Lasers and Pain Treatment

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Summary

The clinical application of low incident power density laser radiation for the treatment of acute and chronic pain is now a well established procedure. This paper reviews the currently available English speaking literature and summarises a selection of serious scientific papers which report a beneficial effect following the treatment of a wide variety of acute and chronic syndromes whose main presenting symptom is pain.

Introduction

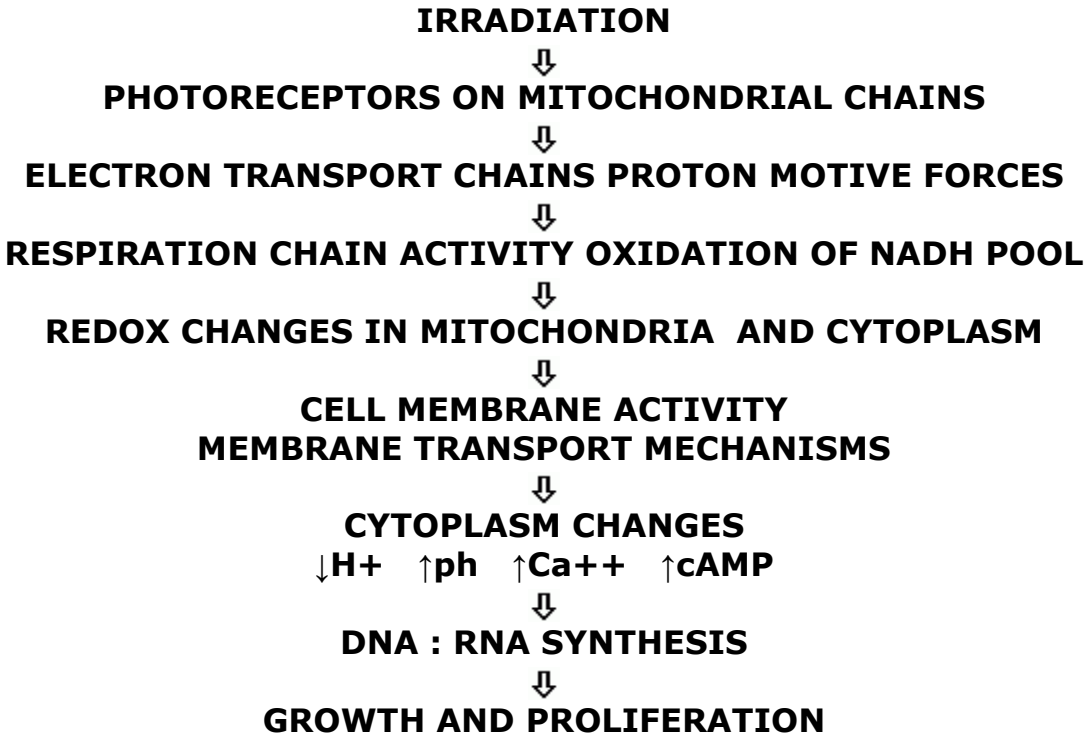
The Helium-Neon (He-Ne) laser at a wavelength of 632.8 nm has proved very successful in promoting wound healing particularly in indolent ulcers resistant to conventional methods of therapy. However, its limited depth of penetration and low power output have rendered it less effective when treating more deep seated causes of pain. The laser more frequently used for pain therapy is the Gallium Aluminium Arsenide (GaAlAs) diode emitting coherent light in the near infra-red waveband, usually 820 - 830 nm, and with a continuous wave power output of some 60 mW. The optoelectronic rationale for choosing these parameters has been discussed by Moore and Calderhead (1).

During the past 15 years experimental research has greatly added to our knowledge of the response of tissue radiation. Figure 1 summarises some 10 years work by Karu (2) into the cellular response to photon energy. Additional research at the Tissue Repair Research Unit at Guy`s Hospital, London, has detailed the local tissue changes following exposure to laser light. The current concept is one of a dual response to laser bioactivation.

The immediate or primary effect is a local tissue response to direct irradiation and comprises vasodilatation with increased circulatory flow: enhanced lymphatic drainage; increased

neutrophil, macrophage and fibroblast activity; and an improved metabolic function in depressed or damaged cells. The delayed or secondary response consists of a systemic effect caused by circulating photoproducts of irradiation in the blood and lymphatic systems. Increased plasma concentrations of certain types of prostaglandins, enkephalins and endorphins have all been identified and most probably play a major role in the mechanism of pain attenuation.

Figure 1: Cellular response to laser irradiation



Acute pain therapy

Acute trauma is invariably associated with a degree of soft tissue injury comprising swelling, haematoma, pain, reduced mobility and in the lower limbs impaired weight bearing. Sporting injuries and domestic accidents usually involve damage to muscles, joint ligaments and tendons. Examples include a sprained ankle or

wristed or a twisted knee. Most extensive soft tissue damage tends to result from industrial crush injuries or road traffic accidents. In the absence of bone fracture or other injury demanding priority treatment laser therapy should be instituted at the earliest opportunity. Kumar (3) reported a comparative study in 50 patients with inversion injuries of the ankle. He found that compared to conventional physiotherapy the laser treated patients showed a more rapid resolution of symptoms and an earlier return to full weight bearing. Patients were treated with a GaAlAs diode laser (830 nm: 60 mW) at 48 hour intervals on a maximum of 3 occasions. A similar therapeutic regime has been described for whiplash injuries of the cervical spine (4). Ben Hatit and Lammens (5) used a defocussed CO_2 laser to treat a variety of acute musculoskeletal problems. The energy density varied between 40 - 70 J/cm^2. Patients were treated twice a week for up to 10 sessions.

Beneficial effects of laser therapy in acute small joint inflammation in rheumatoid arthritis has been described by Asada et al (6). Multiple point irradiation using a GaAlAs diode (830 nm:60 mW) was applied for 15 seconds to each point. Pain was reduced by up to 66 % together with an improvement in the measured range of movement (ROM).

In a similar report involving 938 patients with osteoarticular pain Soriano (7) found pain attenuation of 88 % when treating a variety of acute conditions such as tendosynovitis, lumbago and cervical pain. He used a GaAs diode (940 nm: pulsed 10,000 Hz: average power 40 mW) to treat patients twice weekly for a maximum of 10 sessions. The energy density delivered was 6 - 10 J/cm^2 per irradiated point.

Laser therapy also proved helpful in reducing the severity and duration of postoperative pain. In a comparative study involving 20 patients undergoing elective cholecystectomy Moore et al (8) reported a 50 % reduction in the postoperative pain experienced by the laser treated patients together with a concomitant reduction in analgesie requirements.

Chronic pain syndromes

Chronic pain, as the name implies, may last for months or years. Pain may arise as a result of damage caused by trauma or surgery or be manifested as a symptom of a systemic desease

process. In later life pain due to musculoskeletal "wear and tear" is very common. Finally neuralgic pain such as postherpetic or trigeminal neuralgia can cause prolonged problems to sufferers. A high percentage of patients referred for laser therapy will have already shown little or no response to conventional methods of treatment.

In rheumatoid arthritis (RA) laser therapy can benefit not only the pain of acute small joint inflammation but also the more established chronic pain of the disease. Gartner (9) in an excellent review article on rheumatology considered some 18 papers published over a 10 year period. All involved double blind trials of therapy with 5 having a cross-over element. In considering the effect of laser therapy in chronic rheumatoid and associated musculoskeletal conditions all but one of the reports noted a significant improvement in pain. In his own work Gartner used a 904 nm infra-red laser to treat a variety of tendinopathies with a better than 80 % success rate in relieving pain. He compared this to a similar rate of pain attenuation using anti-inflammatory drugs (NSAIDs) but noted that whilst laser therapy was free of side effects some 20 % of patients treated with NSAIDs suffered unacceptable side effects of medication. Asada and his colleagues (10) in a further study of some 170 patients with rheumatoid arthritis used similar laser parameters and treatment protocols to their earlier reported work. The group achieved pain attenuation of up to 90 % and improvement in ROM of up to 56 %.

In a report of some 1000 treatments using a GaAlAs diode laser (830 nm: 60 mW) for a wide variety of chronic pain syndromes Moore (11) noted an overall reduction in pain levels of some 70 %. Trelles et al (12) used a similar diode laser to treat 40 patients with degenerative joint disease to the knee. They delivered 18 J/cm^2 to each of 4 points around the knee twice a week for 8 weeks and reported a significant pain reduction in 82 % with improved joint mobility. Li (13) used a 25 mW combined CO^2/HeNe laser to treat 90 patients with cervical spondylosis. Laser therapy was administered to a variety of acupuncture points for 10 minutes daily for 2 periods each of 10 days with an intervening rest period of 10 days. 90 % of patients showed symptoms improvement with an excellent result in 43 %.

Fender and Diffee (14) reported an interesting trial involving patients suffering from chronic generalized musculoskeletal pain. They irradiated the stellete ganglion using a HeNe laser

with an initial exposure of 6 minutes (36 J/cm^2) gradually increasing over 4 - 6 weeks to a maximum of 15 minutes (90 J/cm2). They postulated a mechanism of reduced sympathetic irritability causing a stabilisation of the response loop and a breaking of the pain cycle. In resistant cases they also treated segmental dermatomes and site specific trigger points.

Patients suffering from postherpetic neuralgia (PHN) have shown a good response to laser therapy. In a double blind cross-over trial Moore et al (15) reported a mean reduction in pain levels of 74 %. Patients were treated with a GaAlAs diode (830 nm: 60 mW) with the laser applied in contact mode to the centre of each 2 cm^2 grid over the affected area giving 24 - 30 J/cm^2 to each point. Treatment was given twice a week for 4 weeks. Using an identical treatment protocol but an extended regime of some 12 weeks Kemmotsu et al (16) reported at the end of treatment pain attenuation of 89 %. Otsuka and colleagues (17) used an 8.5 mW HeNe scanner to treat the acute rash of herpes zoster. Once the skin rash has subsided treatment was continued using a GaAlAs laser (830 nm: 60 mW). Within 1 month pain had been reduced by 76 % with a final end treatment improvement of 97 %. The early introduction of laser therapy produced a rapid resolution of acute herpes zoster rash and a reduced incidence of PHN.

Discussion

Laser therapy is effective for a wide variety of acute and chronic pain syndromes. During the past 7 years the Laser Therapy Journal has featured some 30 papers on the subject. The preferred laser is the GaAlAs diode emitting light in the near infra-red usually at 830 nm. The majority of reports detail a power output of 60 mW continuous wave. Recently, however, researchers have been assessing the use of higher output powers in the range of 150 - 300 mW.

In a prelim inary trial Yamada and Ogawa (18) compared the results of treating PHN with 60 and 150 mW. They found that the higher output power reduced both the frequency and duration of the treatment sessions and improved pain attenuation by some 25 %. Ohshiro (19) has devised an ingenious protocol for a computer controlled double blind comparative trial which compensates for the placebo effect of treatment and for patient

and therapist bias. In a paper comparing the therapeutic outcomes in 2 geographically separate but otherwise identical clinics Shiroto (20) described how a positive therapist attitude motivated by enthusiasm and commitment can improve the results of therapy by 15 - 20 %.

There remains a need for more scientific studies based on well constructed double blind comparative trials. Nevertheless the bulk of published work to date supports the use of laser therapy for the treatment of pain. In a repor of the cost-effective benefits of using laser therapy to treat PHN Moore (21) noted that, compared with conventional methods of treatment, laser proved to be not only more effective but more economical as well. The added advantage of absence of side effects, non-invasive nature of therapy and the case of application ensured good patient acceptance of the treatment modality.

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Joint International Laser Conference in Edinburgh

In September, 2003, the Edinburgh International Conference Centre in Scotland hosted the Joint International Laser Conference, organized jointly by the American Society for Laser Medicine and Surgery, European Laser Association and British Medical Laser Association. More than 500 registered participants had the opportunity of seeing not only the most advanced laser medical technology presented by 39 exhibitors, but also of attending numerous meetings and presentations, getting acquainted with top issues of laser surgery and therapy. A significant portion of scientific papers and posters dealt with laser therapy (LLLT), and theory was well supplemented with a series of educational courses called "How I do it". The organizers provided Laser Partner with full text of some of the lectures and now we bring the first one.

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