Low-Level Laser Therapy for control of vertigo in Ménière Disease: a pilot study on 10 patients

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Abstract:

Objective: to assess the efficacy of Low-Level Laser Therapy (LLLT) for Ménière's Disease (MD)

Methods: twenty patients with unilateral MD were included in the study; all presented with uncontrolled vertigo. The patients were randomly divided into two groups: group 1 patients received LLLT , 20 min. a day with Tinnitool® for 6 months while group 2 received betahistine 16 mg. twice a day for 6 months. According to AAO-HNS guidelines the main outcome for vertigo control is considered to be the number of events/month in the 6 months before treatment compared with the same parameter in the 6 months of therapy. The duration of events expressed in minutes was also considered. Moreover a hearing test was performed before and after therapy and results were reported as the pure tone average of 500-1000-2000-3000 Hz frequencies.

All results were valued at the baseline, after 3 and 6 months of therapy.

Results: Compared to the baseline the number and duration of events were significantly reduced in both groups; statistical significance was detected from the three months control in both groups ($p<0.05$ with the multiple pair comparison test). Betahistine seems to have a faster action in events reduction ($p<0.05$ comparing the 3-months results between the two groups). Audiometric exam did not show statistically significant difference between the two groups

Conclusions: In our experience LLLT seems to prevent vertigo events in MD, although results indicated that it has a slower action that betahistine. Dose-dependent therapeutic effects could explain the last result. In our opinion, increased blood flow in the inner ear could be the main mechanism leading to the therapeutic results.

Introduction:

Ménière Disease (MD) is a inner ear disorder characterized by recurrent episodic vertigo, fluctuating hearing loss and tinnitus. [1-2]. The incidence is estimated to be between 50 and 350 per hundred thousand per year.[3]. The natural history of MD is typically variable in intensity and frequency. Initial attacks are often predominantly vestibular, while later attacks are more marked by hearing loss and tinnitus. The disease is usually unilateral.

Raised endolymphatic pressure (hydrops) is commonly accepted as causal condition, although a direct causal relationship between Ménière's and endolymphatic hydrops remains unproven.[4] . Other causes of inner ear disease and central causes of vertigo need to be excluded for MD diagnosis. Medical treatment to for prevent acute vertigo episodes includes dietary and lifestyle modification, including the reduction of caffeine, alcohol, tobacco and stress; a low salt diet and increased intake of water have been suggested to be useful.[5] First choise pharmacological MD treatment includes diuretics and betahistine.[6]. Transmeatal low-level laser treatment (LLLT) has recently been proposed as a therapeutic procedure for cochlear dysfunction such as cochlear tinnitus or sensorineural hearing loss. The therapeutic mechanism of this procedure is under debate. It has been assumed that low intensity laser irradiation increases cell proliferation [7], synthesis of ATP [8] and collagen [9], and the release of growth factors [10-11], it also promotes the local blood flow in the inner ear and activates repair mechanisms through photochemical and photophysical stimulation of the mitochondria in hairy cells [12]. The LLLT procedure is safe, without a significant complication rate. As far as we know, LLLT has never been experimented as a possible procedure for recurrent vertigo in MD.

Matherial and methods:

In order to assess the efficacy of LLLT for MD, 20 patients with unilateral MD recruited between January 2006 and February 2007 at the outpatients facilties of the Vestibular Disorders Ambulatory at San Raffaele Hospital of Milan were included in the study. All of them were attending their first examination in our hospital and all had been undergoing only low-salt and increased water diet therapy during the previous 6 months or more.

They all presented definete MD according to AAO-HNSF criteria [13], consisting of:

- At least two episodes of vertigo of at least 20 min.
- Audiometrically confirmed sensorineural hearing loss on at least one occasion
- Tinnutus or aural fullness during episodes
- Exclusion of other possible causes of vertigo; all of them received a Central Nervous System (CNS) NMR

All the patient presented uncontrolled vertigo and had not received any drug therapy for vertigo in the preceding 3 months. They were included if they met the following criteria:

- ✓ presented definite MD
- ✓ had no CNS, autoimmune or infectious diseases
- ✓ had normal serological exams, above all for glycemic rate and hepato-renal function
- ✓ did not received therapies with antihistamines, calcium-antagonists, antiaggregants, diuretics and corticosteroids (a 15 days wash-out was observed).
- ✓ accepted the protocol for LLLT

The patients were free to leave the protocol at any time and choose a different therapeutic strategy. The protocol was approved by The San Raffaele Hospital Ethic Committee for a larger study on laser therapy for inner ear diseases and tinnitus.

The patients were randomly divided into two groups: group 1 patients received LLLT (group L), 20 minutes a day with Tinnitool® for 6 month while group 2 received betahistine (group B) 16 mg. twice a day (8 a.m and p.m.) for 6 months. All patients in the two groups were told to continue low-salt and increased water diet.

In group L patients mean age was 44.1±13.3; six were males and four females, seven presented MD in the left ear and three on the right ear. In group B the mean age was 42.5±12.3 , five were males and five 5 females, and five of them had right ear MD. The mean interval from the onset of symptoms to the first hospital visit was 3.2 ± 3.8 years in the L group and 3.1±3.2 years for The B group. There was no statistical difference between the groups.

According to AAO-HNS guidelines[13] the main outcome for vertigo control was considered to be the number of events/month of at least 20 minutes in the 6 months before treatment compared with same parameter in the 6 months of therapy. The duration of events expressed in minutes was also considered. Moreover a hearing test was performed before and after therapy and results were reported as the pure tone average of 500, 1000, 2000 and 3000 Hz frequencies.

All results were assessed at the baseline (the start of therapy) and after 3 and 6 months of therapy. Pre and post therapy results will be described as Laser pre and post-therapy(L_{pre}, L_{post}) and Betahistine pre and post-therapy (B_{pre} and B_{post}). Continuous variables were analysed by ANOVA, multiple comparisons within and between groups and non- parametric measures were analysed by the Friedman and χ^2 tests.

Results

Results for the number of events/month in the LLLT group and betahistine groups and statistical analysis are summarized in the table 1.

	Events/month baseline	Events/month 3 months control	Events/month 6 months control
Betahistine group (n = 10)	6.7 ± 9.4	2.1 ± 3.4 ($p<0.05$)	1.9 ± 3.0 ($p<0.05$)
LLLT group (n = 10)	6.8 ± 9.1	4.1 ± 3.8 ($p<0.05$)	2.1 ± 3.4 ($p<0.05$)

Tab 1: Number of events/month and statistical analysis in the two groups. Statistical analysis is referred to the baseline

Compared to the baseline, the number of events were significantly reduced in both groups; statistical significance was detected in the 3-month control in both groups ($p<0.05$ with the multiple pair comparison test). Betahistine seems to have a faster action in event reduction ($p<0.05$ comparing the 3-months results between the two groups).

The results for duration of events are summarized in Table 2.

	Duration of events baseline	Duration of events 3 months control	Duration of events 6 months control
Betahistine group (n = 10)	62 ± 51	30 ± 24 ($p<0.05$)	15 ± 12 ($p<0.05$)
LLLT group (n = 10)	65 ± 46	39 ± 32 ($p<0.05$)	20 ± 16 ($p<0.05$)

Tab 2: duration of events expressed in minutes. Statistical analysis is referred to the baseline

The duration of events are decreased in both groups from the 3-months control and the results are statistically significant; at the 3-months control the duration of events is shorter in the betahistine group but this is not statistically significant.

Table 3 shows the audiometric exams results (expressed as the value of PTA hearing level average at 500 , 1000, 2000 and 3000 Hz frequencies) .

	PTA-HL Vaseline	PTA-HL 3 months control	PTA-HL 6 months control
Betahistine group (n = 10)	33.6 ± 17.4	33.5 ± 17.2 (ns)	31.7 ± 16.5 (ns)
LLLT group (n = 10)	33.1 ± 16.6	33.2 ± 14.6 (ns)	33.0 ± 14.8 (ns)

Tab 3: Pure Tone Audiometry Hearing Level (PTA-HL) for frequencies of 500,1000,2000 and 3000 Hz (ns means no significant)

Statistical analysis of the audiometric exam results did not show a statistical difference in the two groups comparated to the baseline and also between the two groups PTA-HL remained the same in both groups. The percentage of improvements in the number of events and duration is shown in Figure 1.

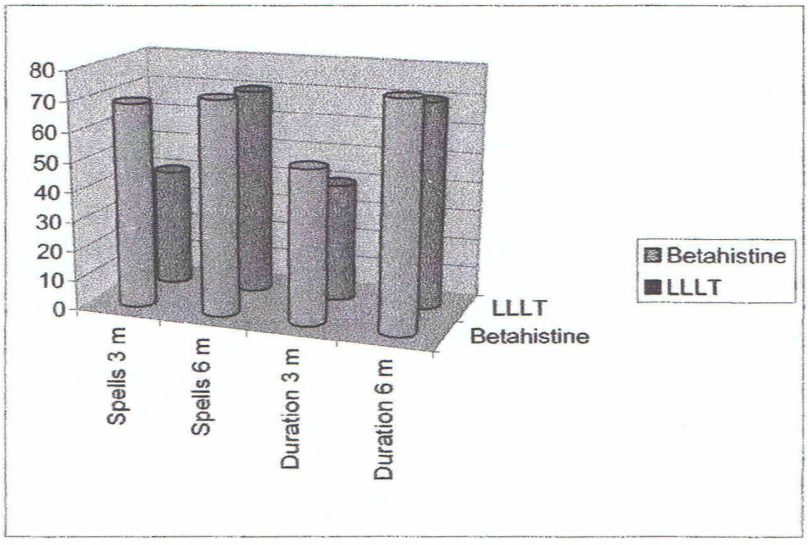

Figura 1

Figure 1: Percentage improvement in the number of events duration in the two groups at 3 and 6 months control.

LLLT patients did not show any side effect in the 6-month period of therapy. In the betahistine group 2 patients reported intermittent headache although it was not necessary to stop the therapy. No subjective variation of tinnitus has been reported by patients.

Discussion

Betahistine is a well known drug used in the treatment of MD; the mechanism of action is based on interaction with H_1 and H_3 receptors, leading to the inhibition of firing activity of the vestibular nuclei, the decrease of the resting discharge at the labyrinthine ampullar hairy cells increase in cochlear blood flow. It effect on reducing events in MD is well known.[14-15-16]

The therapeutic effect of betahistine and its safety have been shown in many controlled studies. [17-18]

By now betahistine is one of the most reliable drugs in reducing events in MD.

Despite the low number of patients reported in our paper, betahistine showed excellent therapeutic results; at the 3 months control events were reduced by 69% and duration of events decreased by 52%. After 6 months events had decreased by 72% and duration by 76%. On the other hand no significant results have been shown for hearing level. Results are not different from those reported in other papers. [6-18]

Low-Level-laser-therapy (LLLT) targeting the inner ear has been discussed as a therapeutic procedure for cochlear dysfunction such as chronic cochlear tinnitus or sensorineural hearing loss. Earlier studies have demonstrated dose-dependent biological and physiological effects of LLLT such as enhanced recovery of peripheral nerve injuries, which could be of therapeutic interest in cochlear dysfunction. No studies have been conducted on LLLT in vertigo control and prevention. In our experience LLLT seems to prevent vertigo events in MD, although results have established that it has a slower action. Dose-dependent therapeutic effects could explain this last result.

As for the number and duration of events, there is an overlap in the LLLT and Betahistine groups in the 6 months control ; nonetheless a significant difference between the 2 groups in present at the 3 month control.

No results on PTA-HL could be proved in both LLLT and Betahistine groups, it is believed that LLLT increases ATP synthesis, cells proliferation and increase blood-flow in the inner ear. This last mechanism is in our opinion a major candidate to explain the therapeutic effects of overlapping betahistine results in the 6 months control.

Wa would like to underline some points:

- ✓ LLLT is a safe procedure; no significant side-effects have been reported in previous studies.
- ✓ LLLT may act in lowering the number and duration of events in MD.
- ✓ The therapeutic protocol can be performed over long periods.
- ✓ LLLT does not exclude a concomitant drug therapy.

Our results encourage the use of LLLT in lowering the number and duration of MD vertiginous episodes. Nonetheless further studies are needed.

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