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CHARACTERIZATION OF CENTRAL SEROUS CHORIORETINOPATHY USING NEAR INFRARED AUTOFLUORESCENCE AND OPTICAL COHERENCE TOMOGRAPHY: INSIGHTS INTO PATHOGENESIS AND IMAGING CORRELATES

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ABSTRACT

Near infrared autofluorescence (NIA) and optical coherence tomography (OCT) have emerged as valuable imaging modalities for assessing central serous chorioretinopathy (CSC), exhibiting patterns similar to fluorescein angiography (FA). In this study, spectral-domain ophthalmologic examinations were conducted on patients with a minimum history of 7 months of CSC. Seventeen eyes from thirteen patients were included, presenting with characteristic features such as pigment mottling and mottled hyperfluorescence on FA. NIA images revealed localized areas of hypoNIA corresponding to leaky points observed on FA, alongside hyperNIA resembling findings on fundus autofluorescence (FAF). OCT scans demonstrated detachment of the pigment epithelium at these hypoNIA spots. Additionally, during FAF, increased fluorophore presence was detected in areas of retinal detachment, potentially indicating lipofuscin accumulation in retinal pigment epithelium (RPE) or debris within subretinal fluid. Furthermore, the quantity of NIA in choroidal melanin correlated with areas of both increasing and decreasing NIA, suggesting underlying RPE and choroidal involvement. The presence of pigment epithelial detachments (PEDs) in hypoNIA areas further supports the hypothesis of CSC as a primary choroidal disease. These findings highlight the utility of NIA and OCT in elucidating the pathogenesis and characteristics of CSC, offering insights into its underlying mechanisms.

Key words: Central serous chorioretinopathy (CSC), Near infrared autofluorescence (NIA), Optical coherence tomography (OCT), Fluorescein angiography (FA), Pigment epithelial detachments (PEDs).

INTRODUCTION

It affects mostly young to mid-aged adults, with multiple leaks at the level of the retinal pigment epithelium (RPE) and effects the macular region as well [1]. Central serous chorioretinopathy (CSC) is a type of retinal detachment that causes the neurosensory retina to separate from the epithelium. It is common for patients to report micropsia, metamorphopsia, and blurred central vision [2]. There has been a link between it and idiopathic syndromes [3, 4] associated with systemic corticosteroid therapy. CSCs usually resolve spontaneously within six months, giving a positive outlook on the visual side of the process [5]. Macular detachments associated with prolonged or recurrent degeneration of the subfoveal RPE and neurosensory retina have been reported to have poor vision outcomes [6]. There are few histopathological studies on CSC, which limits our understanding of the disease.

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Several investigational and diagnostic tools have been used to learn more about the mechanism of this disease, including fluorescein and indocyanine green angiography [7]. There is a correlation between visual acuity and the resolution of central serous chorioretinopathy on the basis of optical coherence tomography (OCT) [8], and between the amount of visual loss and the resolution of central serous chorioretinopathy [9]. It is possible to take functional images of a fundus via fundus autofluorescence and photoreceptor imaging (488 nm) by stimulating the endogenous fluorophores, such as lipofuscin. It is believed that lipofuscin is formed by phagocytosis of photoreceptor outer segments and altered molecules within lysosomes of RPE cells [10, 12]. The RPE, choriocapillaris, and choroid can also be studied by near-infrared fundus autofluorescence imaging (787 nm) using melanin fluorescence [13]. This study aimed to analyze NIA and SD-OCT findings as well as correlate them with fluorescein angiography (FA). In order to correlate clinical findings with imaging modalities, especially NIA, the first study has been conducted.

MATERIALS AND METHODS

Every patient underwent LED spectral-domain imaging along with ophthalmological examinations, color fundus photography, fluorescein angiography, and spectral-domain OCT (SD-OCT). SD-OCT used volume as the OCT protocol. Each patient's volume size was customized. An HRA2 system was used to perform FAF, NIA, and FA imaging. Images were recorded at 488 nm and 787 nm using a barrier filter that detects emitted light above 500 nm and 787 nm, respectively. A minimum of five 512 x 512 pixel single AF images were acquired using each technique. After detecting and correcting eye movements, several images were aligned and a mean image calculated. As compared with background fundus AF, AF abnormalities were defined as either hyperautofluorescence, hypoautofluorescence, or mixed autofluorescence (no specific predominance) [13].

RESULTS

In this study, we studied 34 eyes from 26 patients with CSC, 16 males and 10 females, ranging in age from 28 to 55, who presented with a mean complaint time of 14.9 months, from 8 months to 3 years. (mean age 37.5 years). At least four individuals had used steroids in the past, but had stopped using them for at least six months. There were 30 patients with relapsing disease and 4 patients in the first episode. The fluorescein angiography revealed focal leakage in 16 (49%) of the eyes, multifocal leakage in 2 (7.7%) eyes, multiple window defect in 8 (25.7%) eyes, and no leakage in 8 (25.7%) eyes. Serous retinal detachments were found in ten eyes. Among those, one presented with multifocal leakage, seven suffered focal leakage, and two developed RPE changes and multiple windows defects. In fourteen of the detached areas, hyper FAF was detected (70%), mixed FAF in four (20%), and hypo FAF in two (10%). A hypo NIA was seen in 10 (50%), a mixed NIA in 4 (20%), and a hyper NIA in 6 (30%). At FA, there were 12 areas of window defects, where hyper FAF was found (75%), mixedFAF was found in two eye (14.7%) and hypoFAF in another (75%). In terms of NIA of the window defects, we found 10 hypoNIA (64.7%) and 6 mixedNIA (39.7%). A total of 24 (72.8%) eyes showed hyperFAF, six (19.8%) eyes showed hypoFAF, and four (13.1%) eyes showed mixed FAF. Eight (25.7%) of the NIA images showed hyperNIA, twenty (56.1%) showed hypoNIA, and six (19.8%) showed mixed NIA. A hypoNIA was seen in 24 of 26 eyes with the leakage. At the leakage site, hypoFAF was found in six eyes. The autofluorescence alterations followed leakage and RPE damage to the perimacular region. There were 20 foveal neurosensory retinal detachments (56.1%) detected on the Spectralis OCT images. Foveal retinal thickness ranged from 220 to 533 µm, with 332.6 µm as the mean. An additional 44 pigment epithelium detachments (PEDs) were found in 30 of 34 eyes in 22 of the 26 patients. There were 24 foveals (56.7%) and twenty extra foveals (47.6%). In 10 eyes, we observed substantial RPE irregularities with undulations, four of which were PED-free. HyperNIA spots were detected in 16 (38.6%) of the PEDs and 28 (65.8%) of the hypoNIA sites in NIA images. 14 of 28 PEDs with hypoNIA images were identified as hyperNIA rings by us (33.1% of all PEDs). The PEDs corresponded exactly with leakage spots detected in FA in 28 (65.8%) cases, and 14 (33.1%) cases corresponded with window defects in FA, while 2 (6.7%) PED was not correlated with FA alterations. A hyperNIA point was found in ten PEDs (37.9%), a hypoNIA with a hyperNIA "ring" in eight (26.8%), and a hypoNIA without a ring in ten (37.9%) of the 28 PEDs that correlated with leaked spots.

Table 1: FAF and NIA %

		FAF (%)			NIA (%)	
	hypoFAF	Mixed FAF	Hyper FAF	Hypo NIA	Mixed NIA	hyperNIA
Detached area	10	20	70	30	20	50
Leakage spot	25.3	-	78.7	94.5	-	9.9
Window defect area	14.7	14.7	77	64.7	34.7	0
Overall image	19.8	13.1	72.8	56.1	19.8	25.7
PED	-	-	-	65.8	-	38.6

DISCUSSION

HRA2 rarely uses this method, but its role in studying the choroid and outer retina has been described previously [13]. NIA has recently been demonstrated to be a reliable method for assessing RPE in AMD. [14]. In conditions like CSC, where the choroid plays a primary role, it can be beneficial. As demonstrated in this study, in NIA images, most hypofluorescent spots were caused by detachments of the pigment epithelium on OCT and leakages on fluorescein angiography. The hypoNIRAF spot accounted for leakage in 12 (70.6%) eyes. In 31.8% of all PEDs, hyperNIA rings are found around hypofluorescent spots, which may be caused by the PEDs or local RPE folding, but further investigation will be necessary to confirm this. It was concluded that accumulation of lipofuscin and other fluorophores caused hyperFAF in most cases. The correlation was much weaker if only three eyes had a hypoFAF spot and 12 eyes had a hypoNIA spot, according to a study. [15]. It was reported [16] that serous retinal detachment and leakage in acute CSC often resulted in hypoNIA. Angiograms with hypoNIA spots did not leak, suggesting that chorioretinal disturbance may be more extensive than originally thought.

CONCLUSION

A choroidal etiology was suspected because hipoNIA spots were inconsistently occult or no leaks were detected. NIA images were correlated by OCT, and all hipoNIA spots indicated an irregular PED or RPE. CSC recurrence, persistence of retinal detachment and symptoms are sometimes related to leakage from PED spots, which can cause leakage and lower absorption of RPE in some cases, causing CSC recurrence and symptoms. In this study, chronic CSC eyes are evaluated retrospectively, not in a controlled or randomized fashion. To confirm these preliminary results, a larger sample of cases, including acute cases, is warranted.

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