Dietary Prevention of Adult Macular Degeneration
ω-3 Fatty Acids and Antioxidants

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Abstract

Adult macular degeneration (AMD) is the leading cause of blindness in those over 55 in the United States (US). Treatment of AMD is not very successful, therefore finding ways to prevent or slow the progression of the disease is important. The development of AMD is described in this chapter. Because the pathogenesis is thought to begin with hardening of the retinal arteries, dietary research has focused on fats and antioxidants that have been shown to be effective in decreasing the risk for cardiovascular disease.

Lowering total fat, saturated fat, and trans fats in the diet and improving the balance ω-3: ω-6 fatty acid ratio in the diet may help decrease inflammatory damage leading to AMD. The inflammatory cascade is described with emphasis on the role of ω-3 and ω-6 fatty acids. Docosahexaenoic acid (DHA) is an ω-3 fatty acid found in abundance in the retina; increasing intake of DHA, particularly from fish also decreases the risk of developing AMD. Antioxidants in the diet, particularly vitamins A, C, E, and zinc, may help decrease oxidative damage in the retina that could lead to AMD. Current recommendations for decreasing risk factors for AMD are listed.

Key Words: Adult macular degeneration; diet; nutrition; ω-3 fatty acids; ω-6 fatty acids; antioxidants.

1. INTRODUCTION

Adult macular degeneration (AMD) is the leading cause of blindness in the United States (US). It is estimated that it will reach epidemic numbers with the aging of baby boomers. There are approx 15 million people with AMD in the US. Of these, 1.5 million have the most severe form of AMD (1). A new case of AMD is diagnosed every three minutes in the US (2). The socioeconomic and emotional impact of AMD on individuals because of its reading and driving capability impairment is particularly high, making it an important public health issue. It is estimated that by the year 2020, there will be almost 3 million people with severe AMD in the US (3). While many ways of treating AMD are under study, currently less than 1% of people with AMD are treated successfully. Increasing ω-3 fatty acids and antioxidants in the diet may play a role in the prevention of AMD or in slowing its progression.

AMD occurs primarily in people over the age of 55. The macula of the retina, the concentrated area of photosensitive cells which enables us to see colors and fine details, begins to lose function leading to blurred, distorted or lost vision in the center of the...
visual field (4). Because the brain compensates so well for loss of vision in the early stages of AMD, diagnosis tends to be made only after much damage has occurred and is therefore difficult to treat successfully.

To understand the mechanisms of the damage that cause AMD, one must first understand the anatomy and physiology of the macula in the retina. The macula is a small portion of the retina in the back of the eye. The macula is responsible for central vision. The fovea is the sensitive portion of the macula; it is about the size of the period at the end of this sentence and is the focal point of damage in AMD. The retina lies on top of a network of blood vessels called the choroid, the microvasculature of the eye, which supplies oxygen and nutrients to the retina as well as removes waste products away from the retina. Between the retina and the microvasculature is a compact layer of fibers, called Bruch’s membrane, which provide structural support for the retina and elasticity to help protect this delicate tissue from damage. Nutrients, oxygen and wastes travel unimpeded through Bruch’s membrane in the healthy eye. The transfer of oxygen and nutrients into the retina is aided by small pumps in the retinol pigment epithelium (RPE)—a single layer of cells between the retina and Bruch’s membrane.

As one ages, the small vessels of the microvasculature of the eye can harden, preventing waste products from the macula from being adequately removed and decreasing oxygen and nutrient supply to the macula. Waste material accumulates in Bruch’s membrane in small pockets called drusen. As drusen accumulates, it causes the macula to bow upwards, further away from its blood supply, decreasing further the exchange of toxins, oxygen and nutrients. It is this debris accumulation, drusen, and lack of normal blood flow that cause AMD.

There are two forms of AMD: dry and wet. According to the Macular Degeneration Foundation there are 13.5 million Americans with dry AMD and 1.5 million with the wet form of AMD. Dry AMD is caused from this debris accumulation and decreased blood flow. The physical distortion of the retina from being pushed upward causes visual distortion and some loss of vision. As the lack of blood flow and decreased removal of debris continues, further bowing of the retina causes more visual distortion and vision loss. Ten percent of those with dry AMD will go on to develop the wet form of AMD: as the body tries to restore blood flow to the retina, blood vessels begin to grow up into Bruch’s membrane. Drusen is then reabsorbed by these blood vessels. Unfortunately these vessels are not as strong as normal vasculature and begin to leak fluid into the pocket created from the reabsorbed drusen, pushing the macula upward. This resembles a blister formation. As images are projected onto this uneven and distorted surface of the retina, the image itself is seen as uneven and distorted. Eventually these new blood vessels break through the RPE and leak fluid into the space directly under the photosensitive cells. Further ballooning upward of the macula continues with blood leakage into the area, eventually causing scarring and severe vision loss. These are called disciform scars.

Because the pathogenesis of AMD is thought to begin with hardening of the arteries supplying the retina, it is believed that the same mechanisms that cause coronary atherosclerosis may lead to AMD. Thus looking at fats and antioxidants in the diet may help provide some preventive dietary measures for AMD just as these dietary factors can be modified to decrease heart disease risk.

It is also known that a particular type of fatty acid, docosahexaenoic acid, DHA, a long-chain ω-3 fatty acid, plays a role in visual development in utero and is abundant in