Medical Journal of Babylon
Vol. 14- No. 2 : 317 – 321 , 2017
http://www.medicaljb.com
ISSN 2312-6760©2017 University of Babylon

Original Research Article

Effect of Nd: YAG Laser Irradiation on The Non-Enzymatic Anti-Oxidative Marker (Uric Acid) in Patients with Diabetes Mellitus (DM)

Zina Tariq Ali
College of Health and Medical Technology, Middle Technical University, Baghdad, IRAQ

E-mail: zinatrq99@yahoo.com

Accepted 20 June, 2017

Abstract

Either scattered or absorbed, the laser light when entered a biological tissue based on how the photon is distributed in the target tissue, and the effect of radiation is determined by absorption. Antioxidants can protect against damage induced by radiation. Uric acid has an excellent antioxidant capacity in prevention and reduced severity of diabetic complications. This study aims to conduct an assessment over the effect of Nd: YAG laser irradiation on the level of scavenging system marker (uric acid)) in blood samples taken from diabetic patients and apparently healthy control individuals. Serum uric acid was assessed by enzymatic colorimetric test before and after irradiation by pulsed Nd: YAG laser in diabetic patients (n=102)) as compared with control (n=97)) at wave length (1064 nm)) 25 pulse with energy (700mJ)) in diabetic patients and healthy control with age range 20-70 for both groups. Serum uric acid level after Nd: YAG laser irradiation was significantly higher than those without irradiation for control group (P< 0.001)) and its level after irradiation was significantly lower than those without irradiation for diabetic patients (P< 0.01)). Before laser irradiation, a significant difference occurred between both samples: (Patients and control (P< 0.05))), but the results showed highly significant differences in uric acid level after irradiation based on Nd: YAG laser for control and diabetic samples (P< 0.001)). An effect of Nd: YAG laser irradiation on uric acid concentration values as a scavenger parameter in control which is highly significant altered after irradiation, meanwhile, a significant decline occurred in its level among diabetic patients after irradiation.

Key Words: Uric acid, oxidative stress, Nd: YAG laser, diabetes mellitus (DM).

تأثير الاشعاع بليزر الأندياك على مؤشر مضاد الأكسدة غير الأنزيمي (حمض اليوريك) لدى مرضى داء السكري

الخلاصة

أن دخول الليزر في النسيج الحي يكون أما بالتشتت أو بالأمتصاص من خلال توزيع الفوتونات الضوئية في النسيج الهدف.أن تأثيرالأمتصاص لوحده هو الذي يحدد تأثير الأشعاع. بإمكان مضادات الأكسدة الحماية ضد التحطم الناتج بواسطة الجذور الحرة الي تنتج بفعل الأشعاع. يعتبر حمض اليوريك مضاداً ممتازاً للأكسدة في منع وتقليل شدة مضاعفات داء السكري.ان الهدف من هذه الدراسة هو تقييم تأثير التشعيع بواسطة ليزر الاندياك على مستوى مؤشر مضاد الأكسدة (حمض اليوريك) في عينات الدم لمجموعتي مرضى داء السكري والسيطرة.لقد تمّ قياس مستوى حمض اليوريك بواسطة المقايسة الأنزيمية اللونية قبل وبعد التشعيع بواسطة ليزر الاندياك بطول موجي (١٠٤٦) nm بمعدل للنبضات (٢٥) نبضة وبطاقة (٧٠٠) ملي جول لمجموعة السيطرة البالغ عددهم (٩٧) ومرضى السكري البالغ عددهم (١٠٢) واللذين تراوحت أعمارهم بين (٢٠-٧٠) سنة.أظهرت النتائج أن مستوى مؤشر حمض اليوريك قد ارتفع ارتفاعا معنوياً (اقل من ٠,٠٠١) في مصول عينات السيطرة بعد التشعيع بليزر الأندياك مقارنة بمستواه قبل التشعيع. أما بالنسبة لمجموعة مرضى السكري فقد أنخفض مستوى الحمض انخفاضا معنويا بعد التشعيع بليزر الأندياك (اقل من ٠,٠١) مقارنة بمستواه

قبل التشعيع. وعند مقارنة مستوى الحمض في كلتا المجموعتين (السيطرة و المرضى) ، كانت الفروق معنوية (اقل من ٠,٠٥) . أما مستوى الحمض ما بعد التشعيع فلقد ارتفع ارتفاعا معنوياً وبفروق معنوية (اقل من٠,٠٠١) مقارنة بمستواه بين المجموعتين.

الكلمات المفتاحية: حمض اليوريك، الأجهاد التأكسدي، ليزر الأندياك، داء السكري.

Introduction

The laser light is either absorbed or scattered, when thrown on a biological tissue, and based on the way the photons are distributed in the tissue, the effect of radiation is determined. The electronic structure of molecule can be altered by the absorption of photon. The laser impact in biological tissues can be categorized into three general aspects: 1-Photochemical, 2-Thermal, and 3- Ionizing [2,1]. As a result of Radiation, cells could be directly damaged by ionization of DNA and other cellular targets could be indirectly damaged as well [4,3]. In the normal physiological circumstances, an oxygen generation balance occurs with free radicals and antioxidants defenses system based on deactivation of organisms as a protection means against free radicals toxicity. The condition called: oxidative stress arises from the process of impairment in the oxidant/ antioxidant equilibrium [5]. The high levels of (ROS)) that are created while chronic inflammatory diseases or associated with toxic chemicals, radiation, or environmental stresses are considered as cytotoxic [6-8]. Moreover, many crucial biological molecules could be unfavorably altered causing disorder of form and function. Antioxidants provide protection against the detriment caused by free radicals at different levels, and the inhibition of the formation of reactive oxygen species (ROS) is one of these levels. By scavenging free components like water-soluble antioxidant (e.g. uric acid), it is thought to serve as a front line of defense [9, 10]. Uric acid plays the role of a key protection factor against oxidative stress in the shape of free radicals. Since it has double bonds, uric acid possesses an excellent antioxidant capacity. Hence, it can handle 2/3 of total plasma antioxidant capacity [11-14]. Many reports made by a number of laboratories tend to lower energy laser light therapy (LLLT)) conducted in vitro, resulting in generation of various kinds of ROS. Several reports published by Lubart and Laboratory on reactive oxygen species (ROS)) generation after (LLLT)), indicating that ROS could be produced by white with non-coherent blue green red /w infrared (IR)) light. In addition, it has been suggested that ROS may be resulted from laser irradiation with light between 400-500 nm through a photosensitization process. However, ROS from mitochondria may be directly emerged from longer wave length [6].

The engagement of free radicals in the onset of diabetes and the development of diabetes complications are clearly shown through experimental evidence. Free radical scavengers are proven as effective in prevention of experimental diabetes on animal models and on Type 1 (IDDM)) and on type 2 (NIDDM)) patients, and in reduction of severity of diabetic complications [8].

Many studies attribute the subsequent alteration in multiple intracellular processes after irradiation to the initial oxidative damage resulted from the free radicals [10, 3].

The aim of this study was to conduct assessment over the effect of Nd: YAG laser irradiation following the technique of non-enzymatic antioxidant marker (uric acid) evaluation in the serum of blood samples of control and diabetic patients groups before and after laser irradiation.

Materials and Methods

Subjects enrolled in this study with total number of (199), seen in the form of healthy subjects (97), and the control group (39 males and 58 females), were all normal on routine laboratory tests and medical examinations, and patients with diabetes mellitus (DM) type 2 were 102 (31 males and 71 females) depending on pathological diagnosis at age range from (20-70) years for both groups. The blood samples that collected from control and patients as two groups, the first group is kept without Nd:YAG laser irradiation, and the second group was irradiated by Nd:YAG laser. The laser device type HUAFGi Q-switched YAG laser system (at energy 700 mJ, 25 pulses, wave length 1064nm, frequency 1 Hz at 49º C, with a distance between the laser device and the tested tube about 10cm)). Then, the level of uric acid was measured by enzymatic colorimetric test (Uricase-PAP) in blood samples with and without irradiation for control and patients. The absorbance was read at 510 nm. The thermal effect of the laser energy was not assessed in this study.

Results

The current study revealed clearly as shown in table (1), that the represented data are statistically analyzed mean values and standard deviation (Mean ± Std. Deviation) for age that ranges from (20-70) of study groups (patients(n=102) (31 males and 71 females) and (control (n=97) (39 males and 58 females) .

Table 1: Statistical distribution of mean of age (Mean ± SD) according to the gender for Patients and Control.

Gender	patients (n=102)		Control (n=97)	
	n	Age (Mean ± Std. Deviation)	n	Age (Mean ± Std. Deviation)
Male	31	(54.16 ± 8.645)	39	(44.410± 8.732)
Female	71	(52.57 ± 8.037)	58	(46.47± 11.063)

Serum uric acid concentration level (mg/dL) was statistically high significant (P<0.001) when we compare its mean values between the level before and after Nd:YAG laser irradiation for control group(n=97) ,and decreased significantly(P<0.01)for patients group (n=102)by using student̓s t-test (Table 2).

Table 2 : Statistical t- Test for Nd:YAG Laser effect on patients and control groups between after and before irradiation.

Study groups	T	P-Value	C.S
Laser effect before - Laser effect after\ Patients	3.164	.002	P< 0.01(HS)
Laser effect before - Laser effect after \ Control	7.218	.000	P< 0.001(HS)

In table (3), the level of uric acid concentration (mg/ dL) for diabetic patients and control groups was considered with significant difference (P<0.05) before Nd:YAG laser irradiation, and highly significant difference (P<0.001) for control group after laser irradiation.

Table 3: Statistical t- Test of Laser effect between patients and control study groups.

Study groups	T	P-Value	C.S
Laser effect before\ Patients - Laser effect before\ Control	2.311	.023	P< 0.05 (S)
Laser effect after \ Patients - Laser effect after \ Control	3.789	.000	P< 0.001 (HS)

Discussion

The Nd:YAG laser is regarded as the most widely spread member among laser family members that are largely categorized together under the name: solid –state lasers. The primary mechanism of action of the standard 1064 nm wave length Nd:YAG laser on biologic tissue is dependent upon the conversion of radiant optical energy into thermal energy, this depending on absorption and scattering of beam within the tissue [19]. There is a big chance that thermal negative effects are caused by visible or infrared radiation, as a result of its exposure that may last from fractions of milliseconds to many seconds [18]. It is also thought by many studies that the potential alteration in multiple intracellular processes after irradiation is caused by the initial oxidative damage resulting from the free radicals [4]. There is a number of factors that may influence the state of oxidative stress, these factors include: chemical agents and radiation. Radiation –induced damage and oxidative stress are closely tied [15]. In control group, the uric acid concentration values showed an elevation at a big variation between before and after Nd: YAG laser irradiation at P<0.001. Since the contribution of the uric acid get to > 50% of antioxidant capacity of blood, it is considered as a protective factor against the oxidation and reactive oxygen species (ROS) that is produced by radiation. Uric acid affects scavenging when it comes to free radicals that produced by radiation (table 1) [3]. The results revealed that the uric acid concentration values showed a significant reduction at P< 0.01 in diabetic patients group after irradiation as compared to those blood samples without laser irradiation. In general, for non –diabetic sample, these reactive species are effectively excluded from several intracellular and extracellular antioxidants system. However, in diabetes sample, the increased intracellular concentration of ROS appears to overwhelm the ability of many cells to neutralize radicals [9]. There are indices that the antioxidant defense is impaired in diabetic subjects, suggesting a disturbed capacity of scavenging free radicals [16]. It is thought that the diabetic patient decreases ant oxidative system and increases products of oxidative damage versus control group, since the hyperglycemia itself contribute to the generation of ROS and oxidative stress which eventually leads to oxidative damage (Table 2) [5].

Conclusion

There is an effect of pulsed Nd : YAG laser irradiation on serum uric acid concentration values as a antioxidative marker which is highly significant after laser irradiation for control group and lower significant in patients group after laser irradiation.

References

1) Malek S.G; laser tissue interaction, Medical International SARL, 2001, Issue 3.
2) Jawad M.M, Abdul Qader S.T, Zaidan A.A, Naji A.W. and Abdul Qader I.T: An overview of laser principles, laser tissue interaction mechanism and laser safety precaution of medical laser uses. Intern. J. Pharmacol. 2011 (7):149-160.
3) Borek C.; Antioxidants and Radiation therapy .J. Nutr. 2004, 134 (11):3 207 S. 3209S.
4) Simon NL, Soule Bp., Ly D; Saleh AD., Savage JE.: Ionizing radiation induced oxidative stress alters mi RNA expression. Journal Pone PL.S ONE, 2009, 4 [7], 1-7.
5) Zhi Pan H., Zhang L., Guo M., Sui H, Li H., WA W., Qu N, Liang M., Chang D.: The oxidative stress in diabetes mellitus and diabetic neuropathy. A cta Diabetol 2010; 47 (suppl1): S71- S 76.
6) Hamblim M.R., Waynant R.W., Anders J. Mechanisms of low light therapy. Proc. SPIE, 2009, 7165: 716502-11.
7) Imlay J. A: Path ways of oxidative damage. Ann. Rev. Microbiol., 2003, 57: 395-418.
8) Shuryak I, Brenner DJ. Effects of radiation qualities on interactions between oxidative stress, protein and DNA damage in Deinococcus radiodurans. Radiation environ Biophys. 2010.
9) Da Silva S.B, Costa JP, Dintado M.E, Ferreira D C and Sarmento prevention and treatment of diabetic retinopathy – A review. J. Diabetes Metab; 2010; 1: 111.
10) Halliwell B, Gutteridge JMC: Free radicals in biology and medicine, Oxford University press, 2007; P: 143-165.
11) Marciniak A, Ltanicki K, Springer E, Barham S: Influence of non- enzymatic antioxidants on antioxidation status in acute hemorrhagic necroting pancreas-titis in rat. Bull. Vet. Inst. Pulawy, 2005, 49:133-139.
12) Spitsin Sand Kaptowski H: Role of uric acid in multiple sclerosis, In; Current Topics in Microbiology and Immuno-logy, 2001, 1(318): 325-342.
13) Manzato E: Uric acid: An old actor for a new role. Intern. Emerg. Med. 2007, 2:.1-2.
14) Shaye K. ,Eran K., Shmuel S., Shlomo S., Yechezkel S., and David O.,: The association between serum uric acid and diabetes mellitus is strong in women. J. Women health, September 2013; 22 (9): 782-789.
15) Spitz DR, Azzam EI, Li JJ, Gius D: Metabolic oxidation reduction reaction and cellular response to ionizing radiation: A unifying concept in stress response biology. Cancer Metast. Rev.; 2004, 23(3-4): 311-322.
16) Lippi G, Montagnana M, Franchini M, Guidi GC, Targher G; :Uric acid concentration in patient with acute coronary system. Internat. Emerg. Med., 2008, 3: 409-411.
17) Devasagayam T, Tilak J, Boloor K, Ghaskadbi S, Lele R.: Free radicals and antioxidants in human health: current status and future prospects. JAPI. 2004; 52:794–804.
18) Watanabe S: Basics of laser application to dermatology. Arch. Dermatol. Res., (2008):12_30.
19) TB. Mark: Development of a process for characterization of Nd:YAG crystals: A thesis :20 2003,4-8.