassium conductance in mammalian Muller (glial) cells: a comparative study. The Journal of neuroscience. 1987 Aug 1;7(8):2423-32.

8- Newman EA, Frambach DA, Odette LL. Control of extracellular potassium levels by retinal glial cell K+ siphoning. Science (New York, NY). 1984 Sep 14;225(4667):1174.

9- Oakley B, Katz BJ, Xu Z, Zheng J. Spatial buffering of extracellular potassium by Müller (glial) cells in the toad retina. Experimental eye research. 1992 Oct 1;55(4):539-50.

10- Winter M, Eberhardt W, Scholz C, Reichenbach A. Failure of potassium siphoning by Muller cells: a new hypothesis of perfluorocarbon liquid–induced retinopathy. Investigative ophthalmology & visual science. 2000 Jan 1;41(1):256-61.

11- Tehrani NM, Riazi-Esfahani H, Jafarzadehpur E, Mirzajani A, Talebi H, Amini A, Mazloumi M, Roohipoor R, Riazi-Esfahani M. Multifocal electroretinogram in diabetic macular edema; Correlation with visual acuity and optical coherence tomography. Journal of ophthalmic & vision research. 2015 Apr; 10(2):165.