Ruby Laser Effects on the Blood Flow in Micro Vessels

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INTRODUCTION

The purpose of our experiment is to study the physiological reaction involved by low intensity laser irradiation on blood micro-vessels.

Due to the physical properties of lasers, it is possible to focus the light power on a very small area such as micron square area. So, we can irradiate, with a given light intensity, a very limited part of a micro-vessel.

According to the work of KOCHEN and BAEZ (1, 2, 3) who studied laser action on mesenteric vascular system in the rat, we built an experiment in order to observe reaction of micro-vessels found in a transparent cell implanted in rabbit's ear.

The initial method, described by J. C. SANDISON (5), start with the following principle.

If a whole is made in a rabbit's ear and if we replace the tissue by two glass lamellas, very closed to each another, conjunctive tissue will fill the space between the lamellas and the microscopic observation of the new tissue become possible.

MATERIAL AND METHODS

The study use a transparent cell for a rabbit's ear, according to the technic described by AHERN, BARCLAY and EBERT (4).

Cell implantation is performed on rabbit anesthetized with an intravenous injection. The ear perforation is made with a punch in order to obtain four perforations: one central and three peripheral ones.

Then, starting from the central perforation toward the peripheral ones, the skin is separated from the cartilage on both the internal and the external faces of the ear. With small scissors, the lifted tissue is cut into three segments which are pinned back away the opening; this operation is performed on both side of the ear. In this way, a circular area, consisting only of cartilage, is exposed.
The prepared surface is cleaned with a normal saline solution mixed with streptomycin to prevent infection.

Then, the experimental cell called the "Clark cell", is installed. The cell is made from a plastic material and consists of a circular plate, the central portion of which is slightly raised and fits into the central perforation. The plate is also provided with three pins which fit into the peripheral perforations. This circular plate is placed on the internal surface on the rabbit's ear. On the external face, the perforation is covered by a thin glass lamella which is held in place with a plastic ring fastened to the pins with copper screws. In this way, the central portion of the ear is situated between the two glass lamellas, enabling the microscopic observation of the experiment.

Four or six weeks after the implantation, the vascularisation of the cell is complete and the cell is ready for use.

The experiment use a ruby laser coupled with a Richert microscope.

The laser (type R. L. 10M from the Compagnie Générale d'Electricité) is a relaxed laser with a 400 Microseconds impulsion time; the emission wavelength is 694.3 nanometters, and the energy level, on the target, may be adjusted from 3 to 13 millijoules.

The laser head mounts one of the optical way of the microscope; the two optical axis are aligned in order to obtain a good control of the laser impact.

The other optical way of the microscope is reserved for the observation which is made with a 480 magnifying power. A safety isolation of the two optical way is done during the laser shot.

The results are recorded using a T.V. camera with a monitor and a video tape recorder.

During the experiment, the rabbit is treated with an intra-muscular injection of valium (5 mg / k.w.) in order to obtain more easy and complete immobilization; this drug, without any effect on peripheral vasomotricity, is fast active (10 min.) and its action persists during several hours.

The rabbit's ear is then placed on the microscope plate and the cell adjusted on the optical axis.

We choose for the experiment superficial vessels having 15 to 40 microns diameter and a constant blood flow, so that we can clearly observe the circulation of leucocytes, erythrocytes and platelets; the vessel is centered on the laser axis and a given light energy is delivered.

After the laser shot, we observe the physiological reactions during few minutes.

All the steps of the experiment are recorded in order to perform a fine analysis of the physiological reactions which are often very fast.