HISTOLOGICAL STUDY OF THE EFFECT OF ARGON LASER ON THE IRIS OF RABBITS

THESIS

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بسم الله الرحمن الرحيم

سبحانك لا علم لنا إلا ما علمتنا
إنك أنت العليم الحكيم

صدق الله العظيم

بسم الله الرحمن الرحيم

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To The Soul of My Father
To My Dear Mother
To My Family

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AND AIM OF WORK

Laser is a device that produces high intensity light of single wave length, and in such a fine parallel beam that it can be focused onto very small spot. The name is an acronym derived from: Light Amplification by Stimulated Emission of Radiation and the theoretical basis for this process was first proposed by Einstein in 1917 (L'Esperance, 1989).

Now the variety and applications of laser systems are going to encompass virtually every surgical speciality. In opthalmology, this provides one of the most widely used roles for the laser in medicine. The advent of ophthalmic laser instrumentation has provided the surgeon with the opportunity to cauterize, coagulate and photically incise portions of the eye in a relatively non-invasive manner.

Argon laser irridotomy is a full-thickness iris hole created by using the thermal laser energy to make the defect instead of open surgery. It is used in the treatment of angle closure glucoma and represents a major advance in surgical technique. This aperture should be permanent and its dimension should guarantee a channel of sufficient capacity for flow from the posterior to the anterior chamber. However, the most troublesome and one of the common complications of argon laser iridotomy is late closure of an initially successful iridotomy.

Although several clinical studies of the use of argon laser on the iris have been reported, yet the histopathological changes in the iris at various time intervals following laser photocoagulation have not been adequately documented.

So, the aim of this work is to describe the changes occurring in the iris of pigmented rabbits at various time intervals after exposure to argon laser. Description of the sequence of events which occur in the iris after laser iridotomy will be attempted after two hours, one week, one month and two months successively.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

PHYSICAL PROPERTIES OF LASER RADIATION

In nature, an atom or molecule has an innumerable number of levels or spectral lines, populated by photons. The atom can not exchange energy with its environment in a continuous manner; it can exist only in a stationary or ground state. In the ground or unexcited state, the electrons or photons are close to the nucleus and have less energy (Belcher et al., 1984).

If an atom in the ground state, and a radiation field containing photons of the appropriate wave length is incident upon it, it can absorb a photon and go into the excited state. In the excited state, photons orbit further from the nucleus and have more energy. So the energy absorbed will cause the electron to jump from an inner to an outer ring, placing the atom in an excited state. After sometime, this electron jumps from the outer ring back to the inner ring and a photon of fixed frequency is emitted i.e. spontaneous emission occurs and the atom will return to the stable ground state. This means that if atoms or molecules have their electrons, artificially excited above the ground state, (Fig. 1) by an external source of energy, they can return to the ground state spontaneously, reemitting the energy as a photon of light moving outward in any direction. This is called spontaneous emission of radiation (Beckman, 1985).

In addition, if an atom is already in the excited state and a photon of specific wave length is added, this will cause the electron in the outer ring to jump into a more inner ring and emit a photon of a frequency that is identical to the one by which it was stimulated. This process is called stimulated emission.

The energy radiated by stimulated radiation is in phase and coherent with the incident beam, in contrast with spontaneous emission which is emitted in any direction. So the trick involved in obtaining laser is to stimulate all of the photons emitted as the atoms return to the ground state to move in the same direction and in step with each other i.e. to have spatial and temporal coherence (Boulnois, 1986).

If an excited atom or molecule carrying a pact of energy collides with a photon that contains the same amount of energy (this incoming photon could have been produced from the spontaneous emission from another excited atom of the same material). The collision will cause the excited atom or molecule to liberate its photon of the same energy (and therefore same wave length) in the same direction as in the photon which collided with it. If however, we could achieve a condition where there are more atoms in an excited state than in the ground state, then if a beam of light is introduced, the beam will be amplified because the excited atoms would be stimulated into emitting photons in phase and coherent with the exciting beam (Fuller, 1987).

The basic requirements for attaining laser operation are (Fig. 2).

(1) The Laser Material:

This is the material from which laser light will be obtained. It can be:

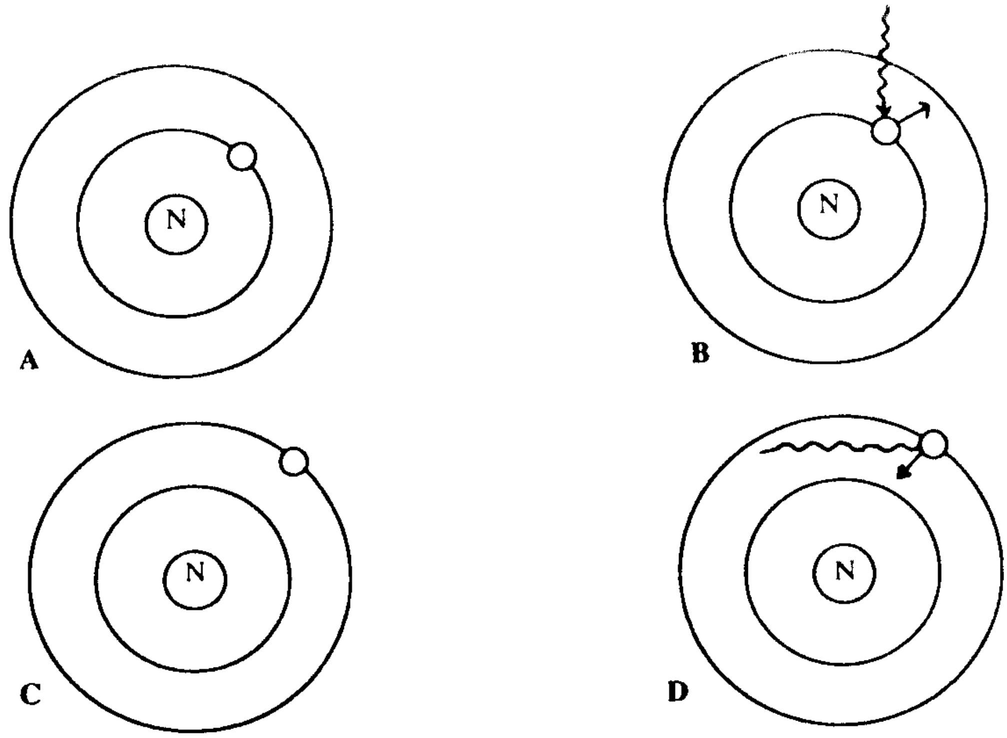

Fig. 1: (A) in the ground or unexcited state the electron orbits close to the nucleus. (B) when the electron is stimulated by external energy it becomes excited. (C) The excited electron jumps to an outer orbit. (D) The excited electron spontaneously drops back to the inner orbit emitting a photon of light energy in the process (Beckman, 1985).

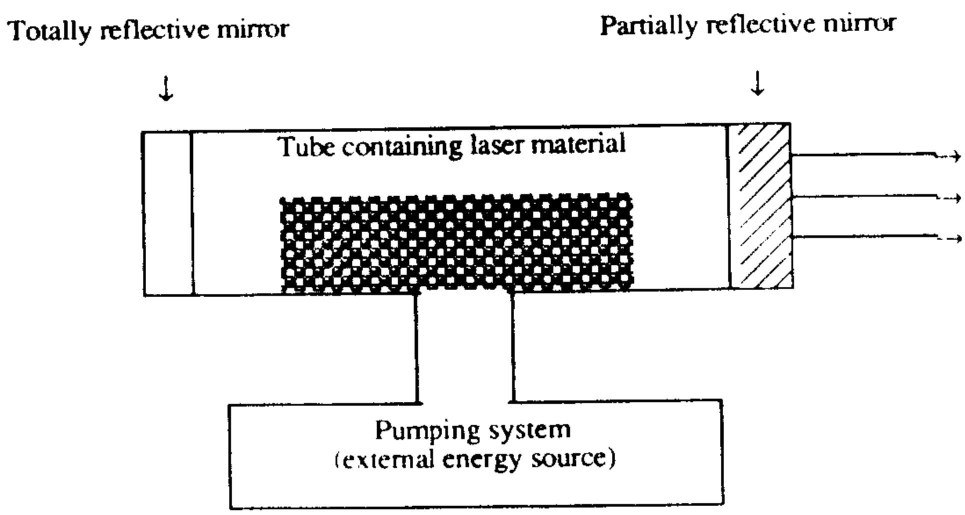

Fig. 2: Basic components of any laser system (Belcher et al., 1984).

a) Solid:

e.g. - A ruby crystal.

- Neodynium: Yattrium - Aluminium - Garnet (YAG) rod.

- Erbium YAG (Er: YAG).

b) Gas:

e.g. Argon

or Krypton.

or CO_2 (L'Esperance, 1969).

c) Liquid: e.g. organic dyes.

d) or intense rays: e.g. ultra violet radiation can be stimulated in a laser cavity by using a mixture of noble and halogen gases excited by a high current electrical discharge resulting in the excimer laser.

Different materials are associated with laser light outputs of sepcific wavelengths (Enderby, 1987).

N.B. The first source of photo-coagulating beam that received widespread clinical use was the xenon arc photocoagulator. Xenon arc lamps are one of the brightest continuous lamp sources. The colour spectrum of a xenon arc lamp closely resembles day light but it emits a wider spectrum with potentially hazardous emissions in the ultraviolet range (Trokel et al., 1983 and Peyman et al., 1985).

2. The pumping system:

It is the external energy placed into the laser material to stimulate the excited atom into emitting light coherent with the exciting light beam. This external energy is obtained from passing an electric current through the laser material or by accelerating electrons from an electron gun causing them to strike the laser material (Belcher et al., 1984).

3. The optical cavity (The laser tube):

The laser material is placed in an optical cavity that acts as a resonator, and more atoms are placed in an upper or excited state than in a lower state. The optical cavity consists of two mirrors carefully aligned to each other.One of these mirrors is totally reflective and the other is made partially reflctive so that some of the radiation will be allowed out of the cavity. Laser light is created when energy is pumped into the system and the specific atomic transitions occur in the laser material (Mainster et al., 1983).

Some of the excited atoms in the medium emit spontaneous radiation in various directions. Some of these radiation will hit one of the mirrors and return, passing through the medium. This re-entering radiation has exactly the correct wave length and will thus stimulate some of the atoms into emitting radiation, thus amplifying the beam. After the wave bounces back from the other mirror, it will be amplified as it passes through the medium again. Thus, a coherent beam is built up very quickly. Only waves propagating in directions closely