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Low level laser lowers erythrocyte sedimentation rate and improve functional capacity among hypertensive obese elderly women

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This study was conducted in pursuit of gaining and understands effects of the low level laser irradiation on ESR which is very essential way in revealing the mechanisms of the action of laser radiation on improving functional capacity in stage I hypertensive obese elderly women. The purpose of this study is to investigate the effect of low level laser radiation on erythrocyte sedimentation rate and 6 minute walking test. Blood samples were obtained from 80 obese elderly women with stage I hypertension, each sample was divided into two equal samples (40 for each), one of them was considered as control follow medical treatment only while the other experimental exposed to low level laser irradiation in addition to the traditional medical treatment. The wavelength of 650 nm was used for irradiation with GaA/AS semiconductor, with power output started by 5mW. The irradiation time was 30 minutes then increased till 45 minutes, 3 times per week for 3 months. The erythrocyte sedimentation rate and 6 minute walking test was measured before and after laser irradiation and compared with un-irradiated control sample. The results of this study showed that erythrocyte sedimentation rate value was significantly decreased by 26.25 % and in turn 6 minute walking distance significantly increased by 27.54%. low level laser irradiation induces physical changes in blood rheology and consequently lowers erythrocyte sedimentation rate and upgrade functional capacity for those selected patients

Keywords: erythrocyte sedimentation rate, functional capacity, low level laser.

INTRODUCTION

Hypertension and obesity are major modifiable atherothrombotic risk factors that alter subjects' functional capacity. Many epidemiological studies demonstrated that hypertension associated with excessive fat accumulation in adipose tissues prevalence increases with advancing age and it is slightly higher in postmenopausal women which have graded continuous, independent and positive association with cardiovascular outcomes. (Baker et al., 2007)

Boutens and Stienstra (2016) inferred that, both obesity and hypertension are characterized by increase concentrations of circulating inflammatory cytokines which in turn increases ESR level. Erythrocyte sedimentation rate is a common hematology nonspecific measure of inflammation by rating red blood cells sedimentation in a period of one hour. It has been reported that ESR levels can be greatly influenced by infections, malignancies or thrombotic risk factors and also tend to be higher in females than in males (Nestel, 2012) and become higher with

aging and excessive body mass index (BMI). (Radovits et al., 2008)

Elderly people proportion in the total population is increasing in most countries because of advances in medical revolution and heightening life expectancy but elderly care and attention still considered a luxury issue in Egypt. (Aly et al., 2002) Aging is a multifactorial dynamic process which trigger decline in elderly functional capacity in several ways considering the different geographic regions (Costa et al., 2006).

Functional capacity is considered a broad and interdisciplinary approach to health status in elderly. Thus, there were various dimensions that affect those including social relationships, physical environment and the demographic, socioeconomic, cultural and psychological conditions (WHO; 2001) The most important thing in life of older people is to cope with the activities in daily living independently as long as possible and prevention of further deterioration in their health medical status with presence of normal physiological changes coexist with aging. (ATS statement, 2002).

High ESR level in elderly population has been associated to clinical manifestations such as functional dependence, low cognitive performance, increased mortality and geriatric syndromes (Manson et al., 2004). The relation between hypertension and impaired functional capacity still unclear but it may rely on improper oxygen tissue perfusion under the effect of narrow blood vessels (obesity) and high ESR level. (Hulens et al., 2003.)

In the field of therapeutic laser application, there is fast and noticeable progress to achieve effective and valid procedures .Low level laser has numerous wide therapeutic applications but the most important issue is safety and doesn't cause living cell damage. (Vladimirov et al., 2004). Laser bio stimulation causes changes in cellular metabolism and tissue oxygen supply that improved through increased blood perfusion and accelerated hemoglobin dissociation (Karu, 2008). Since low level laser blood photo stimulation as non-invasive instrument was proven to have a variety of effectiveness on multiple bio systems, we intended in this study to clear up the impact of low level laser in vivo as new trend in therapeutic laser application for improving functional capacity (6 minute walking test) in hypertensive obese elderly women through modulation of ESR level

MATERIALS AND METHODS

Subjects

The study protocol and procedure was approved by the ethics committee of Faculty of Physical Therapy, Cairo University, Egypt. Informed consent was obtained from each participant prior to the start of the study. A prospective, controlled experimental study was conducted in eighty stage I hypertensive women (according to JNC, 2015) with 32.38 ± 1.34 body mass index who volunteered to participate, were aged from 55-65 years. They were randomly assigned into two groups (A random table was used for the randomization. A series of random numbers was selected from the random table (from the first line, left to right) to assign each subject based on odd or even number. An odd number assigned a subject into the experimental group, 40 participant women), and an even number assigned a subject into the control group, 40 participant women).The experimental group received low level laser therapy for three months (with mean age 59.8 ± 2.44 years) in addition to the traditional medical treatment and control group follow their traditional medical treatment only with no low level laser intervention (with mean 59.48 ± 2.45 years)

Pregnant or smoker women, anemia, history of malignant disease, blood donation within at least 30 days, consuming any drugs which might be affecting blood viscosity, renal failure or presence of recent coronary artery disease patients had been excluded from this study.

Procedures

All subjects' baseline data were collected before any treatment was given. The data recollection was 3 months after intervention

Erythrocyte sedimentation rate (ESR) measuring

Blood sample: The blood samples were collected from all the participants. About 2 ml of blood were collected through venipuncture in ESR vacuum tube containing sodium citrate (1.3 mg/ml of blood) as an anticoagulant. The samples were then managed instantly after collection (no intervention) stored no longer than 2 hours at room temperature and held up right into 10 manual racks. After 3 months, the same procedure was done for both groups to estimate ESR level.

Functional capacity assessment and procedure

The six-minute walking test (6MWD) is applied as a method of functional capacity evaluation in hypertensive subjects (Gusmão et al., 2009) due to its simplicity and easy use (Solway et al., 2001). Subjects were instructed to walk from end to end at their self-selected pace a long flat, straight, enclosed 30 m corridor marked by colour tape at each end, while attempting to cover as much distance as possible in 6 minute.

Low levels laser description and application

Subjects in the experimental group were received laser radiation three times weekly conducted on alternate days, for 3 months, accounting for 36 applications in the Laser group. The irradiation duration and power was set at low levels at first (start with 30 minutes and 5Mw) then increased gradually along the treatment period till 45 min. at highest power (notice any undesirable effects). The technical data of laser radiation are listed below. The laser (Wuhan, China) consists of a GaA/As semiconductor and operates at a wavelength of 650 nm. The output power is 5 mW, but it can be adjusted. The device operates at an ambient temperature of -20 to $+40$ ° C and a relative humidity of $\leq 85\%$. (Gerhard and Daniela, 2016)

The laser penetrates the vessel walls with a wavelength of 650 nm. The tissue absorbs the energy of the laser in order to produce lipoprotein lipase. Subsequently, the microcirculation and the oxygen transportation capacity of the red blood cells are improved.

Data analysis

Descriptive statistics and t-test were conducted for comparison of the mean age and

BMI between study and control groups. Two-way mixed MANOVA test was conducted to compare the effect of time (pre versus post) and the effect of low level laser application (between groups), as well as the interaction between time and treatment on mean values of ESR and 6MWD. Statistical significance was accepted for $p < 0.05$. All statistical tests were performed through the statistical package for social studies (SPSS) version 19 for windows. (IBM SPSS, Chicago, IL, USA).

RESULTS

Comparing the general characteristics of the subjects of both groups revealed that there was no significance difference between both groups in the mean age, systemic blood pressure (systolic & diastolic blood pressure) and BMI ($p > 0.05$). (Table 1)

Changes of erythrocyte sedimentation rate (ESR), as shown in Table 2, Multiple pairwise comparison showed that there was no significant difference in the ESR between the experimental and control groups pre-treatment ($p = 0.82$). However, there was a significant decrease in the mean values of the ESR of the experimental group post treatment compared with that of control group ($p = 0.0001$).

Changes in 6 minute walking test (6MWT) Multiple pairwise comparison showed that there was no significant difference in the 6MWD between the experimental and control groups pre-treatment ($p = 0.45$). However, there was a significant increase in the mean values of the 6MWD of the experimental group post treatment compared with that of control group ($p = 0.0001$). (Table 3).

Table 1. Participant demographic data

Participants	Experimental (n=40)	Control(n=40)	MD	t- value	p-value	Sign
	$\bar{X} \pm SD$	$\bar{X} \pm SD$				
Age (years)	59.8 \pm 2.44	59.48 \pm 2.45	0.32	0.65	0.51	NS
BMI (kg/m ²)	32.38 \pm 1.34	32.13 \pm 1.19	0.25	1	0.32	NS
Blood pressure (mmHg)	147.54 \pm 5.93	147.94 \pm 6.21	-0.4	0.48	0.74	NS
Systolic blood pressure						
Diastolic blood pressure	94.36 \pm 2.27	94.38 \pm 2.84	-0.02	0.155	0.96	NS

Table 2. Mean erythrocyte sedimentation rate (ESR) pre and post treatment of the experimental and control groups

ESR (mm/h)	Pre	Post	MD	% of change	P-value	Sig
	$\bar{X} \pm SD$	$\bar{X} \pm SD$				
Experimental group	14.04 ± 2.16	11.12 ± 2.2	- 2.92	26.25	0.0001	S
Control group	11.02 ± 2.37	11.02 ± 2.37	0	0	1	NS
MD	0.1	3.02				
P-value	0.82	0.0001				
Sig	NS	S				

Table 3. Mean 6MWD pre and post treatment of the study and control groups

6MWD (m)	Pre	Post	MD	% of change	P-value	Sig
	$\bar{X} \pm SD$	$\bar{X} \pm SD$				
Experimental group	283.95 ± 7.64	362.16 ± 16.2	-78.21	27.54	0.0001	S
Control group	282.71 ± 8.81	283.52 ± 7.47	-0.81	0.28	0.59	NS
MD	1.24	78.64				
P-value	0.45	0.0001				
Sig	NS	S				

DISCUSSION

The above results indicated that low level laser therapy influenced blood rheology (through significant reduction of ESR) and functional capacity (by increasing walked distance in 6Min.) in elderly obese women with stage I hypertension. There are sectional studies suggest that in moderate hypertension a significant decreases in 6MWT can be seen in more severe stages and/or in the presence of comorbidities (Ribeiro et al., 2001 and Pedrosa et al., 2009). Our findings is supported by the result reported by (Justin et al. 2009) that improving functional capacity after laser irradiation is unclear however, low level laser irradiation impact in blood rheology in high risk patients may be induced by enhancing tissue perfusion and in turn the walked distance

Several studies were in alignment with our observation as ESR should not be neglected for estimation of blood laser irradiation effect in whole blood viscosity with different radiation wave length. Also, the above findings are in agreement with those stated by (Litscher et al., 2002) as they investigate the effect of acupuncture point stimulation; this has been shown to have stabilizing effects on blood pressure and increasing effects on microcirculation. In contrast, an interesting observation was found by (Shaker et al. 2017) in form of increasing ESR in male person post irradiation with 1.5 J/cm² but not in female. This difference between the two studies

may be because of the different ages of selected patients. The findings of this study were limited by the inability to infer the findings to hypertensive male or healthy population as the study being conducted on elderly hypertensive obese female participants only. Female participants were tested due to the higher incidence of dependency after menopause with presence of co-morbidity risk factors (hypertension, obesity and higher ESR levels)

CONCLUSION

Low level laser therapy to some extent is capable of improving functional capacity in stage I hypertensive obese elderly women through lowering ESR level and improves blood rheology

CONFLICT OF INTEREST

The authors hereby declare that no conflict of interests exists in connection with the publication of this article.

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AUTHOR CONTRIBUTIONS

ENA designed and performed the experiments and also wrote the manuscript. EBE perform laboratory measures. ZMH, SHM and SMI performed continuous guidance and suggestions during the performance of the experiment, data

analysis and reviewed the manuscript. All authors read and approved the final version.

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