

Comparative analysis of cytogenetic effects of red (0,63 mkm) and infrared (0,85 mkm) Low Intensity Lasers

Gvantsa Kharaishvili, Anna Gogelia

Genetic Department of Clinical and Experimental Medicine Institute of Tbilisi State Medical University, Georgia

ABSTRACT

High therapeutic efficacy and wide-spread usage of Low-intensity Lasers made it interesting to investigate their cytogenetic effects. For this purpose white laboratory mice were irradiated by submaximal doses of red (0,63 mkm) and infrared (0,85 mkm) low intensity lasers and their cytogenetic effects on bone marrow cells were investigated microscopically. It is ascertained that submaximal doses of both (red and infrared) Low intensity Laser Irradiation (LILI) shows mutagenic influence on chromosome apparatus of laboratory animals and is directly connected with the number of session and exposition, but aberration frequency is relatively low for red laser (rl): 10 minute red laser irradiation during 5 days doesn't change the number of aberration in comparison by the disorder of cell cycle or blockage of nucleic acid repair process.

KEYWORDS: *Low Intensity Laser, chromosome aberrations, bone marrow*

Together with the traditional means of modern medicine alternative, none-pharmacological methods have found their feet. Among them Low Intensity Laser beam has the most therapeutic efficacy. Its anti-inflammatory, analgesic, reparative, immunostimulative and rephlexogenic activity are the results of main features of Lasers, which are coherency, monochromacy and high penetration of tissues [1,2].

There are many theories to explain the mechanisms of Laser effects on biological objects. The main idea of these theories lies in absorption of light by tissue, that is followed by the chain of processes: The primary photolytic or photochemical action – photosensibilizing processes and energy transportation to membrane components of cell – production of physiologically active materials – involving neurohumoral reactions – terminal photobiological effect.

Change of cell metabolism – induced by Laser is reflected on chromosomes – basic components of the nucleus, as nucleic acids have high sensitivity towards light beam. There are many experimental researchers and different opinions about genetic danger of lasers. The number of researchers claim that they are safe. e.g. Irradiation with red Laser (660 nm, 12 mW, 5 kHz, doze 2-20 J/cm²) on mammalian cells doesn't cause any cytotoxic or genotoxic effect [3]; Its radioprotective effect is also concluded and it has expressed after radiation injury, but prophylactic, defensive one is not shown [4]; Later, T. Karu at al. established, that pre-irradiation with 1 J/cm² of HeNe beam increases the number of survival HeLa cells after

gamma-irradiation. Radio adaptation was observed at high level of X-rays [5]. Despite that fact, there are investigations according which various doses of Lasers cause indisputable mutagenic effects. e.g. the number of acentric fragments increased in 10 h as a result of 193, 223 and 248 nm, 5-10 mW Laser irradiation, it normalized in 72h [6]. Structural chromosomal abnormalities were found in onion (*Allium fistulosum* L.) cells at wavelength 6328 Å, output 2 and 14 mW. In comparison with control group the number of structural abnormalities increased according to Laser doze [7]; In other experiment, Chinese Hamster Cells were irradiated by Argon Laser and cytogenetic effect was received. Aberrations were represented with chromatid and chromosomal gaps, dysenteric chromosomes. Aberration frequency was highest at the wavelength of 514,4 and 488,0 nm [8].

The aim of our experiment was estimating effects of submaximal doses of red (rl) and infrared (irl) Low Intensity Lasers .

The object of the research was white, nonlinear, laboratory mice of 20-30 g weight. Two groups of mice were irradiated: The 1-st group was irradiated with red Laser (wavelength 0,63 mkm, output 70 mW, frequency 80 Hz); and the 2-nd one with infrared Laser (0,85 nm, 18 mW, 150-200 Hz). Irradiation was carried out with therapeutic instrument „Adept”, with contact method. The number of sessions was 5, 10 and 15 days, exposition was 10, 20 and 30 minutes. In general 18 mice were irradiated during the experiment.

Irradiation Type	Session Num.	Metaphase Num.	Aberrationtypes						Sum
			Aneuploidy		Acentr.fr.	Gaps	PSC	Polyploidy	
			Hyperpioidy	Hypoploidy					
Infrared 0,85 mkm	5	190	7(3,7%)	2(1,04%)	-	1(0,52%)	-	-	5,26%
	10	210	7(3,3%)	3(1,4%)	1(0,48%)	1(0,48%)	1(0,48%)	-	6,14%
	15	178	12(6,5%)	-	1(0,9%)	2(1,8%)	-	1(0,9%)	10,1%
Red 0,63 mkm	5	200	5(2,5%)	-	2(1%)	1(0,5%)	-	1(0,5%)	4,5%
	10	150	5(3,3%)	2(1%)	-	1(0,66%)	-	-	5,26%
	15	113	8(7%)	-	1(0,88%)	1(0,88%)	-	-	8,76%
control		214	5(2,3%)	-	2(0,9%)	1(0,45%)	2(0,9%)	-	4,55%

Tab.1 Direct relation between the aberration frequency, session number and exposition is also obvious..

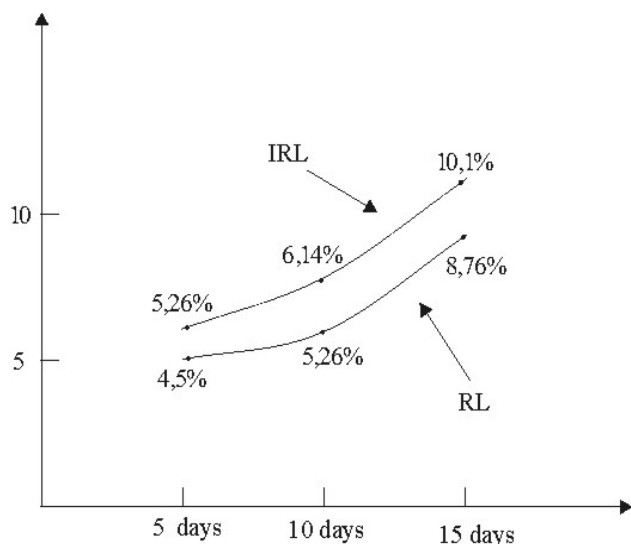


Fig.1 Changes in chromosome aberration frequency in relation with the number of session induced by red (rl) and infrared (irl) laser.

After the last irradiation (in 72h) 0,5 mcg/ml of colchicine was injected intraperitoneally to stop cell cycle on the metaphase stage. The mice were killed by decapitation. Bone marrow drugs were prepared by the Ford method

and stained with azur-eozine. Metaphases were coded and studied under microscope for the objective analysis.

The gained results prove the increase of the number of chromosome aberration in comparison with the control group. Aberrations increased as a result of both types of Lasers, this number is relatively low for red Laser. Direct relation between the aberration frequency, session number and exposition is also obvious. (see Tab.1).

It must be remarked that 10 minute red Laser irradiation during 5 days doesn't change the number of aberrations (4,5%) in comparison with control rates (4,55%).

It is also underlined that the increase of aberration frequency for both types of Laser more significant after 10 session: 10,1% (irl) and 8,76% (rl) (see Fig.1). The number of numerical abnormalities, such as aneuploidy is more common. Acentric fragments, gaps, premature separation of chromosomes were also found.

Such results can be explained either by the disorder of cell cycle or blockage of nucleic acid repair that might be caused by the microthermal, vibrational and conformational, or strong electromagnetic field actions of Laser beam photons [8].

Thus, chromosomal changes caused by submaximal doses of red and infrared LIL are directly connected to exposition and the number of sessions.

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Сравнительный анализ цитогенетических эффектов красных (0,63 мкм) и инфракрасных (0,85 мкм) лазеров

Гванца Хараишвили, Анна Гогелия

Отдел генетики Научно-исследовательского института экспериментальной и клинической медицины Тбилисского государственного медицинского университета, Грузия

РЕЗЮМЕ

Высокая терапевтическая эффективность обусловила широкое применение низкоинтенсивных лазеров (НИЛ). Однако обнаружались цитогенетические эффекты этих лучей. Изучено влияние субмаксимальных доз низкоинтенсивных лазеров на хромосомы костного мозга белых лабораторных мышей; применялись красные (0,63 мкм) и инфракрасные (0,85 мкм) лазерные лучи. Установлено, что субмаксимальные дозы низкоинтенсивного лазерного излучения (НИЛИ) вызывают мутагенный эффект в хромосомном аппарате лабораторных животных, выраженность которого прямо пропорциональна экспозиции и количеству сеансов. Вместе с тем, частота хромосомных aberrаций сравнительно ниже при действии красного света: при 5-дневном облучении этим лазером с 10-ти минутной экспозицией результаты не отличаются от контрольных показателей, что, видимо, обусловлено нарушением клеточного цикла или повреждением репаративных процессов нуклеиновых кислот.

КЛЮЧЕВЫЕ СЛОВА: низкоинтенсивные лазеры, хромосомные aberrации, костный мозг