THE FIRST LAW OF PHOTOCHEMISTRY AND LASERS

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Even among scientists, physicians and laser experts, there exist misconceptions about the properties of light. However, if people using light in research and in therapy would just learn the First Law of Photochemistry, then many of the misconceptions about light would disappear, and the quality of papers on the effects of light would improve greatly. In fact, prior knowledge of the First Law of Photochemistry would prevent many research projects from even being started, and would also prevent reviewers from accepting papers that ignore this Law. This brief communication is intended to explain the First Law of Photochemistry, and to clarify some existing misconceptions about lasers.

The First Law of Photochemistry

The First Law of Photochemistry states that "Light Must Be Absorbed for Photochemistry to Occur". Since photobiological and phototherapeutic effects are initiated by photochemistry, unless light is absorbed by a system, no photochemistry will occur, and no photobiological effects will be observed. Thus, a simple absorption spectrum (or transmission spectrum) of the system under study will immediately tell one if a particular wavelength of light has a chance of producing a photobiological effect. To repeat, if a system does not absorb a particular wavelength of light, then that wavelength of light will have no effect on the system, no matter how long one irradiates.

Some years ago I wrote a Letter to the Editor of the journal, Pain,[1] entitled "Ignorance of Photobiology: a Major Pitfall in Using Lasers in Medicine." My letter concerned a paper published in that journal on nerve stimulation by light, as related to the low level laser therapy of pain. This paper stated that "the cornea is an ideal preparation for this investigation:[1] it is optically transparent to He-Ne laser radiation, which assures that the entire nerve is actually exposed to any potential effects of this radiation."

I wrote: "If this 'ideal' property of the cornea is really true, i.e., it is truly 'optically transparent' to 632.5 nm radiation, then from the First Law of Photochemistry one can immediately prove, without any doubt, that the experiments (reported in this paper) will be negative, as in fact they were." Thus, we have an example where a lack of knowledge of the very simple First Law of Photochemistry resulted in the waste of time and money by the researchers, and allowed the

reviewers to accept a paper that should have been rejected. This was not the only problemwith this paper.

Unfortunately, there are many papers in the literature that would not (and should not) have been published, if the authors and the reviewers had known the First Law of Photochemistry.

Lasers Do Not Have Magical Properties

Lasers can seem magical if their unique properties of micro-dot focusing, very high intensity, coherent radiation, possibility of ultrashort pulses, and monochromaticity are ALL made use of. If the first four properties are not useful in a particular application, then a laser is just an expensive light bulb (albeit, monochromatic), whose emitted radiation follows (except for coherence) all of the same laws of physics and chemistry that the same wavelength of light from a conventional (non-coherent) light source follows.

One practice that has furthered the misconception that lasers are magical is the use in publications of vague terms such as "Nitrogen and He-Ne Laser Exposure...", "...Effects of Laser Therapy in ...", or "...with Diode Laser Therapy", instead of specifying the wavelength of light that the laser produces. A laser itself can produce no biological effect, unless you drop it on your toe. A laser is just an apparatus that produces light. It is the emitted light from a laser that produces photochemistry and therefore photobiology, not the laser (apparatus) itself.

This then is a plea to all authors to specify in the title, abstract and text of their papers, the wavelength of the light that the laser produces (not just the gas used in manufacturing the laser). Of course, in the experimental section, all of the manufacturer's specifications for the laser should be mentioned, as well as the dosimetry.

Summary

Always remember The First Law of Photochemistry: "Light Must Be Absorbed for Photochemistry to Occur", and that photochemistry produces photobiological effects.

References

1. Smith KC, Ignorance of Photobiology: a Major Pitfall in Using Lasers in Medicine, Pain, 47, 243, 1991.