

Effect of Ho-YAG Laser Therapy on Complete Blood Count for Lithotripsy(In Vitro)

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Abstract

Background : The purpose of this study is to investigate the in vitro effect of Ho – YAG laser on Complete Blood Picture in blood sample from ureteroscopic lithotripsy (patients with urinary stones) . The study is conducted the effect Ho-YAG laser on Complete Blood Count (CBC) was estimated before and after exposure in vitro .**Objective :** To show the effect of (Ho-YAG) laser on Complete Blood Picture . **Subject & Methods :** The study was conducted on Complete Blood Picture , the taken number of parameters (10) was estimated before and after exposure .**Results :** Result showed that there was a significant decreased in the percentage of Lymphocyte , PLT , HCT , RBC , HBG , MCHC , after exposure to 2100 nm (Ho-YAG) laser . It is found that (Ho-YAG) laser increase some parameters of WBCs , MCV , MONO and MCH and after exposure .**Conclusion :** Irradiation of blood by Ho-YAG laser lead to a decrease in the number of some parameters , including Lymphocyte cells , PLT , HCT , RBC , HBG and MCHC decreasing But the rest parameters of WBCs , MCV , MONO and MCH are increased by irradiation .
Keywords: (2100 nm) holmium- YAG laser , Complete Blood Count (CBC) .

Introduction

For several years it was holmium laser available for endurological applications , because it was considered the main application in lithotripsy result of a typical repetition rates (< 12 Hz) are low and the values of energy (< 2 J) many tissue related applications with the laser systems ⁽¹⁾ . a physiological type of cell death distinguish by certain morphological nuclear and biochemical changes ⁽²⁾ .

The holmium laser, Ho: YAG, has an infrared wavelength of 2100 nm . It is a perfect lithotripter, suitable for all types of fragmentation of urinary stones due to the impact of the strong photo acoustic effect and high peak power . The optical penetration is up to 0.4 mm, but because of higher absorption through the water ⁽³⁾ . Holmium laser at the wave length of 2100 nm has clinically very important physical properties owing to a balance between the coefficients of absorption and scatter . The property of a laser to be absorbed by the incident target gives it the ability to cut sharply, and is described as the coefficient of absorption .

Scattering be important to ensure seal blood into the surrounding tissue to maintain the cease haemorrhage . The Cutting and coagulation characteristics of the laser is also based on the survival of the pulse duration and the pulse length so is the idea way to divide and eradication of a member of haemorrhage position at the shed on thin damaged tissue . Laser power capacity reached effectively through flexible thin silica fiber have beneficial use through flexible miniature endoscopes to deal with the damaged tissue of the flexible urinary system to be effective with minimal damage .

Most of the authors have recommended the use of 0.2 - 0.8 joules at 10 -20 pulses per second . Holmium laser at the wave length of 2100 nm has clinically very important physical properties owing to a balance between the coefficients of absorption and scatter. The property of a laser to be absorbed by the incident target (in the present context human tissue) gives it the ability to cut sharply, and is described as the coefficient of absorption. Carbon dioxide laser happens to be on one end of the spectrum with one of the sharpest cutting lasers ⁽⁴⁾ .

During the past few decades have witnessed surgical treatment of urinary tract due to improvements in technology ⁽⁵⁾ .

Currently ureteroscopy (URS) is a precise, minimally invasive surgical intervention that can assess the entire collecting system to treat a stone using intracorporeal lithotripsy⁽⁶⁾. Ho: YAG laser lithotripsy has become the reference standard for both rigid and flexible URS ⁽⁷⁾. The Ho -YAG laser is a solid state, pulsed laser that emits light at 2100 nm .The optical absorption coefficient for water at this wavelength is approximately 40 cm⁻¹ so that the holmium wavelength is absorbed significantly by water. Since tissues are composed mainly of water, the majority of the holmium energy is absorbed superficially and this results in superficial cutting or ablating only⁽⁸⁾

Whole blood is an excellent model for studying a systemic human organ, because it permits one to study the interaction of its constituents after laser light irradiation at different wavelengths⁽⁹⁾

METHODS AND MATERIALS

Fresh whole blood was obtained from Hussein Teaching hospital department of urology user to lithotripsy from

30 patients, The present study was undertaken to examine the effect of Ho- YAG laser irradiation wave length (2.12 μw) Typical pulse duration (100 ns- 250 μs) interaction (thermal + mechanical) absorption coefficient (30 cm^{-1}) Tissue penetration (< 0.5 mm) , (KARL Storz – Endoskope , Germany) on whole blood . Lymphocytes from this blood can be considered to be immunologically intact, and the other hematologic parameters were normal in these samples due serial phlebotomy of these patients at regular intervals .

The human blood samples are obtained from patients, The samples of blood 6 ml were obtained immediately treated with EDTA anticoagulant from Sigma Company and each sample was divided into two aliquots samples and inserted into tubes of 1cm diameter (one control and the another for irradiation with HO-YAG laser at maximum output power (1.2- 0.5 J) and control To assure its homogeneity, the blood was stirred gently before and during irradiation in all samples at 3 min intervals approximately , The laser was continuous wave type, who were referred for various blood analyses Ruby hematology analyzer (RUBY EC – REP , Diagnostics Division , Germany) for measurements of complete blood count (CBC) , to assess the effect of holmium laser irradiation on CBC .

This irradiation administer was over to be the laser energy per volume unit (J/cm^3) rather than the laser energy per area surface unit (J/cm^2) .The laser output power is 0.8 J , irradiation time is 3 min and the fluence is 48 J/cm^3 .

For HO- YAG laser the equation will be :

$$f = \frac{p(w)*t}{v} \dots\dots\dots (10)$$

Statistics analysis : In this work, Use statistical analysis was made using SPSS, version 23 to determine the effect of HO-YAG laser on the complete blood count the most crucial concern is the difference between the control and laser irradiation thus a paired t-test $P < 0.01$ was used to evaluate the difference between the irradiated samples and non-irradiated control . For those with significant difference, the percentage of relative variance (R.V.) was calculated to evaluate the extent of the relative change between irradiated and non-irradiated samples. All values are means \pm SD .

Results

The results of the effects Ho-YAG laser on human blood in vitro for CBC parameters of 30 patients before and after irradiation are shown in the following tables (1) . A positive results in which the relative variation (R.V.) of a given blood parameter is the difference between its value after irradiation and before irradiation, divided by the value before irradiation .

$R.V = \Delta X / X$ (where ΔX is difference between before and after irradiation) .

In this study we measure the effect of Ho- YAG laser on CBC the following parameters : CBC measurements include 10 parameters these are white blood cells, or leucocytes .

WBC : Leukocyte count ; normal values ranging between 4 and 11 thousands / mm^3 . Experimental data (Table 1) indicated that the relative variations(R.V.) of WBC ranged between -41.9 % and 17.9% . In 17 cases out of 30, the variations were positive; they were negative in 13 cases .

The results showed a significant increase ($P < 0.01$) in the White blood cell count of (9.7093 \pm 3.52423 cell/ mm^3) .

RBC: Erythrocytes count; normal values ranging between 4 and 6.5 millions / mm^3 . the relative variations (R.V.) of the RBC ranged between -11.8 % and 6.7% . In 11 cases out of 30, the variations were positive and in 19 case were negative. The results showed a significant decrease ($P < 0.01$) in RBCs irradiated (4.6767 \pm 0.62133 cell/ mm^3)

HBG: Hemoglobin concentration, normal values ranging between 11 and 16 gm/dl . the relative variations (R.V.) of HBG ranged between -5.5 % and 10.3 % (P -value = 0.01) . In 9 cases out of 30, the variations were positive, and in 21 case it was negative.

The results showed a significant decrease ($P < 0.01$) in Hb irradiated (13.5083 \pm 1.64064g/dl) .

HCT or packed cells volume PCV: Hematocrit, normal values ranging between 36 and 54% . the relative variations (R.V.) of HCT ranged between -2.1 % and 11.22 % . In 8 cases out of 29 , the variations were positive, and in 21 case it was negative . showed a significant decrease ($P < 0.01$) in Hematocrit irradiated (38.7803 \pm 6.32727 %)

MCV: Mean corpuscular volume, normal values ranging between 75 and 97 μm^3 . the relative variation (R.V.) of MCV ranged between -5.6% and 21.1% . In 27 cases out of 30, the variation were positive, and 3 cases they were negative . The results showed a significant increase ($P < 0.01$) in the MCV irradiated (80.522 \pm 9.04412 Fl) .

MCH: Mean corpuscular hemoglobin, normal values ranging between 25 and 33 picograms. The relative variations of the MCH ranged between -13.3% and 11.8% . In 24 cases out of 29, the variations were positive,

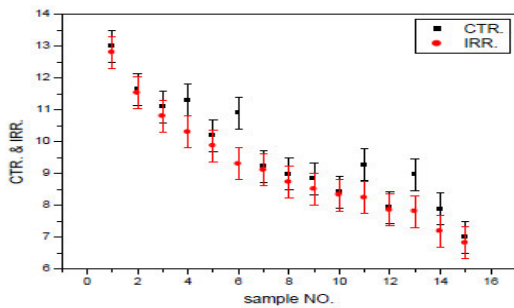
and 5 cases they were negative. And in one case no effect . The results showed a significant increase ($P < 0.01$) in the MCH irradiated (33.9437 ± 2.25414 pg) .

MCHC: Mean corpuscular hemoglobin concentration , normal value ranging between (29.5 and 35.9 g/dl) the relative variations of MCHC ranged between -9 % and 9.2 . In 3 cases out of 30, the variations were positive, and 27 cases they were negative . showed a significant decrease ($P < 0.01$) in MCHC irradiated (33.9437 ± 2.25414 g/dl) .

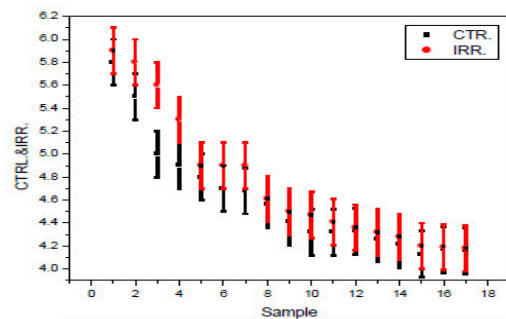
PLT: Platelet or thrombocytes count, normal values ranging between 141 and 450 thousands/ mm^3 . the relative variation of the PLT ranged between - 20% and 27.5 % . In 4 cases out of 30, the variations were positive, and in 26 cases they were negative . showed a significant decrease ($P < 0.01$) in Platelet irradiated (299.4333 ± 79.9558 cell/ mm^3) .

Lymph: Lymphocyte number, in concentration, normal values ranging between 10 and 60 % . the relative variations of the lymphocyte number ranged between -26.8% and 54.3 % . In 14 cases out of 30, the variations were positive, and in 16 cases they were negative . showed a significant decrease ($P < 0.01$) in Lymphocytes irradiated ($2.757 \pm 0.86603\%$) .

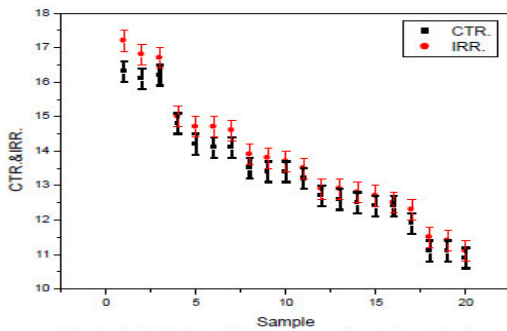
Mono: Monocytes number, in concentration, normal values ranging between 1 and 15%) the relative variations of the Monocytes ranged between -18.1% and 13.9 % . In 23 cases out of 30, the variations were positive, and in 7 cases they were negative . The results showed a significant increase ($P < 0.01$) in the Monocytes irradiated (0.504 ± 0.15165 %) .



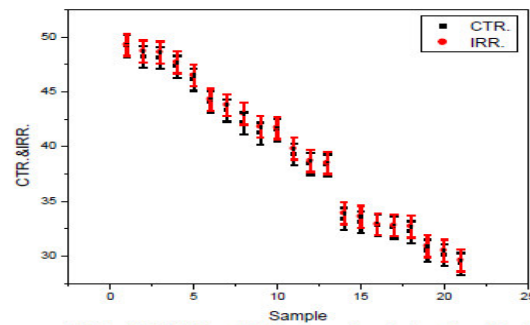
Effect of HO-YAG laser on WBCs in cases of control and irradiated



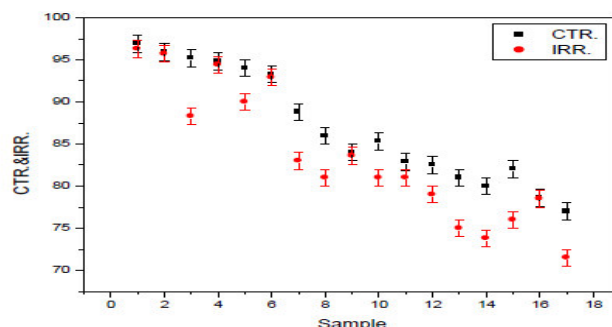
Effect of HO-YAG on RBCs in cases of control and irradiated



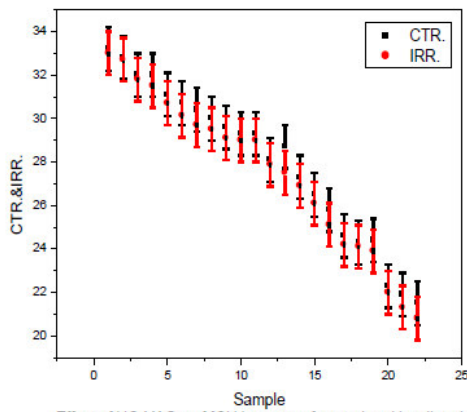
Effect of HO-YAG on HBG in cases of control and irradiated



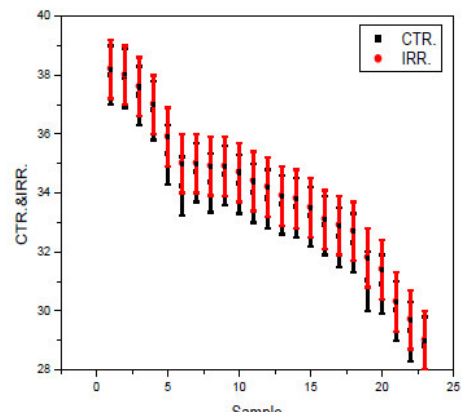
Effect of HO-YAG on HCT in cases of control and irradiated



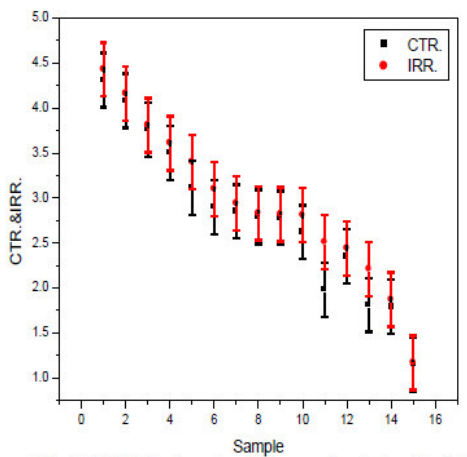
Effect of HO-YAG on MCV in cases of control and irradiated



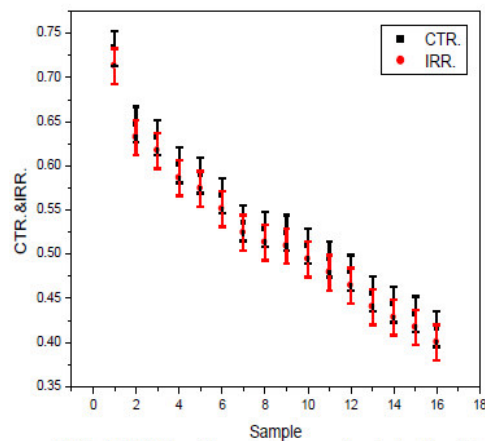
Effect of HO-YAG on MCH in cases of control and irradiated



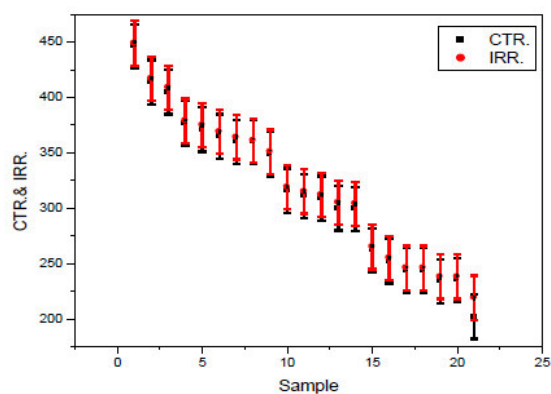
Effect of HO-YAG on MCHC in cases of control and irradiated



Effect of HO-YAG on Lymphocyte in cases of control and irradiated



Effect of HO-YAG on Monocyte in cases of control and irradiated



Effect of HO-YAG on Platelet in cases of control and irradiated

NO.	WBC			RBC			HBG			HCT			MCV		
	CTR	IRR	R.V.	CTR	IRR	R.V.	CTR	IRR	R.V.	CTR	IRR	R.V.	CTR	IRR	R.V.
S1	11.3	10.3	8.8	4.54	4.4	3.08	14.2	13.7	3.5	43.1	41.6	3.48	94.8	94.4	0.4
S2	9.44	13.4	-41.9	4.3	4.13	3.95	12.3	11.9	3.3	41	36.4	11.22	95.2	88.3	7.2
S3	11.1	10.8	2.7	4.28	4.26	0.46	13.7	13.4	2.2	39.9	39.6	0.75	93.3	92.9	0.4
S4	8.98	8.73	2.8	4.06	3.82	5.91	11.7	10.5	10.3	29.6	29.4	0.68	72.9	77	-5.6
S5	8.97	7.81	12.9	4.92	4.59	6.7	14.7	13.9	5.4	38.7	36.4	5.94	78.7	79.3	-0.8
S6	8.13	8.21	-0.98	4.17	4.19	-0.47	12.4	12.5	-0.8	32.8	32.9	-0.30	78.6	78.5	0.1
S7	5.07	5.11	-0.78	3.95	3.92	0.75	11.7	11.6	0.9	31.7	31.4	0.95	80.3	80.2	0.1
S8	8.98	9.55	-6.34	3.32	3.4	-2.4	10.9	11.1	-1.8	32.2	32.7	-1.55	96.9	96.3	0.6
S9	19.6	20.8	-6.12	4.56	4.61	-1	13.9	13.7	1.4	43.3	43.3	0.00	94.8	94	0.8
S10	10.6	10.8	-1.88	4.9	4.89	0.2	14.8	15	-1.4	43.9	43.8	0.23	89.5	89.6	-0.1
S11	7.93	7.85	1.0	4.33	4.36	-0.7	13.4	13.7	-2.2	41.5	41.7	-0.5	95.9	95.7	0.2
S12	17.54	17.4	0.8	4.68	4.9	-4.7	11.9	12.3	-3.4	42.12	43	-2.1	84	83.6	0.5
S13	8.83	8.51	3.6	4.42	4.64	-5.0	13.5	13.9	-3.0	38.4	38.7	-0.8	77	71.5	7.1
S14	7.88	7.19	8.8	4.41	4.5	-2.0	16.1	16.8	-4.3	33.1	33.6	-1.5	89	80.2	9.9
S15	8.42	8.33	1.1	4.97	5.3	-6.6	12.4	12.7	-2.4	29.3	29.6	-1.0	85.3	81	5.0
S16	9.27	8.24	11.1	4.85	4.91	-1.2	11	11.5	-4.5	30.1	30.5	-1.3	90	76	15.6
S17	10.9	9.3	14.7	5.1	5.7	-11.8	16.3	17.2	-5.5	44.1	44.3	-0.5	82	76	7.3
S18	6.99	6.82	2.4	5.02	5.6	-11.6	13.2	13.5	-2.3	49.2	49.3	-0.2	67	62	7.5
S19	11.64	11.53	0.9	4.16	4.18	-0.5	12.7	12.9	-1.6	47.3	47.7	-0.8	69.2	67	3.2
S20	10.18	9.87	3.0	5.5	5.62	-2.2	13.4	13.8	-3.0	46.1	46.5	-0.9	81	75	7.4
S21	9.23	9.11	1.3	4.32	4.41	-2.1	14.1	14.7	-4.3	38.3	38.5	-0.5	94	90	4.3
S22	13	12.8	1.5	5.53	5.81	-5.1	13.8	13.14	4.8	41.2	41.8	-1.5	82.5	79	4.2
S23	6.8	6.9	-1.5	5.8	5.9	-1.7	14.2	14.7	-3.5	39.3	39.8	-1.3	86	81	5.8
S24	7.1	7.8	-9.9	4.87	4.92	-1.0	15.8	15.11	4.4	48.1	48.6	-1.0	82.88	81	2.3
S25	5.5	5.9	-7.3	4.32	4.47	-3.5	16.2	16.7	-3.1	32.6	32.8	-0.6	74	68	8.1
S26	3.8	3.12	17.9	4.21	4.28	-1.7	12.5	12.8	-2.4	43.3	43.8	-1.2	80	73.8	7.8
S27	11.6	11.8	-1.7	4.72	4.91	-4.0	11.1	11.4	-2.7	48.2	48.7	-1.0	86	81	5.8
S28	13.2	13.6	-3.0	4.13	4.2	-1.7	13.5	13.6	-0.7	33.4	33.9	-1.5	88.8	83	6.5
S29	11.4	11.8	-3.5	4.26	4.32	-1.4	12.6	12.9	-2.4	30.5	30.9	-1.3	73.9	69.5	6.0
S30	7.4	7.9	-6.8	5.11	5.16	-1.0	14.1	14.6	-3.5	32.8	32.21	1.8	89.77	70.86	21.1
mean±SD	9.6927±3.29533	9.7093 ±3.52423		4.5903±.52521	4.6767±.6213		13.4033±1.51145	13.5083±1.6406		38.8373±6.26408	38.7803±6.3272		84.4417±8.2845	80.522±9.04412	
P value	0.01			0.01			0.01			0.01			0.01		

Table (1) : The effect of HO-YAG laser on Complete blood picture after 3 min irradiation (irradiance 48 J/cm³)

NO.	MCH			MCHC			LYMPH			MONO			PLT		
	CTR	IRR	R.V.	CTR	IRR	R.V.	CTR	IRR	R.V.	CTR	IRR	R.V.	CTR	IRR	R.V.
S1	31.2	31.2	0	32.9	33.1	-0.6	2.98	2.61	12.4	0.566	0.551	2.7	360	361	-0.3
S2	28.5	28.8	-1.1	29.9	32.6	-9.0	2.35	2.44	-3.8	0.431	0.509	-18.1	228	268	-17.5
S3	32	31.5	1.6	34.2	33.9	0.9	3.42	3.35	2.0	0.589	0.647	-9.8	244	246	-0.8
S4	28.7	27.5	4.2	39.3	35.7	9.2	3.42	3.35	2.0	0.589	0.647	-9.8	244	246	-0.8
S5	29.9	30.3	-1.3	38	38.2	-0.5	3.7	1.69	54.3	0.455	0.479	-5.3	246	212	13.8
S6	29.8	29.9	-0.3	37.9	38	-0.3	1.15	1.17	-1.7	0.494	0.52	-5.3	202	219	-8.4
S7	29.5	29.7	-0.7	36.8	37	-0.5	1.61	1.58	1.9	0.177	0.165	6.8	226	262	-15.9
S8	32.8	32.7	0.3	33.9	34	-0.3	1.98	2.51	-26.8	0.613	0.528	13.9	230	276	-20.0
S9	30.4	29.7	2.3	32	31.6	1.3	1.81	2.21	-22.1	0.735	0.855	-16.3	124	123	0.8
S10	30.3	30.6	-1.0	33.8	34.2	-1.2	4.31	4.43	-2.8	0.377	0.415	-10.1	345	250	27.5
S11	31.1	30.7	1.3	34.3	34.7	-1.2	2.85	2.76	3.2	0.601	0.586	2.5	299	304	-1.7
S12	29.3	29	1.0	32.5	32.9	-1.2	3.44	3.31	3.8	0.528	0.513	2.8	122	125	-2.5
S13	26.4	26.1	1.1	33.5	33.8	-0.9	3.11	3.4	-9.3	0.733	0.713	2.7	235	238	-1.3
S14	33.2	33	0.6	35.3	35.9	-1.7	2.98	2.88	3.4	0.479	0.464	3.1	262	265	-1.1
S15	21.9	20.8	5.0	34	34.7	-2.1	1.22	1.15	5.7	0.176	0.161	8.5	331	329	0.6
S16	26.5	26.1	1.5	37.3	37.6	-0.8	1.85	1.75	5.4	0.647	0.632	2.3	365	369	-1.1
S17	22.3	22	1.3	34.6	34.9	-0.9	2.32	2.27	2.2	0.528	0.513	2.8	371	375	-1.1
S18	24.4	23.9	2.0	33.2	33.5	-0.9	1.84	1.71	7.1	0.455	0.44	3.3	405	409	-1.0
S19	29.6	29.1	1.7	30.9	31.4	-1.6	2.63	2.58	1.9	0.494	0.479	3.0	339	402	-18.6
S20	24.3	24.1	0.8	32.3	32.7	-1.2	4.11	4	2.7	0.589	0.574	2.5	252	255	-1.2
S21	27.3	26.9	1.5	29.3	29.7	-1.4	3.54	3.61	-2.0	0.165	0.15	9.1	309	312	-1.0
S22	29	27.38	5.6	31	31.8	-2.6	2.78	2.82	-1.4	0.524	0.509	2.9	311	315	-1.3
S23	28.1	27.88	0.8	34	34.4	-1.2	3.76	3.81	-1.3	0.632	0.617	2.4	349	351	-0.6
S24	24.6	24.2	1.6	30	30.3	-1.0	2.79	2.83	-1.4	0.443	0.428	3.4	414	417	-0.7
S25	30	29.5	1.7	28.8	29	-0.7	3.5	3.61	-3.1	0.432	0.417	3.5	316	319	-0.9
S26	25.8	25.1	2.7	34.23	35	-2.2	2.62	2.81	-7.3	0.589	0.574	2.5	360	364	-1.1
S27	21.5	21.3	0.9	33.7	33.9	-0.6	2.9	3.1	-6.9	0.535	0.524	2.1	446	449	-0.7
S28	29.3	29	1.0	34.7	35	-0.9	1.79	1.87	-4.5	0.509	0.494	2.9	300	305	-1.7
S29	32	31.8	0.6	33.6	33.9	-0.9	2.85	2.94	-3.2	0.415	0.4	3.6	234	238	-1.7
S30	30.7	30.14	1.8	34.35	34.91	-1.6	4.08	4.16	-2.0	0.632	0.617	2.4	377	379	-0.5
mean±SD	28.3467±3.20428	27.9967±3.32238		33.676±2.558394	33.9437±2.25414		2.7897±0.858653	2.757±0.86603		0.5044±.14251	0.504±.15165		294.8667±79.57852	299.4333±79.95589	
P value	0.01			0.01			0.01			0.01			0.01		

Table (1) : The effect of HO-YAG laser on Complete blood picture after 3 min irradiation (irradiance 48 J/cm³)

N	Control	Irradiation	P value	Mean R.V.(%)
	Mean ±Std.			
30	Mean ±Std.			
WBC	9.6927±3.29533	9.7093 ±3.52423	< 0.01	3.1767±0.91521
RBC	4.5903±0.52521	4.6767±0.62133	< 0.01	0.7017±0.32333
HBG	13.4033±1.51145	13.5083±1.64064	< 0.01	1.2067±0.43512
HCT	38.8373±6.26408	38.7803±6.32727	< 0.01	0.8350±0.42560
MCV	84.4417±8.28450	80.522±9.04412	< 0.01	4.8400±0.89740
MCH	28.3467±3.20428	27.9967±3.32238	< 0.01	1.4300±0.25678
MCHC	33.676±2.55839	33.9437±2.25414	< 0.01	0.3800±0.30852
LYMPH	2.7897±0.85865	2.757±0.86603	< 0.01	3.6000±1.82231
MONO	0.5044±.14251	0.504±.15165	< 0.01	3.0567±0.55454
PLT	294.8667±79.57852	299.4333±79.95589	< 0.01	1.4233±1.00967

Table 2 : Mean and Standard deviation of complete blood count in case of control and irradiated of HO-YAG laser P< 0.01 N : Number of samples .

Discussion

Physical properties: laser tissue interaction

Absorption: the most important factor in laser - tissue interaction. Its direct effect is the generation of heat in the tissue. Depending on the amount of heat generated, the result will be either coagulation or vaporization. As the laser beam penetrates an absorbing medium, its intensity decreases exponentially. In urological applications of laser technology, the two chromophores available in the human body are water and hemoglobin.

Reflection: percentage of the laser beam that is reflected upon interacting with tissue. This causes the beam to lose efficiency and raises the risk to the surrounding tissue, which could suffer an unwanted rise in temperature. Reflection of a given laser depends on the optical properties of the tissue and the irrigation fluid .

Dispersion: from an optical point of view, body tissue is not homogeneous, causing dispersion when the laser beam interacts with it. This dispersion depends on the size of the tissue particles and the wavelength of the laser. Lasers with shorter wavelengths tend to exhibit more dispersion .

The effect of HO-YAG laser irradiation on the organism has several clinical and biological effects, above anti-inflammatory, immunostimulatory, neurotrophic , analgesic, desensitizing , antiedemic , normalizing . The blood rheology and hemodynamics means (depending the break off of the patient and the pathology). The tangible test study was undertaken to assay the positive of HO-YAG laser on human blood in vitro and despite divagate induced modifications on different rheological constants of the blood and in addition to evaluate the appropriateness of these modifications . The results of this interpret take a crack at incomparably demonstrated drift the irradiation of blood at low doses and gifts densities leads to the following effects without causing crass centre stall injure ⁽¹¹⁾ . which display that low powered HO-YAG laser irradiation revive parental carry off on RBC membranes, reducing hypotonic hemolysis and stabilizing the cell membrane . RBC, HGB and HCT were strongly influenced by HO-YAG laser action due to the strong absorption of irradiation standpoint , but bid deadly the RBCs . The mature red blood cell is a relatively simple structure whose defray action is down reference to packaging hemoglobin molecules efficiently, performance them from the lungs to the microcirculation and back always 11 minutes, and keeping them in a effect assert for 120 day . Busy measure of RBCs depends on its acutely hurtful become available impeach (derived from surface glycoproteins) which permits it to bring down rotation circulating cells, thereby interdiction “clumping;” its desolate doughnut-like shape, which is rheologically scale predisposed to and permits trough go about of the cells browse capillaries; and its proficiency to expect oxidative set off to the hemoglobin molecule, thereby living the four iron atoms on at all times hemoglobin molecule in the ferrous (Fe²⁺) state, in which configuration they are able to merge oxygen reversibly. Since the cell contains no nucleus and has no capacity to mingle proteins, weak molecules cannot be replaced on the red blood cells long lifespan .The shape of the cell is maintained , the cell’s volume is even , and hemoglobin and other important molecules in the cell (such as membrane lipids and structural proteins) are protected from oxidation by enzyme systems that are driven by glucose catabolism, The normal red blood cell is fragment impassable crescent disc which maintains osmotic control with the concerning activity . As the surrounding medium becomes hypotonic, , running grit be feigned into the cell to convince sheet anchor . In the course of time lower than certainly hypotonic conditions the cell will fill to power and infringement .The irradiation of red blood cells by HO-YAG laser for 48 J/cm³ makes the red blood cells have increased skills to destroy and agree to bear nearby insufferable hypotonic solutions that lyses un-irradiated normal blood cells ⁽¹²⁾ who reported that low powered lasers stabilized stored erythrocytes in hypotonic satisfy and reduced the turnover in deformability for stored erythrocytes ⁽¹³⁾ .

Conclusion

The exposure of the blood to HO-YAG laser improve its rheological properties . It was observed that the therapy with HO- YAG laser has been more efficient than that with laser in the improvement of properties of human blood cells *in vitro*. In this study we measure the following parameters : CBC measurements include 10 parameters these are white blood cells, or leucocytes number (WBCs), red blood cells or erythrocytes count (RBCs), quantity of hemoglobin (HGB), hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), Platelet or thrombocytes count (PLT) , Lymphocyte number (LYMPH) and Monocytes number (MONO) .

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