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# Histological Study on The kidney and Testis Tissues of Rat by Using Different Types of lasers

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***Abstract*— This study is focusing on studying the effect of different types of lasers on the Kidney and testicles tissues of rat .Co2 laser,635nm laser diode , 785nm laser diode , 405 nm laser diode and 532 SHG Nd:yag Laser were used to exposure these tissues and study the effect of laser on the histology of the rat's organs. So , these study can give the orientation about these tissues' interaction with different types of lasers.**

***Index Terms*— rat's organs, histology, different lasers types.**

## I. INTRODUCTION

Laser light entering the biological tissue is either scattered or absorbed. Scattering is a process by which energy in a beam is redirected without a change in its wavelength. The new direction of the emitted beams from the surface of the refracting particles depend s on the size and shape of the molecules in question as well as the wavelength of the radiation.

In general, scattering and absorption affect the distribution of photons in the tissue target, but
absorption alone determines the effect of the radiation.
Absorption of a photon may alter the
electronic structure of a molecule. The electrons on the outer shell will jump to a higher energy level. An excited molecule usually looses the excess energy when:

- It participates in a chemical reaction (photochemical one)
- It collides with another molecule or atom
- It releases a photon in a spontaneous emission

The excess electron energy is converted into increased relative motion which in turn leads to heat production – thermal effect Photons from infrared radiation differ from ultraviolet and visible light radiation because in addition to depositing their energy by exciting molecular electrons to higher energy levels, they can also directly transfer energy to the vibrational energy levels of irradiated molecules[1].

Since the large scale heat phenomenon is equivalent, at an atomic level, to the kinetic energy of atoms and molecule, the light absorption converts photon energy to heat energy and the target tissue temperature increases.

Furthermore, since vibrating molecules collide with and transfer energy to neighboring molecules, heat energy quickly diffuses to an area much larger than the initially irradiated one.

In general, molecules in biological tissues are opaque to ultraviolet radiation at wavelengths shorter than 300 nm and have strong vibrational absorption bands for infrared radiation at wavelengths great than about 1300 nm. Between 300 and 400 nm only a limited number of bio-molecules have moderate absorption. Most bio-molecules are effectively transparent between 400 and 1300 nm. Difference in the spectral absorption properties of different molecules permits selective damage to specific components of a target tissue.

Laser effects in biological tissues may be divided into three general categories[1]:

(1) Photochemical,
(2) thermal,
(3) ionizing.

## II. ABSORPTION

During absorption, the intensity of an incident electromagnetic wave is attenuated in passing through a medium. The absorbance of a medium is defined as the ratio of absorbed and incident intensities. Absorption is due to a partial conversion of light energy into heat motion or certain vibrations of molecules of the absorbing material. A perfectly transparent medium permits the passage of light without any absorption, i.e. the total radiant energy entering into and emerging from such a medium is the same. Among biological tissues, cornea and lens can be considered as being highly transparent for visible light. In contrast, media in which incident radiation is reduced practically to zero are called opaque.

The terms "transparent" and "opaque" are relative, since they certainly are wavelength-dependent. Cornea and lens, for instance, mainly consist of water which shows a strong absorption at wavelengths in the infrared spectrum.

Hence, these tissues appear opaque in this spectral region. Actually, no medium is known to be either transparent or opaque to all wavelengths of the electromagnetic spectrum.

A substance is said to show general absorption if it reduces the intensity of all wavelengths in the considered spectrum by a similar fraction. In the case of visible light, such substances will thus appear grey to our eye. Selective absorption, on the other hand, is the absorption of certain wavelengths in preference to others. The existence of colors actually originates from selective absorption. Usually, body colors and surface colors are distinguished.

Body color is generated by light which penetrates a certain distance into the substance. By backscattering, it is then

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deviated and escapes backwards from the surface but only after being partially absorbed at selected wavelengths.

In contrast, surface color originates from reflection at the surface itself. It mainly depends on the reflectances which are related to the wavelength of incident radiation .

The ability of a medium to absorb electromagnetic radiation depends on a number of factors, mainly the electronic constitution of its atoms and molecules, the wavelength of radiation, the thickness of the absorbing layer, and internal parameters such as the temperature or concentration of absorbing agents[1].

## III. MATERIAL AND METHOD(HISTOLOGICAL STUDY)

The wavelength and absorption of the kidney is measured by the spectrophotometer as shown in figures below:

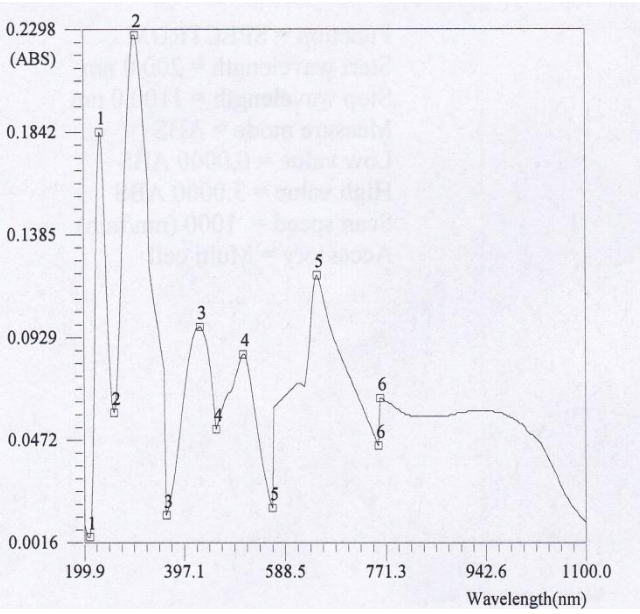



Figure1.wavelength of kidney as measured in spectrophotometer**.**

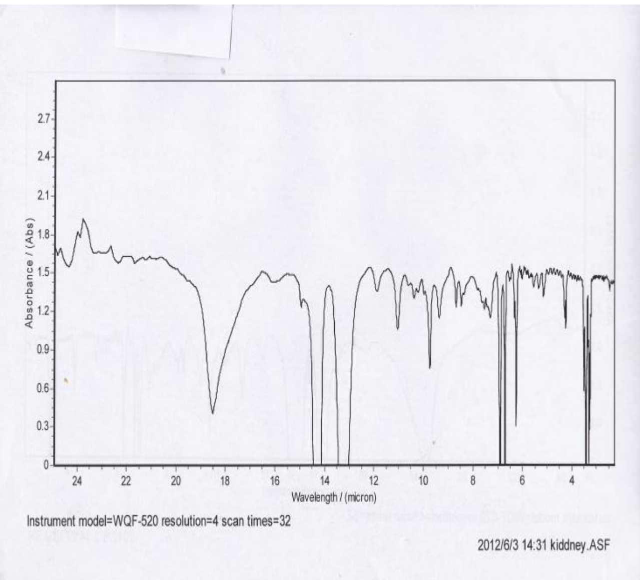



Figure2.Absorbance of kidney**.**

So the wavelength and absorbance of testis can be measured by spectrophotometer as shown in figures below:

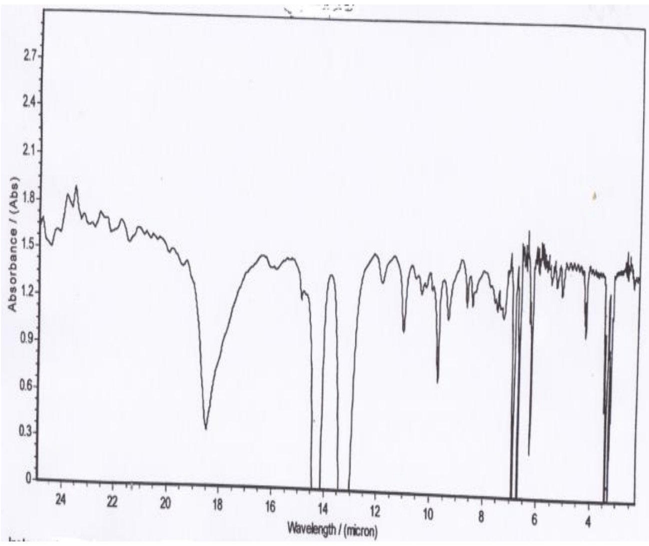



Figure3.Absorbance of testis**.**

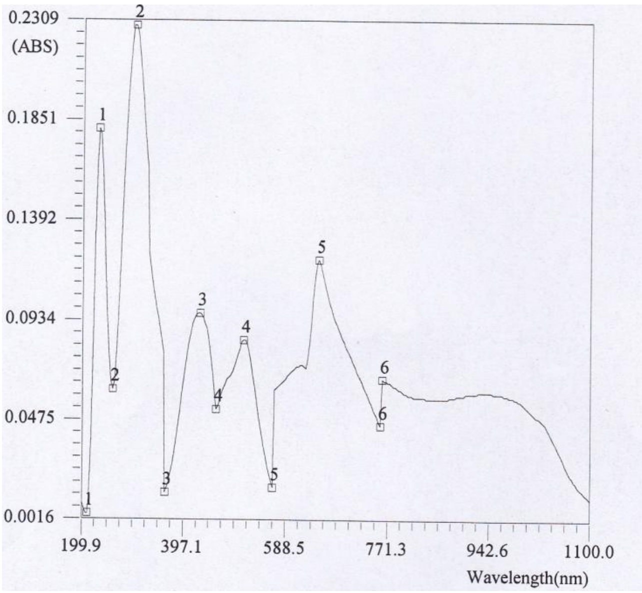



Figure4. wavelength of testis as measured in spectrophotometer**.**

### A. *Co$_2$ Laser:*

The carbon dioxide ($CO_2$) laser was first introduced in 1964 by Patel and has been extensively used in the next two decades as an incision tool in increasingly wide areas, such as neurosurgery, dermatology and plastic surgery, ophthalmology, gynecology, and general surgery. Currently, the $CO_2$ laser is considered an indispensable piece of diagnostic and therapeutic equipment. The $CO_2$ laser produces a beam of infrared light with the principal wavelength bands centering at 10,600 nanometers. Collisional energy transfer between the nitrogen and the carbon dioxide molecule causes vibrational excitation of the carbon dioxide, with sufficient efficiency to lead to the desired population inversion necessary for laser operation. It is easy to actively Q-switch a $CO_2$ laser by means of a rotating mirror or an electro-optic switch, giving rise to Q-switched peak powers up to giga watts (GW) of peak power. $CO_2$ lasers are attracting attention as cutting tools. They are able to seal lymphatic and blood vessels less than 0.5-mm wide and can reduce intraoperative bleeding and the occurrence of postoperative swelling [2].

The high power $Co_2$ laser(10W) was used in the histological study of rat's living organs as shown in Figures below.

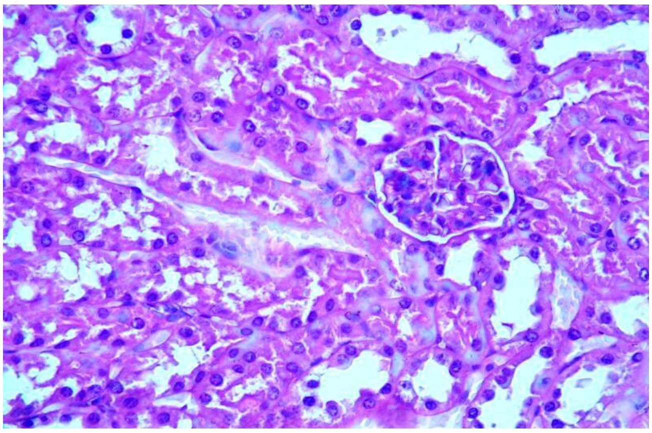


Figure5.Normal structure appearance consist of glomeruli and renal tubules on rat's kidney

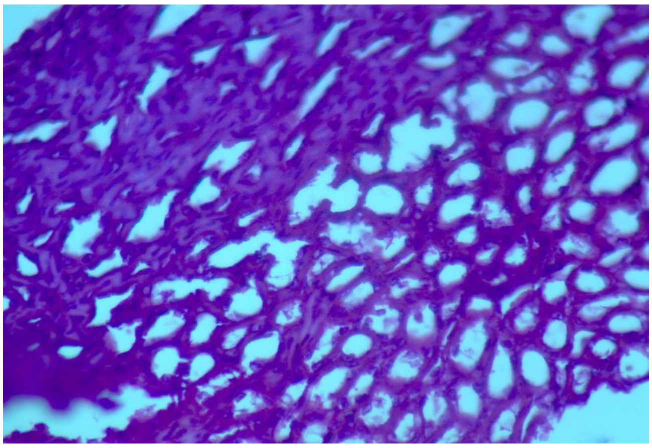


Figure 6. Section of rat's kidney tissue exposed to $co_2$ laser showing degenerative and necrosis of renal tubule. (200 x magnification)

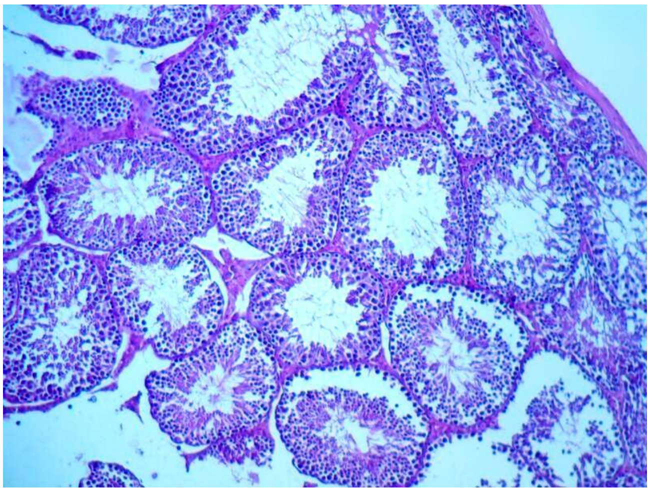


Figure7. Normal structure appearance of seminephrous tubules ,consists sperms on rat's testis. (400 x magnification)

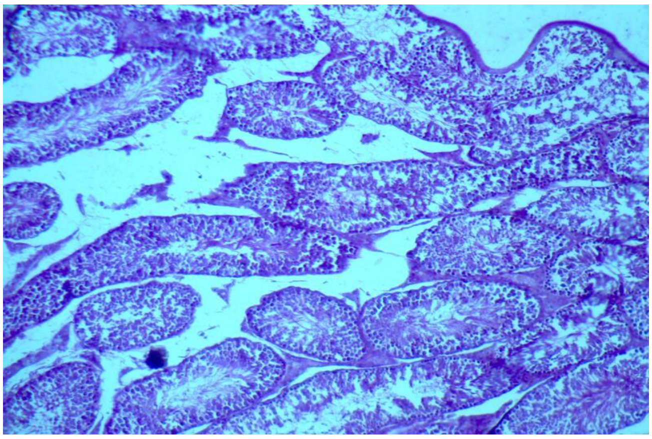


Figure8. Section of rat's testis tissue exposed to $co_2$ laser showing look –like normal appearance . (200 x magnification)

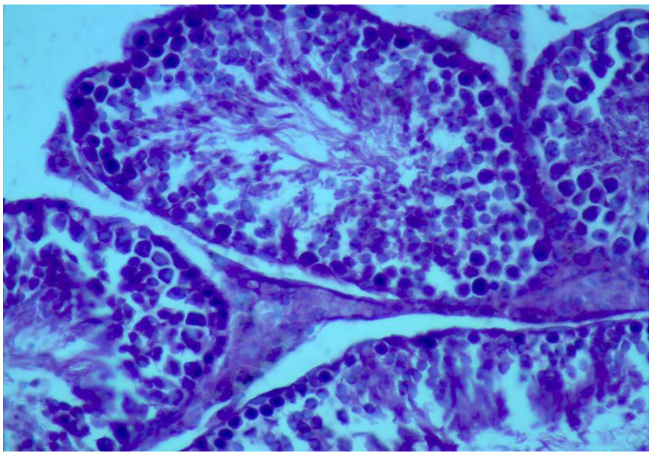
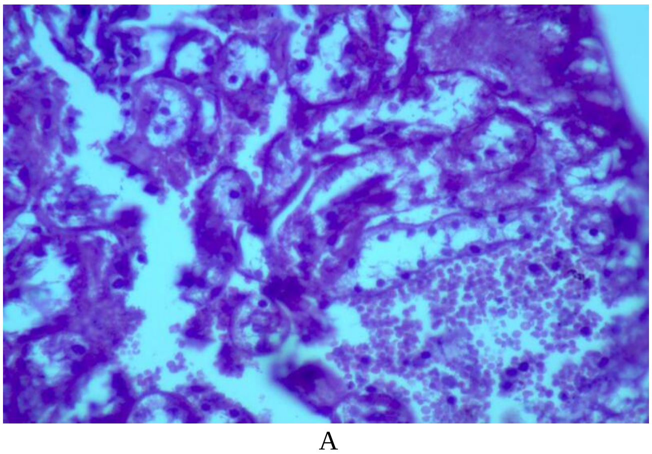


Figure9. Section of rat's testis tissue exposed to $co_2$ laser showing look –like normal appearance with presence of sperms inside the lumen of tubules . (400 x magnification)

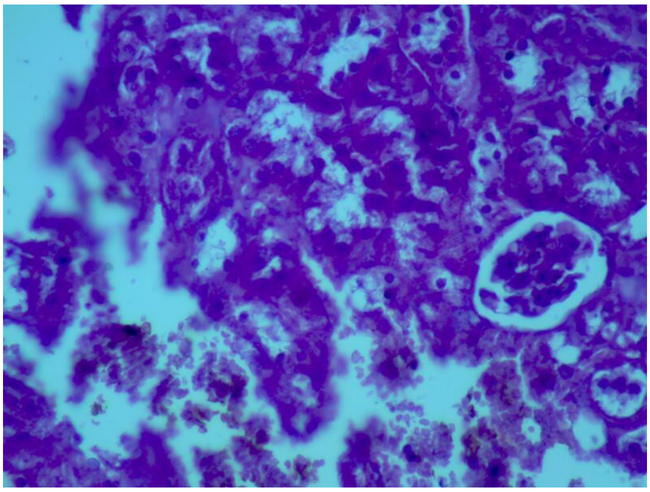
*B. 635-nm laser diode :*

635-nm low-level laser therapy (LLLT) has been used in the treatment of a variety of medical conditions and has been shown to improve wound healing, reduce edema, and relieve acute pain[3].

The low level laser therapy (635nm diode laser) was used in the histological study of rat's living organs as shown in Figures below.



A



**B**

Figure 10. A and B : Kidney Section exposed to 635nm laser diode ,showing degenerative changes and necrosis of renal tubular epithelium.(200 x magnification)

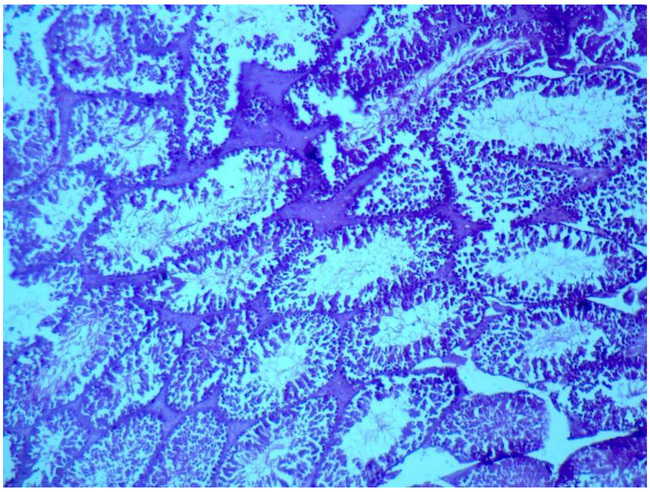


Figure 11. Testis section exposed to 635nm laser diode , showing certain degenerative changes and necrosis of spermatogoni cells of seminephrous tubules. (200 x magnification)

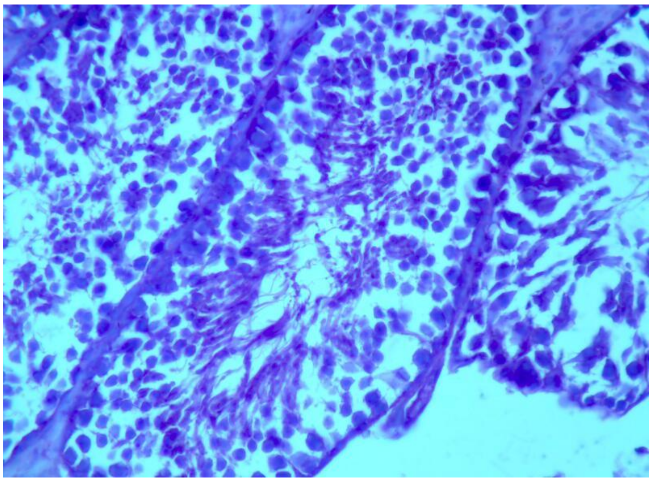


Figure 12. Testis section exposed to 635nm laser diode, showing certain degenerative changes with presence of sperms inside the lumen of tubules. (400 x magnification)

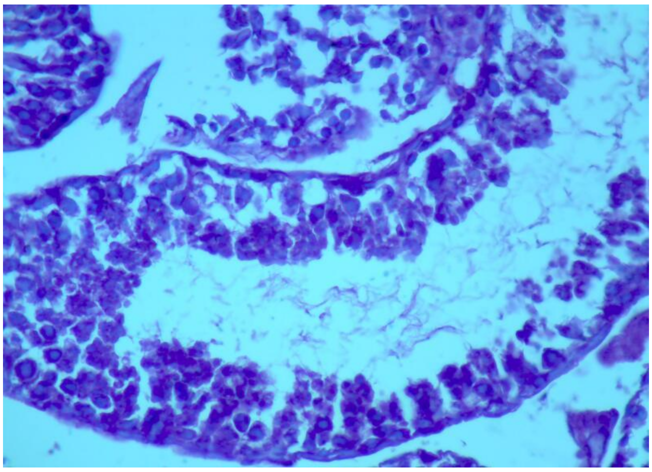


Figure13. Seminephrous tubules to large dose of 635nm laser diode showing certain degenerative changes and necrosis of spermatogoni cells f with no sperms. (400 x magnification)

*C. I785-nm diode laser :*

785nm laser diodes serves a broad range of applications Raman spectroscopy, laser pumping and medical laser therapy[4].

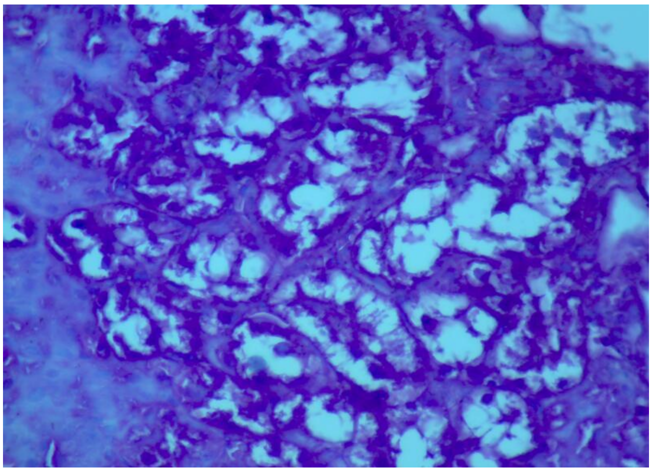


Figure 14. Kidney Section exposed to 785nm laser diode , showing degenerative changes and necrosis of renal tubular epithelium.(400x magnification)

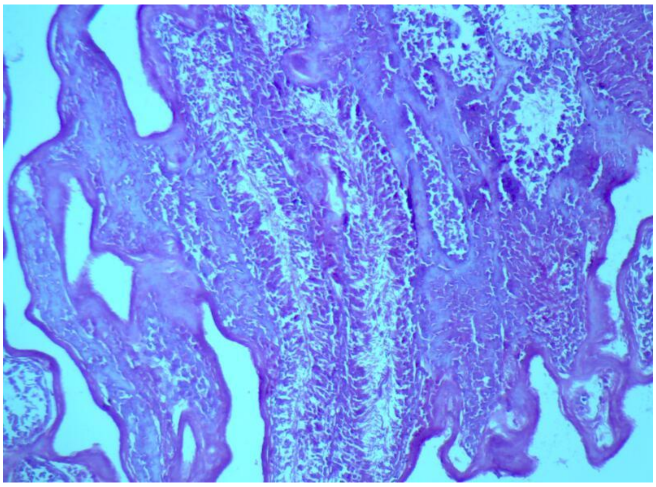


Figure 15. Testis section exposed to 785nm laser diode, showing degenerative changes of spermatogoni cells inside seminephrous tubules. (100 x magnification)

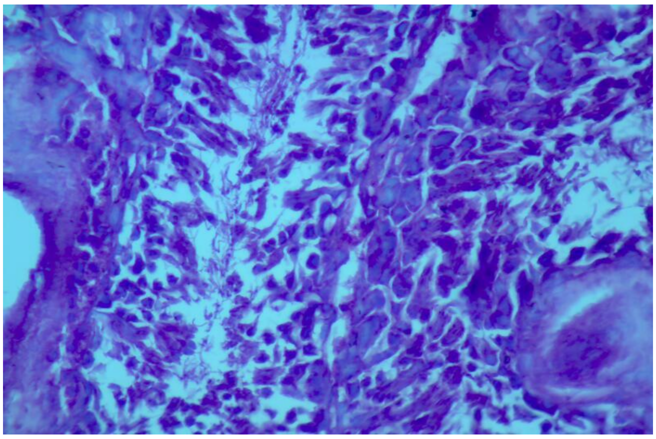


Figure 16. Testis section exposed to 785nm laser diode, showing mild degenerative changes with presence of sperms. (400 x magnification)

*D. 405nm laser diode:*

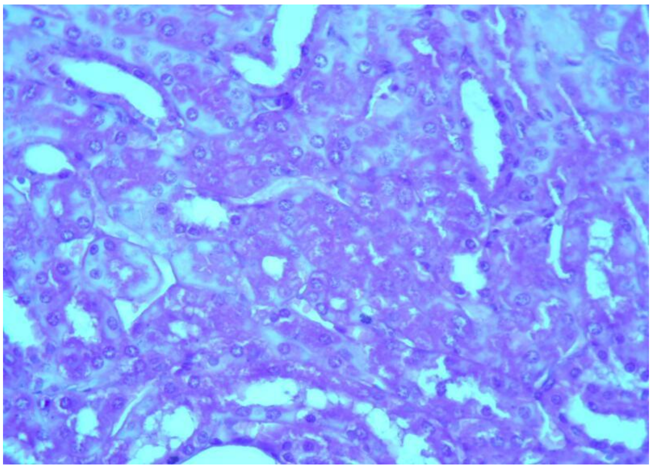


Figure 17. Kidney exposed to 405 nm laser diode , showing normal structure appearance of renal tubules. (200 x magnification)

*E. 532 SHG Nd:yag Laser for 5 sec :*

Nd:YAG lasers are used in ophthalmology to correct posterior capsular opacification, a condition that may occur after cataract surgery, and for peripheral iridotomy in patients with acute angle-closure glaucoma, where it has superseded surgical iridectomy. Frequency-doubled Nd:YAG lasers (wavelength 532 nm) are used for pan-retinal photocoagulation in patients with diabetic retinopathy[5].

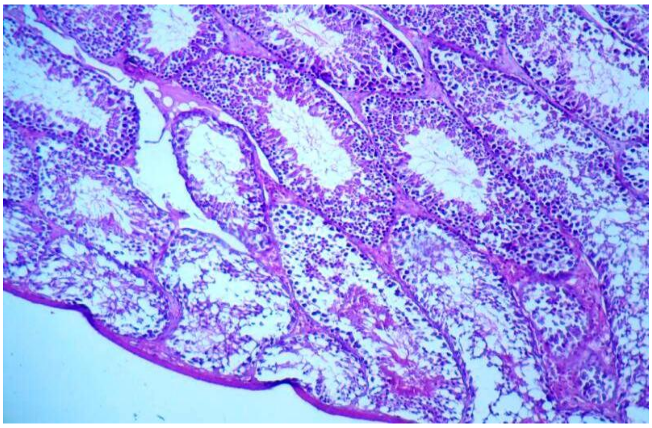


Figure 18.Section of testis exposed to532 SHG Nd:yag Laser showing degenerative and necrosis of spermatogoni cells of the tubule (250 x magnification)

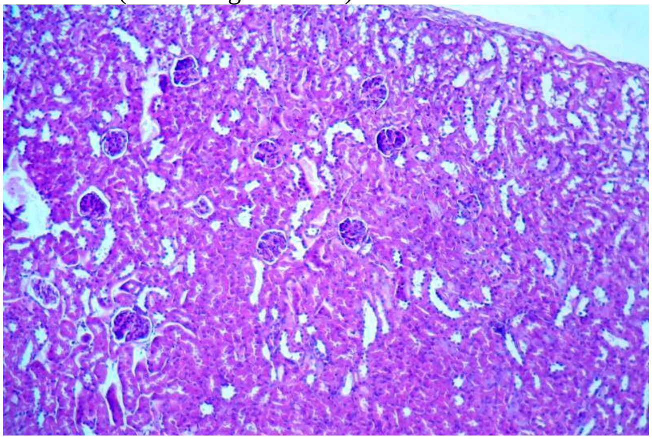


Figure 19.Section of kidney exposed to532 SHG Nd:yag Laser showing look-like normal appearance (100x magnification)

## IV. DISCUSSION

The wavelength of laser light is extremely pure when compared to other sources of light and all of the photons that make up the laser beam have a fixed phase relationship with respect to one another. Because of its affinity for water-based tissues, In this study , 635 nm diode laser had been taken the degenerative effect and kill all the sperms of testis. While the other types have been the effect of necrosis of spermatogoni cells on the testis .

405 nm diode laser and 532 Nd:yag Laser represent the lesser laser type in its effect on the kidney tissue because it's histological section looks like normal , while all other used types of laser make the necrosis of the epithelium of renal tubule.

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