American International Journal of Research in Science, Technology, Engineering & Mathematics

Available online at http://www.iasir.net

ISSN (Print): 2328-3491, ISSN (Online): 2328-3580, ISSN (CD-ROM): 2328-3629

AIJRSTEM is a refereed, indexed, peer-reviewed, multidisciplinary and open access journal published by International Association of Scientific Innovation and Research (IASIR), USA

(An Association Unifying the Sciences, Engineering, and Applied Research)

The Effect of LASER on Blood Viscosity and Its Influential Relation on the Rapidity of Red Blood Cells Precipitation

Raad Sh. Alnayli[1], Zahraa S. Shanon[2], Faid Sh. Hussein[3], Hadeel H. Sagban[4]

Department of Physics,

College of Education, University of Al-Qadisiyah,

Al-Qadisiyah, Iraq

Abstract: *The aim of this study is to investigate the in vitro effect of the hematocrit (packed cell volume) (PCV), the viscosity of red blood cells and the He-Ne laser radiation on Erythrocyte Sedimentation Rate (ESR). He-Ne laser wave length of 632.8nm was used for irradiation with power 5mw.The irradiation time is 15min. The samples of blood were obtained from 20 volunteers, and each sample was divided into two samples for irradiation and control. The ESR was measured after laser irradiation and was compared with un-irradiation control. the results of this study show the increase of ESR is related inversely with (PCV), the sedimentation rate decreases with the increase of viscosity and the laser radiation reduce the erythrocyte sedimentation rate (ESR) of blood samples*

Keywords: *Viscosity of blood, He-Ne laser, Packed cell volume, Erythrocyte Sedimentation rate.*

I. Introduction

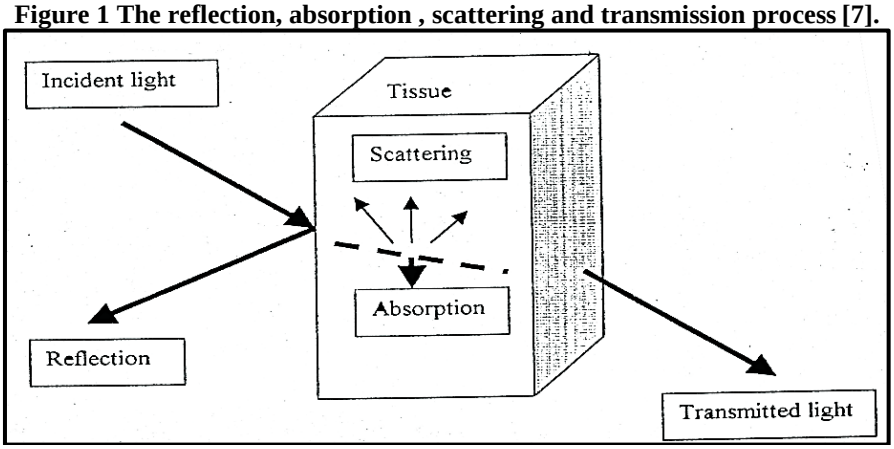
The word of LASER is an acronym for light amplification by stimulated emission of radiation. The laser had been discovered in 1960 and it had been used in 1962 in micro manipulations[1]. Applications of laser have been yielded distinctive researchers in medical fields like the possibility of using it as an (Optical Trap) in rotational cells. During the last three decades of the twentieth century, it has been found out useful applications of laser ray in the fields of medicine, surgery, ophthalmology, industry, automatic control, communications, chemistry and the like. To this point, laser became a tool that is used to treat the serious disease (cancer) by using photic-dynamic treatment, where a sensitive substance of light is injected into the injured body and then laser with wave length of 630 nm can be used for the sake of making chemical reaction that produces poisonous substance to kill tumors. Laser can also be used in sterilization of blood in blood bank which purifies blood from bacteria and viruses [2].

II. Literature Review

A. The Action of Tissue on Laser Light

When a laser beam is an incident on a tissue, four basic physical phenomena can occur as shown in figure (1) Reflection and refraction, Absorption, Scattering and Transmission [3, 4, and 5]. The relative and absolute magnitudes of these phenomena depend on the wavelength of the laser light and the physical properties of the tissue [6].

Figure 1 The reflection, absorption , scattering and transmission process [7].



B. The Effect of Laser on Bio substance

When the laser light is absorbed by a bio substance (a tissue, bacterial suspension, …etc.) it can result in different types of effects depending on the wavelength of the laser radiation, power density, pulse duration, and the nature of the bio substance. Laser effects on the bio substance can be classified according to their wavelength dependency to wavelength dependent and wavelength independent[8].

C. Wavelength Dependent Interaction mechanism

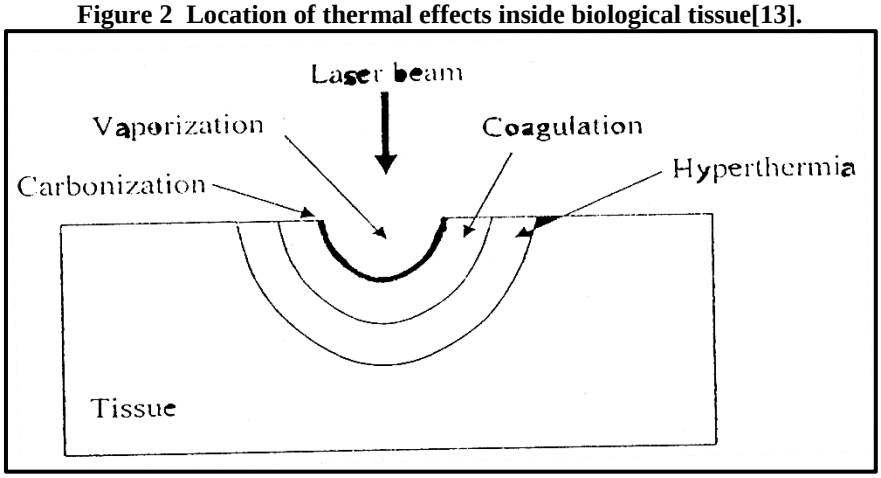
1. Photochemical interaction

At low laser intensities, irradiation of cells at certain wavelength can activate some of the native components in bio substance. In this way specific biochemical reactions, as well as whole cellular metabolism can be altered. This reaction is believed to form the basis of low power laser effect (bio stimulation)[9]. Photochemical ablation involves photo dissociation or direct breaking of intramolecular bonds in biopolymers, caused by absorption of incident photons and subsequent release of bio substance[10]. This occur when the energy of the incident photon is of the order of the bonding energy of a biomolecules then chemical decomposition occurs leading to products occupying rapidly a volume larger than the initial one forming the ablation process[11, 12].

2. Photo thermal interaction

The term thermal interaction refers for a large group of interaction type, where the increase local temperature is the significant parameter change. Thermal effects can be induced by either CW or pulsed laser radiation. At 60^{o}C, denaturation of proteins and collagen occurs which leads to coagulation of tissue and necrosis of cell. At 100^{o}C, water molecules contained in most tissues start to vaporize. The large vaporization heat of water is advantageous, since the vapor generated carries away excess heat and helps to prevent any increase in the temperature of adjacent tissue. Due to the large increase in volume during this phase transition, gas bubbles are found inducing mechanical ruptures and thermal decomposition of tissue fragments. At temperatures exceeding 150^{o}C, carbonization takes place which is observable by the blackening of adjacent tissue and the escape of smoke. To avoid carbonization, the tissue is usually cooled with either water or gas. Finally, beyond 300c, melting can occur, depending on the target material as shown in figure (2) [11].

Figure 2 Location of thermal effects inside biological tissue[13].



III. Experimental Setup

A. Collection of blood samples

Blood samples were collected between 8-10 O'clock and all blood samples were collected from woman age (18-25)year .and the number of sample. The blood was drown from antecubital vein of left or right arm. A tourniquet was applied directly on skin approximately 7 cm above the site of collection. Needles or syringes used have 22 and 23 gauges. Two groups of labeled tubes were used, the tubes group contain EDTA to prevent coagulation.

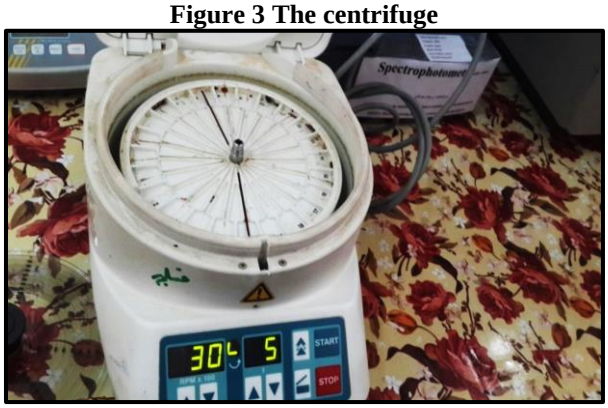
B. Method to PCV

1-Venous blood is drawn from an antecubital vein and into potassium EDTA .Care should be taken to avoid tourniquet stasis since this can elevate venous hematocrit results. The blood is the carefully mixed, preferably on a mechanical rotator. Venous blood may also be obtained through capillary puncture using a heparinized capillary tube to collect the specimen.

2- Once adequately mixed the unmarked end of plain capillary tube is placed in the blood and permitted to fill rapidly to approximately three quarters of its length. tipping the tube horizontally will speed filling. The tube is then removed from the blood and wiped clean of excess blood.

3- the unmarked end is then plugged with modeling clay and placed in the centrifuge as shown in figure (3), clay-filled end against the rubber gasket (i.e., against the peripheral rim). For accuracy, each determination should be done in duplicate or triplicate.
4- Centrifuge for 5 minutes at a set speed (force is approximately 14,500 rpm). This separates red cells from plasma and leaves a band of the buffy coat at the interface consisting of white cells and platelets.
6- The hematocrit is read as the percent of whole venous blood occupied by red cells. With a constant bore capillary tube this can be done by obtaining a distance ratio on a micro hematocrit reader. The reader is first set with the clay-red cell interface at 0 percent. Next, shift the ruled scale or etched line to 100 percent and align it with the plasma meniscus. Read down to the percent spiral line that intersects with the red cell-white cell interface. This percent is the hematocrit value. Do not include the buffy coat layer in this value. If it exceeds 2 percent it should be recorded and noted as volume of packed white cells (VPW).

Figure 3 The centrifuge

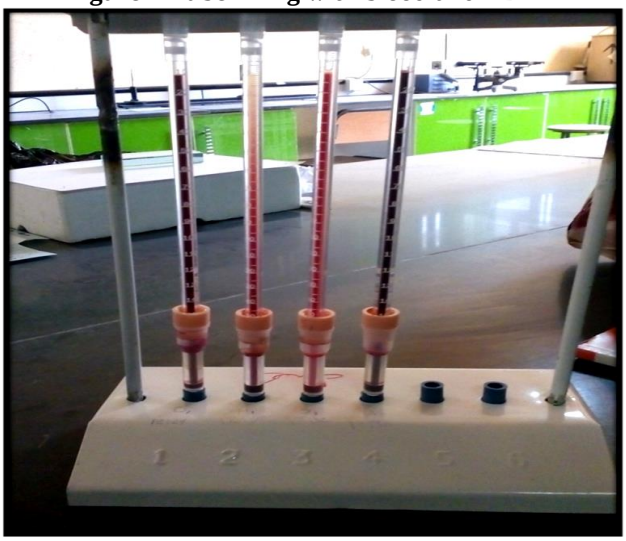


C.

D. **Method to (ESR)**

1-Blood should be collected with proper anticoagulant in proportion to volume of blood to avoid shrinkage of erythrocytes. EDTA (0.5mg/ml of blood) is suggested.
2-Thoroughly mix blood with anticoagulant immediately before filling tube.
3-Use a filling needle, a 9-inch Pasteur pipette or other cannulas that will reach the bottom of the tube. Slowly fill the tube with blood , avoiding air bubbles in the column.
4-Adjust the meniscus of the specimen to the (0) line at the top of the tube.
5-Place tube as shown in figure (4) in the upright, position in a rack that will maintain the tube in this position.
6-At the end of 1 hour read the fall of erythrocytes by recording the level of erythrocytes in the tube . the erythrocyte sedimentation rate is read same side of the tube as the line on the. Reading from the top downward , the **ESR** is read as the fall of cells in mm per 1 hour of time.
7-If the demarcation between plasma and red column is hazy . the level is taken where the full density apparent . Rapid sedimentation will occur with large bore tubes and tall column of blood . It is important to keep the position of the tube vertical at all times slight degrees of tilting will accelerate the **ESR .**

Figure 4 Tube filling with blood and EDTA



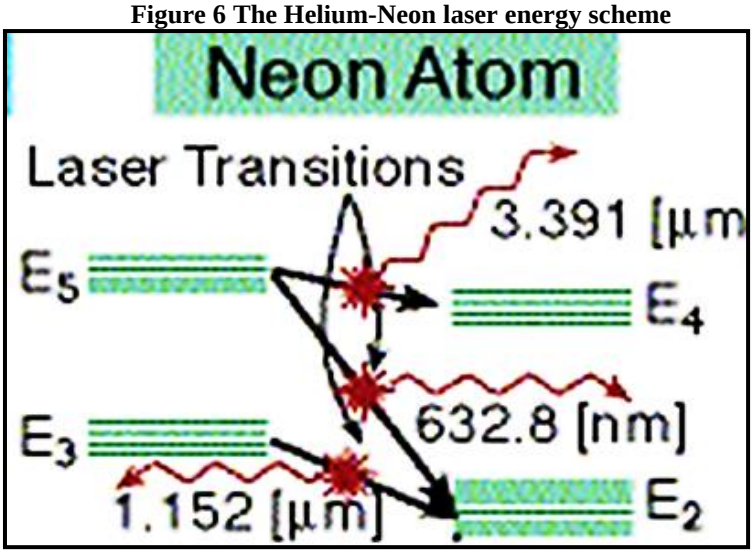
E. Helium-Neon (He-Ne) Laser

The Helium-Neon laser figure (5) was the most common laser until the spread of diode lasers. It was first built in 1961 by Ali Javan. The active medium is a noble gas Neon (Ne), and it is a 4 level laser.

Figure 5 The Helium-Neon laser

Most of the applications of He-Ne Laser use the red wavelength, because it is the strongest line and it is in the visible region of the spectrum. As shown in figure (6), this red light is emitted when the Neon atom goes from the energy level labeled E5 to the energy level labeled E2 , a much bigger energy difference than for the other transitions[14].

Figure 6 The Helium-Neon laser energy scheme



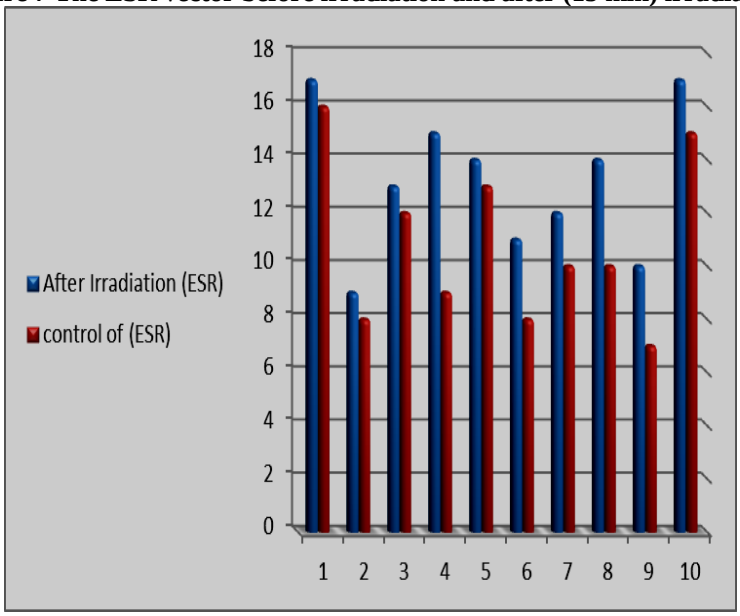
IV. Result and Conclusion

A. ESR measurements :

Table 1 The ESR measurements

Before Irradiation [ESR]	Aftar Irradiation [ESR]
16	17
8	9
12	13
9	15
13	14
8	11
10	12
10	14
7	10
15	17

Figure 7 The ESR vector before irradiation and after (15 min) irradiation

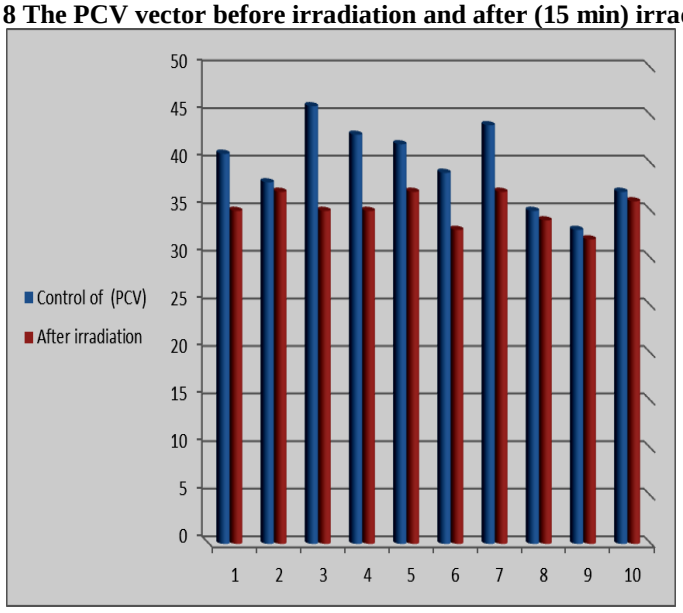


B. **PCV measurements :**

Table 2 The PCV measurements

BEFOR IRRADIATION [PCV]	AFTAR IRRADIATION [PCV]
41	35
38	37
46	35
43	35
42	37
39	33
44	37
35	34
33	32
37	36

Figure 8 The PCV vector before irradiation and after (15 min) irradiation



C. **Discussion :**

A decline in viscosity value as a result of laser irradiation is due to laser irradiation reduced the erythrocyte sedimentation rate ESR of blood samples , the results obtained in this research confirmed clear decrease in the values PCV this results confirmed by, the irradiation by laser increases the protein concentration, which reduces

the viscosity of red blood cells , an inverse relation between the time of irradiation and viscosity observed in this research ., this means that the laser has reduced adhesion between [RBC] this may due to one of two reasons , or both:

(1) in Mechanical change in blood as change in voids or pores of the surfaces and hold surfaces together by interlocking .

(2) Chemical change because of weaker bond is formed if a hydrogen atom in one molecule is attracted to an atom of nitrogen, oxygen , or fluorine in another molecule, a phenomenon called hydrogen bonding .

V. References

[1] Gould, R. Gordon (1959). "The LASER, Light Amplification by Stimulated Emission of Radiation". In Franken, P.A.; Sands R.H. (Eds.). The Ann Arbor Conference on Optical Pumping, the University of Michigan, 15 June through 18 June 1959. p. 128. OCLC 02460155

[2] Thaihammer.S,Lahr.A,Clement,Sengewald.a,Heskl.W.M,Burgemeister.R,and Schutze (2003) "Laser Micro tool in Cell Biology Medicine" laser physics ,13,5.

[3] Markolf, H. N. (1996). Laser Tissue Interaction. Heidelberg, Germany.

[4] Kutsch, V. K. (1993). Laser in Dentistry. Jour. Amer. Dent. Asso. 124: 49-54.

[5] Ginsburg, R. & Geshwind, H. (1992). Primer of Laser Angioplasty. 2nd edition. N Y future publishing Co. Inc.

[6] Keye, W. R. (1990). Laser Surgery in Gynecology & Obstetrics. 2nd edition. Mosby – year book Inc.

[7] Heithoff, D. M.; et. al. (2001). Infection & Immunity. Volume 69. American Society for Microbiology. 11: 6725 – 6730.

[8] Chopra, S. & Chawla, H. M. (1992). Laser in Chemical & Biological Sciences. Wiley Eastern Ltd.

[9] Karu, T. (1999). Primary & Secondary Mechanisms of Action of Visible to Near IR Radiation on Cells. J. photo chem. Photo boils. B. boils.,49:1-17.

[10] Ivanenko, M. & Hering, P. (1998). Hard Tissue Ablation with Mechanically Q – Switched CO2 Laser. SPIE Proc. 3565:110 – 115.

[11] Markolf, H. N. (1996). Laser Tissue Interaction. Heidelberg, Germany.

[12] Lesperance, F. A. (1989). Ophthalmic Lasers. 3rd edition. The C.V. Mosby Company.

[13] Markolf, H. N. (1996). Laser Tissue Interaction. Heidelberg, Germany.

[14] Kutsch, V. K. (1993). Laser in Dentistry. Jour. Amer. Dent. Asso. 124: 49-54

[15] Zahraa S. Shanon, Raad Sh. Alnayli, Khawla J. Tahir, "Study of the Nonlinear Optical Properties of Lithium Triborate Crystal by Using Z-Scan Technique", International Journal of Science and Research (IJSR), Volume 5, Issue 8, pp.1683-1689, August (2016).