COMPUTER CONTROLLED SYSTEM FOR LASER ENERGY DELIVERY TO THE RETINA

I. PRIORITY CLAIM

This application claims the benefit of U.S. Provisional Application Ser. No. 61/116,931 filed on Nov. 21, 2008.

II. FIELD OF THE INVENTION

The present invention is in the field of computer controlled systems for laser energy delivery to the retina.

III. BACKGROUND OF THE INVENTION

Laser retinal injury hazards are present in a variety of military settings. Incident reports abound from adversarial cockpit illumination to battlefield laser rangefinders and target designators as well as episodes of laser injury in government laboratories involved with high energy physics research or other scientific pursuits. Stuck, B. E., H. Zwick, J. Molchany, D. Lund, D. A. Gagliano, "Accidental human laser retinal injuries from military laser," SPIE 2674(7), pp. 7-20 (1996); Zwick H, B. E. Stuck, W. Dunlap, D. K. Scales, D. J. Lund, J. W. Ness, "Accidental bilateral Q-switched neodymium laser exposure: Treatment and recovery of visual function," SPIE 3254, pp. 80-89 (1998). The development of subretinal neovascular membranes represents one of the most vision threatening complications of laser injury.

Currently, treatment of neovascular membranes involves patient rotation through separate stations in order to first diagnose then perform therapeutic membrane ablation using photodynamic therapy (PDT). Treatment involves a cut and paste methodology, with eye care providers estimating lesion size from images generated by the initial patient evaluation. Therapy then occurs with a separate instrument in the general vicinity of suspected retinal involvement. This frequently leads to missing portions of the neovascular membrane resulting in further vision loss and the need for repeat treatments. Thus, current schemes for application of light to produce dye-activation often result in under-treatment and recurrence of the underlying neovascular membrane.

IV. SUMMARY OF THE INVENTION

An embodiment of the invention provides a computer controlled system for laser energy delivery to the retina. More specifically, a method according to an embodiment of the invention captures a diagnostic image of a retina having at least one lesion, wherein the lesion includes a plurality of spots to be treated. Information is received from a user interface, wherein the information includes a duration, intensity, and/or wavelength of treatment for each of the spots. The position and/or size of the spots are determined automatically using an indicator dye locator and/or manually using the user interface. A real-time image of the retina is captured using eye tracking and/or image stabilization techniques. A composite image is created by linking the diagnostic image to the real-time image. At least one updated real-time image of the retina is obtained using eye tracking and/or image stabilization software; and, an annotated image is created by modifying the composite image based on the updated real-time image. A localized laser beam is delivered to each of the spots according to the information, the composite image, and the annotated image.

A device according to an embodiment of the invention includes a retinal imager for capturing a diagnostic image of a retina having at least one lesion, wherein the lesion includes a plurality of spots to be treated. The retinal imager also captures a real-time image and updated real-time images of the retina using eye tracking and/or image stabilization. In at least one embodiment, the indicator dye locator determines the position and/or size of each of the spots. A user interface is provided for receiving information. The information includes a duration, intensity, and/or wavelength of treatment for each of the spots. In at least one embodiment, the information includes the position and/or size of each of the spots. The device further includes a processor for creating a composite image by linking the diagnostic image to the real-time image. The processor also creates an annotated image by modifying the composite image based on the updated real-time image. A laser is provided for delivering a localized laser beam to each of the spots according to the information, the composite image, and the annotated image.

V. BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is described with reference to the accompanying drawings. In the drawings, like reference numbers indicate identical or functionally similar elements.

FIG. **1** illustrates a combination SLO/PDT (scanning laser ophthalmoscope/photodynamic therapy) laser therapy instrument;

FIG. **2** illustrates a flow diagram illustrating operation of a computer controlled system for laser energy delivery to the retina;

FIG. **3** illustrates an example of focal laser treatment;

FIG. **4** illustrates an example of scatter laser sector treatment;

FIG. **5** is a flow diagram illustrating a method according to an embodiment of the invention; and

FIG. **6** is a schematic diagram illustrating a device according to an embodiment of the invention.

VI. DETAILED DESCRIPTION OF THE DRAWINGS

Exemplary, non-limiting, embodiments of the present invention are discussed in detail below. While specific configurations are discussed to provide a clear understanding, it should be understood that the disclosed configurations are provided for illustration purposes only. A person of ordinary skill in the art will recognize that other configurations may be used without departing from the spirit and scope of the invention.

With high performance digital video technology it is possible to diagnose and identify abnormal neovascular membranes in real-time, capture the precise location of the affected retinal tissue, and utilize the same optical pathway to precisely apply therapeutic photodynamic therapy. An advanced optoelectronic device is provided that allows for the precise application of photodynamic therapy. The basic science behind photodynamic therapy utilizes light to activate a photosensitizing parenterally administered dye that interacts with abnormal blood vessels through the formation and release of oxidizing free radicals. As a consequence of this reaction, neovascular membranes are shut down. This reduces the extension of the original laser eye injury into surrounding unaffected retinal tissue. Clinical application of this device also extends to uncommon wartime cases of punctate inner choroidopathy (PIC) associated with ocular histoplasmosis syndrome, as well as conventional clinical treat-