



The Importance of Assessing Dark Adaptation in Patients with Age Related Macular Degeneration

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Introduction

Age-related macular degeneration (AMD) is the leading cause of severe vision loss worldwide [1]. It is estimated that approximately 30% of adults older than 75 years have some sign of AMD, with approximately 10-15% of these patients have advanced stages of the disease [2]. AMD simplest classification comes in two forms: non-neovascular (dry) and neovascular (wet/exudative) [3]. The clear majority of cases are accounted by the non-neovascular in 80-90% of cases, while the neovascular form accounts for 10-20% of cases, being more severe, it accounts for 80% of severe vision loss in AMD patients [4]. There have been reports that up to 70% of patients are unaware that they have AMD until they are diagnosed with late-stage disease [5]. There have been numerous attempts to establish reliable functional outcome measurements in AMD, including contrast sensitivity, low luminance visual acuity (VA), photopic or scotopic light sensitivity and dark adaptation (DA) [6]. While patients with early to intermediate AMD typically have a good best corrected visual acuity (BCVA), impaired vision is a common self-reported problem [3]. There are reports showing that higher levels of self-reported problems in night vision are associated with an increased risk of vision loss [7].

Recent studies have shown that DA can differentiate AMD from healthy eyes, as well as detecting and categorizing the different stages of the disease [7].

Dark Adaptation

The dramatic impact of AMD on dark adaptation speed appears to be caused by the lipid-rich cholesterol deposits within the RPE/Bruch's membrane layer, which drive the basis of drusen formation and disturb the retinoid cycle in the rod photoreceptors [8]. This pathophysiologic basis suggests that dark adaptation may serve as an early diagnostic indicator of AMD. The reported sensitivity has been estimated to be greater than 80% in multiple independent studies, with specificity estimated to be more than 90% [9]. Previously, dark adaptometry's utility as a useful diagnostic tool was hampered by long and cumbersome test duration, with subsequent patient burden and lack of standardized adaptometers. With previous systems requiring up to an hour of test time and more than 100 threshold estimates [10].

Rapid Dark Adaptation Test (6.5 Minutes)

This test was validated by Jackson et al. [9] in which he found that rapid dark adaptation test can be used to detect abnormal dark adaptation associated with AMD. Reaching a sensitivity and specificity of > 90%. One of the interesting features of this new test is the usage or the rod-intercept, which provides a simple, objective interpretation of dark adaptation speed. The use of this test as a screening tool in primary eye care services would theoretically increase the likelihood of diagnosis of early AMD.

AdaptDx (MacuLogix, Hummelstown, PA)

To perform the test, the patient's eyes are dilated to 6 mm by using 1% tropicamide and 2.5% phenylephrine hydrochloride. The patient needs to be refracted prior to the test so that corrective lenses can be used as appropriate for the 30 cm viewing distance to correct for blur. The fellow eye is covered with an eye patch. An Infrared camera displays an image of the eye on the operator control system. The patient's eye is bleached by exposure to a 505 nm photoflash (0.8-ms duration, 1.8×10^4 scotoma $\text{cd}/\text{m}^2 \text{ s}$ intensity). This is equivalent to 76% bleaching level for rods. The patient has 2 seconds to respond to the stimulus by pushing a response button. For each indication that a stimulus is visible, the intensity is decreased for each successive presentation in steps of 0.3 log units until there are no more responses. At this point the target intensity is increased in 0.1 log units until

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Received Date: 05 Dec 2017

Accepted Date: 20 Jan 2018

Published Date: 01 Feb 2018

Citation:

Tolentino M, Paez-Escamilla M,
Deupree E, Deupree DM. The
Importance of Assessing Dark
Adaptation in Patients with Age Related
Macular Degeneration. *Ann Clin Case
Rep.* 2018; 3: 1501.

ISSN: 2474-1655

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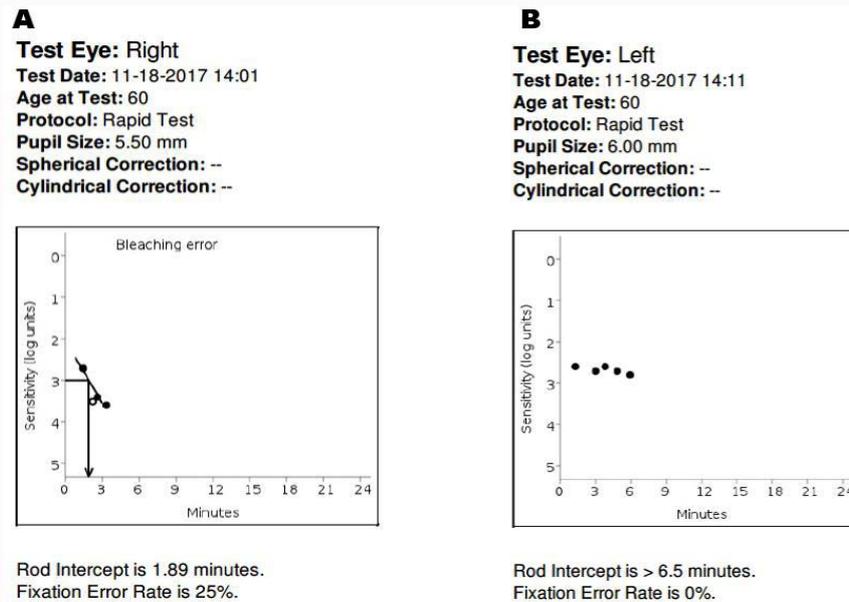


Figure 1: An example of a dark adaptation test performed in the same patient. Figure 1A shows a normal test result performed in the right eye. There is a rod-intercept of 1.89 minutes; which is considered normal, a fixation rate of less than 30% is also considered normal. Figure 1B shows the left eye of the same patient, in which the rod-intercept was > than 6 minutes, clinically the left eye showed damage consistent with moderate macular degeneration.

the patient responds again. This intensity is defined as a threshold. Successive threshold measurements start with the stimulus intensity at 0.2 log units brighter than the previous threshold measurement (Figure 1).

Conclusions

Night vision and low illuminance vision encountered in early AMD is a clinically significant problem similar to visual acuity impairment encountered in late-stage AMD. Dark adaptation is a suitable primary endpoint that aids in the evaluation of treatment efficacy aimed at AMD management.

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