A STUDY IN LASER THERAPY IN WOUND INFECTION

THESIS

Submitted for Partial Fulfillment
of Master Degree in
GENERAL SURGERY

By

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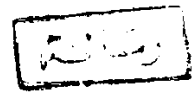

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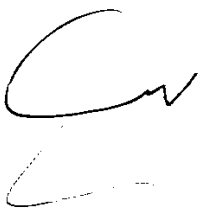

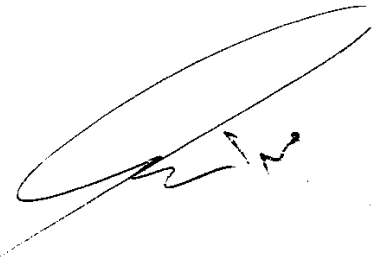

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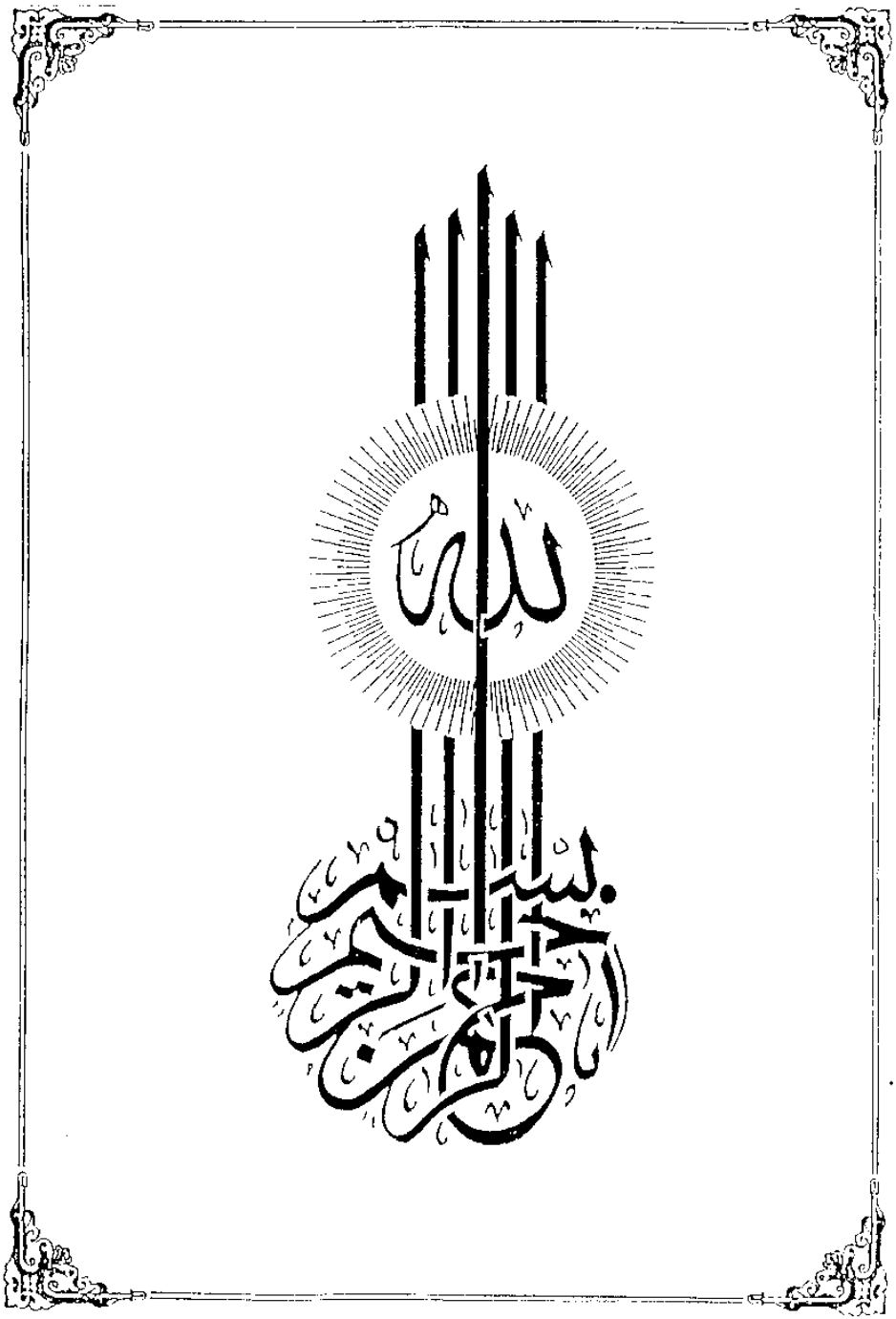

بسم الله الرحمن الرحيم

وقل اعملوا فسيرى الله عملكم
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INTRODUCTION

"Laser" is an acronym derived from Light Amplification by Stimulated Emission of Radiation. It is a device that produces high intensity light of single wavelength and in such a fine parallel beam that can be focused on to a very small spot. Lasers were soon developed to produce light of different wavelengths *(Cochrane, 1986).*

The small divergence and the high monochromaticity of laser light and the resulting possibility of concentrating a very high light intensity at the focal point of a lens are of decisive importance in laser therapy *(Frank, 1986).*

Now a wide range of solid, gas, liquids or vapors are available as a lasing media *(Evrard and Marescaux, 1995).*

The laser beam is parallel, coherent (wave all in phase) and monochromatic (single wave length). The beam is composed of coherent light that why very high concentration of energy can be achieved. Also it can pass down flexible optical fibers to gain access to areas such as gastrointestinal tract or bronchi *(Cochrane, 1986).*

The most important laser-tissue interactions are thermal. The laser acts as a means of delivering energy to tissue which is absorbed as heat. Heating of soft tissues causes thermal contractions of the treated areas. High energy kills the cell in situ and ultimately vaporises. Cellular material, leaving a crater

as the tissues shrinks, small vessels are sealed, which can stop hemorrhage *(Bown and Cross, 1988).*

However, the non thermal use of laser is the combination of a photosensitizing drug and light that can be used to destroy cancer cells. This is called photodynamic therapy. The most widely known and studied applications of thermal laser are the use of argon and Nd:YAG laser through flexible endoscope to stop gastrointestinal hemorrhage. Also laser has been used as thermal scalpel because it incises tissues and achieves hemostasis *(Weiman et al., 1986).*

"Laparoscopic cholecystectomy could be done safely and effectively with laser *(hunter, 1992).*

Laser is used successfully in plastic, breast vascular and urologic surgery.

Role of laser in wound healing:

It was found that, laser light promotes and accelerates healing of wound due to its biostimulatory effects on tissues and it induces neovascularization and neo-epithelization of the skin wound *(Bisht et al., 1994).*

Also it was found that, it has a bactericidal effects on the infectious organisms which delay wound healing *(Wilson et al., 1994).*

HISTORICAL REVIEW

The theoretical basis for laser was first proposed by *Einstein in (1917).* Initially it was applied as microwaves (the maser) and Basov and Prokhorovwon the Nobel prize for their work on this. *Schaum and Townes in (1958)* showed that the principle could be extended to visible light. *(Cochrane, 1986).*

In *(1961) Javan et al.* developed the first gas laser and demonstrated the first continuously operating laser using mixture of helium and neon. Also that year, using a neodymium (Nd.)-doped Yttrium-aluminum garnet (YAG) rod, Johnson developed a laser that emitted energy in the near infrared portion of the spectrum. The argon laser, emitting energy in the blue-green portion of the spectrum was developed by *Bennett et al. (1962).* The Co_2 laser emitting spectral energy in the far infrared portion, was also developed in 1964 by Patel et a. *(Fuller, 1987).*

In 1971 a surgeon named Goodale at the University of Minnesota described the first application of a laser to the gastrointestinal tract. In this patient, he performed open surgery and used a Co_2 laser to coagulate diffuse bleeding from the stomach in an attempt to avoid gastric resection. This article inspired other people in the world to look for the possibility of endoscopic delivery of laser energy for coagulation.

In 1976. Peter Kiefhaber was the first person in the world to coagulate a bleeding patient, using 1,064 micron

Neodymium:YAG laser. In July 1985, Rich and Dwyer was again the first in treating tumors and bleeding using 1,319 micron Nd:YAG laser *(Dwyer, 1986)*.

TYPES OF LASERS

Laser are named after the lasing medium they contain because it is the medium that gives them their particular characteristics such as wavelength and power *(Cochrane, 1986).*

Table (1) lists the most commonly used medical and surgical lasers and their corresponding characteristics. Some lasers (dye lasers) are capable of generating a range of wavelengths. These devices permit the continuous selection of any wavelength within the range. Currently a continuous wave dye lasers are limited to relatively low power applications. A highly experimental, free electron laser is theoretically capable of producing electromagnetic radiation of great intensity throughout most of the electromagnetic spectrum, although current devices are severely restricted in the wavelength. Improvements in these and other lasers hold great promise for the future *(Fuller, 1987).*

Table (1) :

Characteristics of medical lasers.

Laser type	Wave length (UM)	Power range W (joules)	Mode	Delivery system
Co_2	10.600	0.1-100	CW and pulsed	Direct couple to microscope articulated arms Experimental fiberoptics.
Nd:YAG	1.06	5-120	CW and Q-switched	Fiberoptics
Ruby	694	(> 30 J)	Pulsed	Direct couple to microscope
Doubled and glass	503	(> 3 J)	Pulsed	Direct couple to microscope.
Argon	458-515	0.001-25	CW and pulsed	Fiberoptics (hand held and microscope).
Dye	400-700	0.001-6	CW	Fiberoptics

CW = Continuous Wave *(Fuller, 1987).*