Effect of helium-neon laser on wound healing

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To estimate the biostimulatory effects of low intensity laser radiation on healing of skin wounds, two linear skin wounds were produced on either side of dorsal midline in rats and immediately sutured. Wounds on the left side were irradiated daily with helium neon laser at 4 Joules/cm² for 5 min., while those on right side were not exposed and served as controls. The mean time required for complete closure in control group was 7 days while irradiated test wounds took only 5 days to heal (P<0.01). The mean breaking strength, as measured by the ability of the wound to resist rupture against force, was found to be significantly increased in the test group. Early epithelisation, increased fibroblastic reaction, leucocytic infiltration and neovascularisation were seen in the laser irradiated wounds. The results establish the biostimulatory effects of low intensity laser radiation on healing of skin wounds.

Proper and timely wound healing is a vexing problem, faced by all clinicians managing postoperative patients. In majority of patients, normal healing establishes tissue integrity quickly and effectively. However, at times, this healing is delayed and the ability to accelerate the wound healing becomes a highly desirable objective. For instance, if the rate of epithelisation could be enhanced in burns, the morbidity and mortality would be considerably reduced.

Although it is possible, experimentally, to modulate wound healing by physical and pharmacological means, the magnitude of these effects is too small to be of clinical significance. The possible biostimulatory effect of laser is of recent interest and small subdestructive repetitive doses of laser are claimed to be useful in healing of trophic ulcers and indolent wounds1. This study has been conducted to investigate the effect of low energy laser radiation on healing of clean wounds.

Healthy male albino rats (35) weighing between 250 and 350 g were used. They were fed on standard diet. The animals were anesthetized by intramuscular Ketamine hydrochloride (15-25 mg) using aseptic conditions. Paired wounds were made on the shaved dorsal skin on either side of the midline. The incision were 2 cm. long, extending to the loose subcutaneous tissue and were closed immediately with three sutures 5 mm apart using 3/0 silk.

A helium-neon gas laser (continuous wave type) was assembled by Spectra laser, New Delhi (total output 5 mw, wavelength 632.8 nm beam diameter 2 mm at a distance of 1 m) available at the J.K. Institute of Electronics, Allahabad. Twelve animals were examined on days 3 and 5 and 11 on day 7. Laser dose of 1.6 mw/cm² for 2 min. daily for 14 days was used (Energy density 0.2 Joules/cm²). A constant spot of 2 mm. diameter at the centre of the wound on the left side was irradiated. The unexposed wounds on the right side served as controls. All wounds were examined macroscopically for wound closure. The visual criteria for wound closure was chosen arbitrarily and consisted of reduction in the size of the scab to less than a pinhead which was either cast off or was removed easily without bleeding.

The breaking strength was determined as a measure of wound healing using a simple pulley and pliable copper wire attached to a light plastic pan containing weights. Eighteen animals were examined on 7th day and 17 on 14th day. Strips of skin containing the sutured wounds were removed on 7 and 14 (post-injury) day. The stitches were cut and the final specimen contained 1 cm of the incision line transversely at its centre. Each strip thus contained two pieces of normal skin joined by 1 cm of incision line. Both pieces of the strip were pierced by 1/0 silk suture, one was attached to the tensiometer frame and the other to the copper wire.

For histopathological studies wounds were biopsied on 3, 5 and 7 postoperative day. The wounds were completely excised with a thin rim of surrounding skin, no subcutaneous tissue was included. The skin gap was stitched with 3-4 silk sutures. Paraffin blocks of the tissues were prepared and serial sections were routinely stained with haematoxylin and eosin along with Von Gieson's, Verhoff's and reticulin stains. The first, third and fifth sections were studied for leucocytic infiltration, neovascularisation, fibroblastic proliferation, epithelisation and collagenisation according to the following criteria (scores):

(i) Leucocytic infiltration—Absent (0);0-5 cells/HPF (1);6-30 cells/HPF (2);>30 cells/HPF (3).

(ii) Neovascularisation—Absent (0);1-5 new blood vessels/HPF (1); 6-10 new blood vessels/HPF (2); 11-15 or
In this study the acceleration of wound healing as observed on gross examination is in accordance with the findings of Koshlev et al. In this study he irradiated open skin wound in albino rats daily and the wound closure was followed by photography in a standardized way. The rate of closure was enhanced significantly postoperatively. Similar findings were reported by other workers.

On histological examination greater degree of fibroblastic activity was observed in the test wounds as compared to controls. Similar findings have also been reported previously. Increased collagenisation was also found and has been observed by earlier workers.

The increased fibroplasia can be an undesirable component of wound healing and it must be evaluated in view of the complex factors affecting wound healing. This is in accordance with previous workers who observed that He-Ne laser preferentially affects the fibroblasts and epithelial cells along with stimulation of phagocytic activity of polymorphs. Epithelisation and fibroblastic proliferation were found to be the main factors in wound healing under the effect of lasers.

The breaking strength has been reported to be one of the most valid measure of wound healing. The mean breaking strength on the 7th and 14th postoperative day in the irradiated group was 6.1 and 17.7% greater than the non-irradiated controlateral side. This finding is similar to previous experience.

Although the effect of He-Ne laser on wound healing is predominantly local, its biostimulatory effect can be seen in the contralateral nonirradiated side as well (Table 1). Similar findings have been reported by using low power density laser in the range of 0.25 to 4 mw/cm². Power density is the most important determinant of the effect of laser.
laser irradiation on wound healing. Other parameters like wave length, wave character, duration and frequency of application are of secondary importance. Similar results were produced by a wide variety of wave lengths and dosage schedules using Nd-Yg laser; pulsed ruby laser and CO2 laser.

There are some drawbacks using low dose He-Ne laser. Low dose laser exposure may result in viable atypical cells forms and chromosome damage. Tumour cell proliferation and growth areas were also shown to be stimulated by low dose laser but in this study no such effect could be demonstrated in the test wounds in which epithelisation was complete on 5th day. Thus, due to biostimulatory effect of low dose laser, it may be recommended for treatment of clean wounds to achieve early healing with stronger scar tissue.

References
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