Subthreshold Diode Micropulse Laser Photocoagulation (SDM) as Invisible Retinal Phototherapy for Diabetic Macular Edema: A Review

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Abstract:

Purpose: To present the state-of-the-art of subthreshold diode laser micropulse photocoagulation (SDM) as invisible retinal phototherapy for diabetic macular edema (DME).

Method: To review the role and evolution of retinal laser treatment for DME.

Results: Thermal laser retinal photocoagulation has been the cornerstone of treatment for diabetic macular edema for over four decades. Throughout, laser induced retinal damage produced by conventional photocoagulation has been universally accepted as necessary to produce a therapeutic benefit, despite the inherent risks, adverse effects and limitations of thermally destructive treatment. Recently, SDM, performed as invisible retinal phototherapy for DME, has been found to be effective in the absence of any retinal damage or adverse effect, fundamentally altering our understanding of laser treatment for retinal disease.

Summary: The discovery of clinically effective and harmless SDM treatment for DME offers exciting new information that will improve our understanding of laser treatment for retinal disease, expand treatment indications, and improve patient outcomes.

Keywords: Subthreshold, invisible, diode laser, micropulse, photocoagulation, phototherapy, photostimulation, diabetes, diabetic retinopathy, diabetic macular edema.

INTRODUCTION

Information theory states that the amount of information available from a particular event is directly proportional to the unlikelihood of that event occurring [1]. It can be argued that selective burning of the retina with lasers has represented the single most important advance in the treatment of retinal disease. That iatrogenic retinal damage is necessary for effective laser treatment of retinal vascular disease has been universally accepted for almost 5 decades, and remains the prevailing notion [2]. Given the longstanding uniformity of opinion regarding the essential role of laser-induced retinal damage, the finding that retinal laser treatment that does not cause any laser-induced retinal damage can be at least effective as conventional retinal photocoagulation is unexpected, and thus powerfully informative [3-10]. If using lasers to burn the retina represents the seminal advance in the treatment of retinal disease, then learning that those retinal burns are unnecessary may constitute another significant advance, one that may fundamentally alter our understanding of retinal laser treatment for retinal vascular disease and the disease process.

We will examine this invisible retinal phototherapy, currently epitomized by subthreshold diode micropulse (SDM) laser treatment, in the treatment of diabetic macular edema (DME).

Epidemiology of DME

DME is the most common cause of visual loss in persons under 50 years of age in the developed world. Diabetes mellitus (DM), the cause of diabetic retinopathy and thus DME, is increasing in incidence and prevalence worldwide, becoming epidemic not only in the developed world, but in the developing world as well. Diabetic retinopathy may begin to appear in persons with type I (insulin-dependent) DM within 3 – 5 years of disease onset. By 20 years, nearly 100% will have some degree of diabetic retinopathy. While the retinal complications of diabetes can be attenuated by long-term intensive glycemic control, the prevalence of diabetic retinopathy increases with duration of disease. By 10 years, between 14 – 25% of patients will have DME [11-13]. Untreated, patients with "clinically significant" DME have a 32% 3-year risk of potentially disabling "moderate" visual loss, defined as doubling of the visual angle [14]. In addition to individual disability, the social and economic costs of the global diabetes pandemic – and thus DME – can hardly be overestimated.

Conventional Thermal Macular Photocoagulation for DME

Until the advent of thermal retinal photocoagulation there was no generally effective treatment for diabetic retinopathy. Using photocoagulation to produce photothermal retinal

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