Case Report

Low frequency sound stimulation greatly improved the outcome of a refractory postherpetic neuralgia patient with mood and sleep disorder: a case report

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Abstract: Postherpetic neuralgia (PHN) is a common and severe chronic complication of the herpes zoster (HZ) virus (shingles) involving prolonged pain which may last from weeks to years. Primary treatment involves oral therapies, although few patients experience a pain reduction of greater than 50%. Due to limited effective treatments, symptoms and comorbidities, including physical disability and emotional distress, are recurrent, and interfere with daily activities and sleep. A 34-year-old male had experienced refractory PHN on the right 3 to 5 thoracic dermatomes for about 3.5 years, accompanied with mood and sleep disorder. During this time, several treatments had been attempted, including systemic tricyclic antidepressants, opioid analgesics, anticonvulsants, topical lidocaine, epidural block, and spinal cord stimulation (SCS); however, their outcomes had been unsatisfactory. Low frequency sound stimulation (LFSS) was found effective in reducing the pain, and improving the state of both mood and the sleep. At the time of this report, the patient had been using this treatment for more than 240 days, his quality of life had improved significantly, and no side effects had been observed. LFSS is component of musical therapy, which categorized under complementary and alternative medicine (CAM). It uses audible sound (40–120 Hz) to produce a physical effect through the transducer when applied directly to the body, which can affect pain perception via mood and sleep improvement, activating an anti-pain effect in the brain. This case provides a rationale to study LFSS in patients with refractory neuropathic pain.

Keywords: Postherpetic neuralgia (PHN); neuropathic pain; low frequency sound stimulation (LFSS); case report

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Introduction

Postherpetic neuralgia (PHN) is a complication of herpes zoster (HZ) infection, attributed to primary lesion-induced peripheral or central nerve damage or dysfunction in nervous system signaling and central sensitization (1). The general population has a 30% lifetime risk of HZ infection, which increases sharply after the age of 50 years. The annual prevalence of HZ infection in China is 3–5 cases/1,000 individuals. There are 4 million PHN patients in China, indicating that approximately 8.6–13.8% of patients with HZ infection develop PHN (2). In addition to severe spontaneous and/or stimulus-evoked pain, PHN causes physical disability and emotional distress that interfere with daily life activities and sleep (3).

Currently, first-line treatments for PHN consist of oral therapies including, but not limited to, tricyclic antidepressants, opioid analgesics, corticosteroids, and anticonvulsants. However, these medications present a high risk of adverse effects and addiction.

The pain of PHN is often refractory to therapy. Approximately 50% of patients are unresponsive to treatment, while the efficacy is limited among those

remaining, despite the administration of several other medications (4). According to White *et al.*, HZ infection patients with PHN intake 17.1 prescriptions compared to 5.5 for those without PHN (5). Due to the lack of efficient treatments, complex dosage schedules, and low patient satisfaction, PHN patient care is currently unsatisfactory (6).

Low frequency sound stimulation (LFSS), also known as VAT (vibroacoustic therapy), is part of musical therapy, which is categorized as complementary and alternative medicine (CAM) fashion. The LFSS uses audible sound (40–120 Hz) to create a physical effect through the transducer when applied directly to the body, which can affect the human body by making it vibrate at the same frequency, called resonance.

Use of LFSS has been found effective in specific pain conditions, including rheumatoid arthritis using 40 Hz (7); polyarthritis in hands and chest using 40 Hz (8,9); low back pain using 52 Hz (8,9); knee replacement pain (10); postoperative gynecological pain (11); menstrual pain and dysmenorrhea using 52 Hz (8,9); sports injuries (8,9,12); and fibromyalgia (13). For the complexity of pain processing, there was no proof that LFSS works effective for the PHN patients.

Our hypothesis was that LFSS would change the pain perception in PHN patients without the adverse effects which are common in oral or invasive therapies.

We present the following article in accordance with the CARE reporting checklist (available at https://dx.doi.org/10.21037/apm-21-2513).

Case presentation

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

On July 2020, a 34-year-old male was referred to our pain clinic with refractory PHN of the right 3 to 5 thoracic dermatomes for about 3.5 years following the onset of HZ rash in February 2017. When the patient presented at our clinic, he fit the refractory PHN diagnosis criteria (14). He reported continuous neuropathic pain which had been alternatingly aggravated and alleviated over the past 3.5 years. The patient described the pain as "electric", "tingling", and occurring with "bursts of lightning" at the base of the right side anterior thoracic and posterior back, which subsequently radiated to the surrounding areas. He had experienced skin sensitivity that was painful to the touch and clothes. Severe pain symptoms were described as intermittent, lasting from minutes to hours, and several episodes of intense pain were also reported.

The patient also reported symptoms including fatigue, sleep difficulty, chest tightness, shortness of breath, worried state, irritability, abdominal uncomfortable feeling, muscle weakness and myalgia, limbs stiffness, acid reflux, and so on. According to his medical records, there was no other confirmed diagnosis, and no relevant medical conditions. His surgical history included epidural block and SCS. Medication history included previous treatment with first and second- or third-line oral medications of different categories including gabapentin, amitriptyline, lidocaine 5% patch, tramadol, and oxycodone, which were not tolerated by the patient or had ineffective pain control, and had been consequently discontinued. His current medication regimens consisted of pregabalin 75 mg by mouth twice daily; duloxetine 30 mg by mouth once daily; oxycodone and acetaminophen (325 and 5 mg, respectively), 1 pill 3 times daily; and mecobalamin 0.5 mg, 3 times daily.

His numerical rating scale (NRS) pain score was 8 in the onset of the breakthrough pain, 4 in the resting, and 5 on average. His General Anxiety Disorder-7 score (GAD-7) was 6, Patient Health Questionnaire-9 (PHQ-9) score was 20, Self-report Somatic Symptom Scale (SSS) score was 36, Pittsburgh Sleep Quality Index (PQSI) score was 15, and Global Pain Scale (GPS) score was 70.

Taking into account the patient's previous ineffectiveness of medication and surgical history, as well as the mood and sleep disorders based on the GAD-7, PHQ-9, and SSS, all the current medications were continued without any adjustments. Meanwhile, with informed consent, the patient started to receive LFSS through a wearable music player (XINYIBAO®, Chengdu Melody Wellness Tech Company, Sichuan, China).

The music player transmitted pre-recorded music combined with low frequency sound through 35 low-sound subwoofers built into a wearable vest. Loudspeakers were used to generate vibrations and an audible sound was produced through the music player controller. The controller transmitted sound with individually adjustable strength. The patient determined their comfortable sound level on a scale of 1–10. The patient was advised to receive the sound stimulation for no less than a total of 2 hours

Table 1 The results of different assessments at consequent 4 time points

Assessments	Day 0	Day 30	Day 120	Day 240
NRS				
Current pain	8	8	5	4
The worst pain	8	9	6	5
The best pain	4	0	0	0
The average pain	5	6	4	4
GAD-7	6	6	0	0
PHQ-9	20	14	0	0
SSS	36	35	24	22
PQSI	15	6	2	2
Sleep quality	2	1	1	1
Sleep latency	3 (>60 min)	2 (31–60 min)	1 (16–30 min)	1 (16–30 min)
Sleep duration	2 (5–6 h)	0 (>7 h)	0 (>7 h)	0 (>7 h)
Sleep efficiency	3 (<65%)	0 (>85%)	0 (>85%)	0 (>85%)
Sleep disturbances	2	1	1	1
Use of sleep meds	0	0	0	0
Daytime dysfunction	3	2	0	0
GPS	70	37	25	23
Physical pain	37	26	20	18
Emotion	12	5	3	3
Clinical outcomes	21	6	2	2
Activities	0	0	0	0
Medications (all)				
Pregabalin	75 mg bid	75 mg bid	75 mg bid	75 mg bid
Duloxetine	30 mg qd	30 mg qd	30 mg qd	30 mg qd
Oxycodone and Acetaminophen (325 mg; 5 mg)	1 pill tid	1 pill tid	0.5 pill bid	0
Mecobalamin	0.5 mg tid	0.5 mg tid	0.5 mg tid	0.5 mg tid
Chief complaints	Pain, fatigue, sleep difficulty, chest tightness, shortness of breath, worried state, irritability, abdominal uncomfortable feelings, muscle weakness and myalgia, limbs stiffness, acid reflux	Pain, muscle weakness and myalgia, acid reflux	Acid reflux	slight skin itch

NRS, Numerical Rating Scale; GAD-7, General Anxiety Disorder-7; PHQ-9, Patient Health Questionnaire-9; SSS, Self-report Somatic Symptom Scale; PQSI, Pittsburgh Sleep Quality Index; GPS, Global Pain Scale.

total every day, comprising no more than four separate sessions, which meant that each session must have been no less than 30 minutes. The patient was also advised to be calm and focus on the sound during each listening. The sound stimulation could be continued at night, if that suited the patient.

The patient was followed up regularly, and assessments including pain NRS, GAD-7, PHQ-9, SSS, PQSI, and GPS were completed at days 30, 120, and 240 after the first visit to our clinic (*Table 1*).

Discussion

Chronic pain does not function as a warning to prevent physical injury or disease, but rather is a disorder due to dysfunction of neural mechanisms. Melzack (15) proposed that the effect of music is a cerebral mechanism-based body-self neuromatrix (NM). Sensory, cognitive, and affective dimensions influence the perception of pain. These dimensions serve as cognitive-evaluative (attention, expectation, anxiety, and valence) and motivational-affective (neurotransmitter, hormonal, and limbic) inputs. Although the precise mechanism is yet to be elucidated, NM explains the function of treatments involving antidepressants (TCAs), anticonvulsants, and musical therapy.

One of the known dysfunctions of NM is thalamocortical dysrhythmia (TCD), which plays a significant role in developing and maintaining chronic pain (16,17), resulting in disturbed sensation and cognition which affects motor performance (16,18).

As a malfunction of coherent rhythmic oscillation, TCD should be stabilized through rhythmic oscillatory neural activity. Llinás and Ribary (19) showed that thalamocortical oscillation could be reset with auditory stimulation. Ross *et al.* (20) utilized 40 Hz steady-state oscillation with vibratory stimulus. Theoretically, the effect of LFSS regulated the TCD related to neurogenic pain in this patient.

For this refractory PHN patient, we used an episode of sound with low frequency, most of which was 40 Hz. According to the follow-up assessments, the pain was not cured, but it was not causing the patient suffering. His assessment scores of PQSI, GAD-7, PHQ-9, and SSS, mood and clinical outcomes of GPS improved, and the pain NRS and oral medications had been decreased. Meanwhile, no side effects of LFSS were observed. The patient was quite satisfied with the results and expressed his desire to continue with the program.

To the best of our knowledge, this was the first case report on LFSS in the treatment of refractory PHN in a naturalistic setting. The oral medications were continued, so the effects are cumulative to it. The results gave a first impression of how this additional self-care intervention LFSS may be useful in multidisciplinary pain management.

This study explored the novel addition of self-care to LFSS within a naturalistic setting. Results suggest this patient experienced reduced pain, improved mood and sleep from the LFSS. However, LFSS's effects should be investigated in further study. Then more detailed qualitative reports (e.g., pain diaries) would offer additional explorations for this topic and may be especially beneficial for chronic pain patients due to individual variation. The qualitative data were beneficial in exploring what quantitative outcomes mean in practice for patients with persistent pain and comorbid symptoms.

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Footnote

Reporting Checklist: The authors have completed the CARE reporting checklist. Available at https://dx.doi.org/10.21037/apm-21-2513

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://dx.doi.org/10.21037/apm-21-2513). JX is one of the inventors of the wearable music player in Chengdu Melody Wellness Tech Company. The other authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

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