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ESTIMATION THE EFFECT OF LOW ENERGY LASER IRRADIATION OF THE BLOOD ON THE ABSORPTION OF THE ANTIBIOTICS

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Introduction. Laser light allows its transmission through optical fibre, so it can be introduced in to the blood vessels and be in direct contact with the blood, two types of lasers are used in such procedures, the first type is of high energy like Co2, argon and Nd-YAG, their applications include; recanalization of obstructed atherosclerotic vessels, myocardial and valvular surgery, whereas the second type are those of the low level energy, especially the infrared diode lasers which used widely in recent years for irradiation of blood in ischemic heart diseases, myocardial infarctions and arrhythmias accompany acute conditions which is contributed to be due to the action of the laser on the blood oxygenation level and myocardial blood supply.

On specific occasions physicians find that it is very important to optimize the bioavailability of the drug preparations through administration of these preparations in conjunction with other methods of therapy like low energy lasers which have been widely used during the several past decades. The current study aimed to estimate the effect of intravascular blood irradiation with the low level laser when applied in combination with administration of Ampicilline (intramuscular or orally) and its effect on Ampicilline level in the serum.

Materials &Methods. Twenty eight male adult New Zealand rabbits were divided into two equal groups, the first group was treated with Ampicilline (10 mg / kg B.W.) administered intramuscularly (Holland Medicines Company - Netherlands. hollandmc@europe.com) while the second group received the same dose administered as small capsules by mouth (Ajanta Pharma Limited, Ajanta house, 98, Govt. Indl. Area, Charkop, Kandivili, (W) Mumbai 400 067, India). Each group was further subdivided into two subgroups (control & treated with laser). A fine cannula was fixed in the inside marginal vein of the ear to obtain blood samples from the animals. Ampicilline levels were estimated by using HPLC (Schmsu Analytical Laboratory, Japan, 45 J-4002). HPLC is a sensitive and selective chromatographic method with UV detector used for determination of the Ampicilline C-component ratio by HPLC.

A locally constructed semiconductor GaAs diode laser device was used to irradiate the blood of the treated subgroups. The laser used emits an average power of 1 mW at 904 nm, with an optical package which contains a connector and optical fiber with fine canula fixed to its end.

The blood of the animals of the treated subgroups was irradiated once using the device immediately after the administration of the antibiotic. Time of irradiation was 10 minutes. Irradiation method of the blood was by transmission of the laser energy through a fine fiberoptic (Light guide probe with outer diameter of 0.8 mm) passed in to the femoral vein across a fine cannula (20G1 ¼ “mm, B, Braun Melsungen AG, D-34209, Vasofix-Germany) fixed to its end.

Six samples of blood collected from the animals of the both groups after 1, 2, 3, 4, 5 & 6 hours from the time of injecting the antibiotic.

Values from blood samples examination estimated statistically using analysis of variations, ANOVA to compare the responses of all subgroups; control and laser treated throughout the entire period of the study.

Results. Concentration – time relationship of the Ampicilline is shown in tables, 1 & 2 , there is a gradual increase in the readings of the samples at all the given times in both the groups (intramuscular & oral) and all the subgroups (control & treated) beginning from the 1st. hour and reach the peak at the end of the 2nd. hour, then they decrease gradually with time until the end of the experiment.

In the 1st. group, in which the Ampicilline is ad-

Table 1

Concentrations of the Ampicilline in the intramuscular group

Intramuscular							
Time (hr)	Control (ng/ml)			Laser (ng/ml)			
	Mean	SD	SE	Mean	SD	SE	Degree of Significance
1	85	±2.8	0.66	122	±2.3	0.62	*
2	97	±2.3	0.62	163	±2.3	0.62	**
3	76	±2.5	0.65	93	±2.3	0.62	*
4	47	±2.6	0.66	59	±2.3	0.59	*
5	22	±2.3	0.62	34	±2.5	0.65	*
6	13	±2.3	0.62	3	±1.2	0.41	*

Table 2

Concentrations of the Ampicilline in the oral group

Oral							
Time (hr)	Control (ng/ml)			Laser (ng/ml)			
	Mean	SD	SE	Mean	SD	SE	Degree of Significance
1	65	±4.4	0.87	98	±3.2	0.74	*
2	81	±4	0.83	142	±3.7	0.8	*
3	55	±2.3	0.62	49	±3.2	0.74	*
4	30	±2.3	0.62	12	±2.3	0.62	*
5	17	±2.3	0.62	2	±0.6	0.32	*
6	8	±2.3	0.62	Zero	-	-	*

* Highly Significant: P< 0.01 **Very Highly Significant: P< 0.001

ministered IM, there was highly significant P < 0.01 difference in the readings of the treated subgroup when compared with the control one at all the given times except the 2nd. hour in which the readings showed very highly significant P < 0.001 differences in reference to the control subgroup.

In the 2nd. group in which the Ampicilline is administered by mouth, the readings of all the given hours in the treated subgroup showed highly significant P < 0.01 differences when compared with those of the control one.

Comments. The increase in the concentration of the Ampicilline in the blood of the treated subgroup which administered the antibiotic intramuscular was highly significant as compared with the control subgroup , this fact is attributed to the laser light which increases the formation of new capillaries, promotes the healing process and accelerates the angiogenesis, leading to a temporary vasodilatation, and increase in the diameter of blood vessels , the vasodilatation is considered as an important factor increase the bioavailability of the drug.

The values obtained from the treated subgroups which received the drug by mouth , is an increment contributed to the blood irradiation with the laser which activates erythrogenesis and anti-hypoxic activity on tissues , activation of microcirculation are detected.

The action of laser therapy is attributed to the ability of the cell to absorb the photon and transform the energy into adenosine triphosphate – ATP.

Normally ATP is produced by the mitochondria, using oxygen as the primary fuel. Laser stimulation has been shown to enhance the production of ATP by forming singlet oxygen, reactive oxygen species – ROS, or nitric oxide, all of which influence the normal formation of ATP. The increased ATP prompts homeostatic function of the cells to resume.

The increase in the level of the antibiotic was highly significant in both groups for the 1st. and 2nd hours and then began to decrease by time till approximately total clearance. Medications such as procaine, certain antibiotics, and copper-based local substances may enhance the effectiveness of laser energy by enhancing the receptor sites.

Conclusions. The stimulating effect of LLLI on the antibiotic activity is the key point of its therapeutic value. Laser irradiation of blood combined with antibiotic by mouth or IM injection allows obtaining also higher drug saturation in the blood, in comparison with by mouth or IM injection alone.