COMPARATIVE STUDY OF 60 mW DIODE LASER THERAPY AND 150 mW DIODE LASER THERAPY IN THE TREATMENT OF POSTHERPETIC NEURALGIA

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Over the past year, eight patients with postherpetic neuralgia (PHN) were treated with diode low reactive-level laser therapy (LLLT) with an output power of 60 mW at 830 nm, while a further nine cases of PHN were treated with 830 nm diode LLLT at an output power of 150 mW. The data were analyzed to compare the efficacy of the two regimens. Although all the patients were successfully treated, those patients who had received LLLT at 150 mW showed a quicker overall recovery from PHN when compared to those treated with 60 mW LLLT. No clinically significant adverse effect resulting from either of the two regimens was noted. Our results in this preliminary study suggest that 150 mW LLLT was a much more effective therapy than 60 mW LLLT for the treatment of PHN within the period tested. Further controlled and double blinded studies in larger populations will be required to corroborate these preliminary findings.

Key words: LLLT; 60 mW and 150 mW diode laser; postherpetic neuralgia

Introduction

It is well recognized that low reactive-level laser therapy (LLLT) is being utilized in the management of chronic painful diseases, and that this occurs mainly in pain clinics. Recently, LLLT, using a GaAlAs diode laser (60 mW 830 nm, C/W),^{1,2} a 904 nm low energy infrared laser (6 mW)³ and a He-Ne laser (8.5 mW, 632.8 nm)⁽⁴⁾ have all been reported as being an effective treatment for postherpetic neuralgia (PHN). More recently, we have also successfully treated PHN patients with LLLT using a GaAlAs diode laser (150 mW, 830 nm). Until now, however, there has not been a comparative study on the effectiveness of 60 mW LLLT and 150 mW LLLT in the treatment of PHN. The present study compared these two regimes.

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Patients and Methods

Seventeen patients with PHN were selected for this study. All the patients had been unresponsive to at least two weeks of conventional therapy for PHN and were recognized as intractable cases. The group which received 60 mW LLLT consisted of 4 females and 4 males, ranging in age from 55 to 88 years (mean 70.3 ± 13.0 years). The range in duration of PHN prior to LLLT was 0.5 to 3 months (mean 1.7 ± 0.9 month). These 8 PHN patients had visited our clinic complaining of moderate to severe pain during the previous 6 to 12 months. The group which received 150 mW LLLT consisted of 6 females and 3 males ranging in age from 51 to 83 years (mean 68.2 ± 8.9 years). The range in duration of PHN prior to LLLT was 0.5 to 3 months (mean 1.3 ± 0.9 months). These 9 PHN patients had visited our clinic

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complaining of moderate to severe pain during the previous 6 months.

To deliver the LLLT, two diode laser systems were used. One of them was model MLD-1002 (Mochida, Tokyo, Japan), a GaAlAs producing an output power of 60 mW at 830 nm in a continuous wave (C/W) and the other was model MLD-1003 (Mochida, Tokyo, Japan), a GaAlAs producing an output power of 150 mW at 830 nm in a continuous wave (C/W). LLLT was applied to the PHN area for 3 min (10.8 J with 60 mW, 27 J with 150 mW) to 20 min (72 J with 60 mW, 180 J with 150 mW), depending on the size of the affected areas. LLLT was applied 1 to 5 times a week for out-patients and 5 to 6 times a week for in-patients.

Pain scores were obtained using a linear analog scale (0-10). A score of 10 indicated the initial pain level in all patients prior to LLLT (maximum pain level), a score of 5 correlated with a fifty percent decrease from that initial pain level, and 0 correlated with no pain, in other words, total pain attenuation.

The effectiveness of the above-mentioned treatments was assessed utilizing the following 6 points: (1) frequency of LLLT until a pain score of 5 was achieved; (2) duration of LLLT until a pain score of 5 was achieved; (3) total frequency of LLLT; (4) total duration of LLLT; (5) pain score after LLLT (6) rate of improvement. Improvement as a result of LLLT was classified as "excellent" when pain scores were reduced from 10 prior to LLLT to 0 after LLLT; "very good" when pain scores were reduced from 10 to 1 or 2; "good" when pain scores were reduced from 10 to 3-4; "fair" when pain scores were reduced from 10 to 5-6; and "no change" when pain scores remained between 7-10 after LLLT. The rate of improvement was calculated as follows: The number of patients of a particular group which were classified as excellent, very good or good were divided by total patient number $\times 100$. Note that all assessments were carried out by the same doctor. Statistical analysis was performed by Student's *t*-test and a value for *P* less than 0.05 was deemed statistically significant.

Results

The patients' backgrounds and the effectiveness of 60 mW and 150 mW LLLT for PHN are summarized in Tables 1 and 2. There were no statistically significant differences in the mean patient age and the duration of PHN prior to LLLT in the two groups. Means of the frequency and duration of 60 mW LLLT until a pain score of 5 was achieved were 5.5 and 15.9 days, respectively, while those of 150 mW were 1.8 and 3.9 days, respectively. Means of the total frequency and duration of 60 mW LLLT were 13.5 and 5.8 weeks, respectively,

while those of 150 mW were 9.6 and 4.4 weeks, respectively. The averages of the final pain scores after treatment with 60 mW and 150 mW LLLT were 2.1 and 1.4, respectively. The rates of improvement corresponding to 60 mW and 100 mW LLLT were 75.0% and 100%, respectively. The group which was subjected to 150 mW LLLT had a faster rate of improvement from PHN than the group which was subjected to 60 mW LLLT. At the final observation, the pain score and rate of improvement with the 150 mW LLLT were also slightly superior to that of the 60 mW LLLT. There were no adverse effects reported in any patient from either of the two regimens.

Discussion

It has been reported that some therapies such as iontophoresis therapy,⁽⁵⁾ infrared A radiation therapy,⁽⁶⁾ liquid nitrogen therapy⁽⁷⁾ and topical capsaicin treatment⁽⁸⁾ have been effective in the treatment of intractable PHN. Nevertheless, it appears that such therapies have both merits and demerits, and that not all of the PHN patients who received those therapies achieved satisfactory results. It is generally considered that epidural block and stellate ganglion block (SGB) are two of the more successful therapies for PHN, however, only when skilled anaesthesiologists are available are these high level techniques able to be utilized for PHN patients.

Recently LLLT has been reported as being an effective treatment for PHN.⁽¹⁻⁴⁾ Although the mechanisms of LLLT in relation to PHN have as yet to be fully elucidated, some or all of the following appear applicable: activation of $\text{Ca}^{++}\text{ATPase}$ in the vessel wall in the irradiation areas; dilation of blood vessels; increase in blood flow and volume (leading to an increase in skin surface temperature); synthesis and transfer of endogenous pain mediating substances; stabilization of nerve cell membranes; increase in irradiation threshold; and suppression of nerve excitability. Increases in blood flow and skin surface temperature have been confirmed by assays with a blood flow meter⁽⁹⁾ and thermogram.⁽⁹⁾

Although the mechanisms of PHN itself have as yet to be fully elucidated the following appear applicable: decrease in pain threshold of dorsal nerve roots; increase in sympathetic nerve tension; abnormality of eruption (keloid); and pain transfer. Pain transfer occurs as follows: (1) sympathetic nerve excitation by pain stimulus; (2) involuntary contraction of muscles and vessels; (3) metabolic disorders following histanoxia; (4) increase in release of nociceptive pain transfer substances such as acetylcholine, bradykinin and substance P; and (5) increase in pain. The aforementioned pain

Table 1: Summary of PHN patients subjected to 60 mW LLLT.

Case	Age	Sex	Duration of PHN prior to LLLT (months)	Frequency & duration (days) of LLLT until a PH of 5 achieved		Total frequency & duration (weeks) of LLLT		PS prior to $\Rightarrow$ after LLLT	Improvement
1	67	F	3	1	10	3	2	10 $\Rightarrow$ 0	Excellent
2	55	M	3	4	30	4	4	10 $\Rightarrow$ 5	Fair
3	74	F	2	13	21	48	22	10 $\Rightarrow$ 0	Excellent
4	88	F	2	1	1	5	1	10 $\Rightarrow$ 2	Very good
5	49	M	1.5	21	48	22	4	10 $\Rightarrow$ 2	Very good
6	68	M	1	8	11	18	6	10 $\Rightarrow$ 0	Excellent
7	73	F	1	6	30	6	4	10 $\Rightarrow$ 5	Fair
8	88	M	0.5	9	10	20	3	10 $\Rightarrow$ 3	Good
mean $\pm$ s.e.d.									
70.3 $\pm$ 13.0 yrs			1.7 $\pm$ 0.9	5.5 $\pm$ 4.0	15.9 $\pm$ 9.6	13.5 $\pm$ 14.5	5.8 $\pm$ 6.3	2.1 $\pm$ 2.0	rate of improvement 75.0%

Table 2: Summary of PHN patients subjected to 150 mW LLLT.

Case	Age	Sex	Duration of PHN prior to LLLT (months)	Frequency & duration (days) of LLLT until PS of 5 achieved		Total frequency & duration (weeks) of LLLT		PS prior to $\Rightarrow$ after LLLT	improvement
1	74	M	3	1	1	18	3	10 $\Rightarrow$ 3	Good
2	69	F	2	5	20	7	6	10 $\Rightarrow$ 3	Good
3	88	M	2	1	1	5	1	10 $\Rightarrow$ 0	Excellent
4	71	F	1.5	3	7	6	3	10 $\Rightarrow$ 2	Very good
5	77	F	1	2	2	20	3	10 $\Rightarrow$ 3	Good
6	62	F	0.5	1	1	11	3	10 $\Rightarrow$ 0	Excellent
7	51	F	0.5	1	1	5	2	10 $\Rightarrow$ 0	Excellent
8	63	F	0.5	1	1	5	7	10 $\Rightarrow$ 1	Very good
9	64	M	0.5	1	1	9	12	10 $\Rightarrow$ 1	Very good
means $\pm$ s.e.d.									
68.2 $\pm$ 8.9			1.3 $\pm$ 0.9	1.8 $\pm$ 1.3	3.9 $\pm$ 6.0	9.6 $\pm$ 5.4	4.4 $\pm$ 3.2	1.4 $\pm$ 1.3	rate of improvement 100%

Table 3: Comparative study of effectiveness between 60 mW and 150 mW LLLT.

Kind of LLLT	Mean age	Frequency & duration (days) of LLLT until a PS of 5 achieved		Total frequency & duration (weeks) of LLLT		Final PS	Rate of improvement
60 mW	70.3	5.5 (100%)	15.9 (100%)	13.5 (100%)	5.8 (100%)	2.1	75.0%
150 mW	68.2	1.8 *(33%)	3.9*(25%)	9.6 (71%)	4.4 (76%)	1.4	100 %

PS : pain score

* : p < 0.05 150 mW LLLT group versus 60 mW LLLT group

circulation may be reflected in overtension of the autonomic nerve, sensory nerve and motor nerve. The LLLT mechanisms listed above may possibly be involved in blocking some or all steps of the pain transfer.

The GaAlAs diode laser is one of the laser systems associated with LLLT. Most GaAlAs diode lasers reported in the literature have an output power of 60 mW. Recently the 150 mW GaAlAs diode laser, more than twice the output power of the 60 mW laser, has been developed and utilized. In this present study, the efficacy of 60 mW and 150 mW LLLT in the treatment of PHN was investigated. The group which received 60 mW LLLT consisted of 8 patients, while the group which received 150 mW consisted of 9 patients. All patients of both the 60 mW and 150 mW LLLT groups visited our clinic complaining of moderate to severe pain. The duration of PHN prior to LLLT was under 3 months in all patients, and all had been previously subjected to conventional therapy for PHN such as infrared irradiation, pharmacological agents and non-steroid ointment (NSAIDs). Such therapies had been administered for at least 2 weeks with little improvement. Although the mean age of the 150 mW group was a little younger than that of the 60 mW group, and the mean PHN duration period prior to LLLT in the 150 mW group was slightly shorter than that of the 60 mW groups, there were no statistically significant differences as evaluated by the Student's t-test.

Although the patient number was comparatively small, the efficacy of 150 mW LLLT was shown to be superior to that of 60 mW LLLT in all points assessed (Table 3). In particular, the frequency and duration of therapy with 150 mW LLLT until a pain score of 5 was achieved was 33% and 25% compared with 60 mW LLLT. It was statistically significantly different as assessed by the Student's t-test. Furthermore, the total frequency and duration with 150 mW LLLT was 71% and 76% compared with 60 mW LLLT. The final pain score and rate of improvement with 150 mW LLLT were also slightly superior to that of 60 mW LLLT. These results indicate that 150 mW LLLT is more effective within the period of the present study than 60 mW LLLT. We therefore suggest that 150 mW LLLT may be a more suitable alternative than 60 mW LLLT in the treatment of PHN. It is generally considered that higher power densities in LLLT are more effective than lower ones applied for a longer period to give the same incident energy density.⁽¹¹⁾ It follows from this that a higher powered LLLT system of 150 mW might be more clinically effective than a lower powered laser such as the 60 mW systems currently in use, however there have been no clinical data until now. Some doubts have also been expressed about the possible photothermal

element which may accompany LLLT systems of over 100 mW output power, and this needs to be addressed in separate basic studies.

Conclusion

This is a preliminary report on a comparative study of 60 mW and 150 mW LLLT, the results of which indicate that the higher powered LLLT system of 150 mW was more effective than the 60 mW laser in clinical laser therapy. The authors recognize that the patient population in this preliminary study was very low, and that there was no attempt to control or to double blind the study. However, from the encouraging preliminary data herein presented, the authors feel that further studies with larger populations, placebo control, double blinding and perhaps a crossover element are warranted.

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