

# HIGH-INTENSITY LASER THERAPY TO TREAT NEUROPATHIC PAIN IN POST-HERPETIC NEURALGIA

Richard Suherlim<sup>1</sup>, I Putu Eka Widyadharm<sup>2</sup>, I Made Oka Adnyana<sup>2</sup>, Anak Agung Ayu Suryapraba<sup>2</sup>

**Correspondence:** richardsuherlim1919@gmail.com

<sup>1</sup>Department of Neurology, Neurology Resident, Faculty of Medicine, Udayana University, Sanglah Hospital, Denpasar, Bali, Indonesia.

<sup>2</sup>Department of Neurology, Faculty of Medicine, Udayana University, Sanglah Hospital, Denpasar, Bali, Indonesia.

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## ABSTRACT

Post-herpetic neuralgia (PHN) is chronic neuropathic pain that is felt for at least 3 months or more at the site of the rash due to herpes zoster infection. Epidemiological studies get a prevalence of 0.49 cases of PHN per 1000 people per year. The clinical manifestation of PHN is chronic pain on the skin lesions due to herpes zoster infection. The therapy that is commonly used as the first line is the provision of pharmacotherapy such as gabapentin or pregabalin. An 83-year-old male patient with a diagnosis of PHN that had been felt for 5 years. He has been taking drugs for 5 years but the pain has not improved. The patient is given high-intensity laser therapy. After 5 treatments with an interval of 1-2 weeks, pain was significantly reduced from an 8/10 scale to 4/10. The frequency of occurrence of severe pain is also reduced from 5 times per day to only 1 time per day. The use of high-intensity laser therapy is not commonly used as a therapy for PHN. Based on its mechanism of action, the use of high-intensity laser therapy is worth considering because of its effectiveness in treating pain in a shorter time than low-intensity laser therapy.

**Keyword:** Laser, high intensity, pain, post-herpetic neuralgia

## Introduction

Post-herpetic neuralgia (PHN) is chronic neuropathic pain that is felt for at least 3 months or more at the site of the rash due herpes zoster infection. Herpes zoster infection is the result of reactivation of the dormant varicella zoster virus in the spinal cord sensory nerve ganglion.<sup>1,2</sup>

Epidemiological studies found a prevalence of 0.49 cases of PHN per 1000 people per year.<sup>3</sup> Based on data collected from 13 teaching hospitals in Indonesia, out of 2,232 herpes zoster patients, 593 (26.5%) of them suffered from PHN.<sup>4</sup> A study by Fei Yang et al in China showed that 29.8% of patients with herpes zoster will suffer from PHN. There is no significant difference in the incidence of PHN patients by gender.<sup>5</sup>

The pathophysiology of PHN is neuronal damage that affects the peripheral nervous system and the central nervous system. This damage causes the peripheral nerves to cause a spontaneous discharge and lower the threshold for a pain-producing action potential, which is not triggered by a painful stimulus (allodynia). Central sensitization also plays an important role in PHN.<sup>3</sup>

The clinical manifestation of PHN is chronic pain on the skin lesions due to herpes zoster infection. The skin lesions are usually dermatomal, on only 1 side of the body, with the appearance of a rash or vesicle. Patients with PHN experience 3 types of pain, continuous pain without a stimulus which is usually described as burning, aching, or throbbing, intermittent pain without a stimulus which is

usually described as stabbing, sharp, or like being electrocuted, and pain caused by the stimulus (hyperalgesia or allodynia).<sup>6</sup>

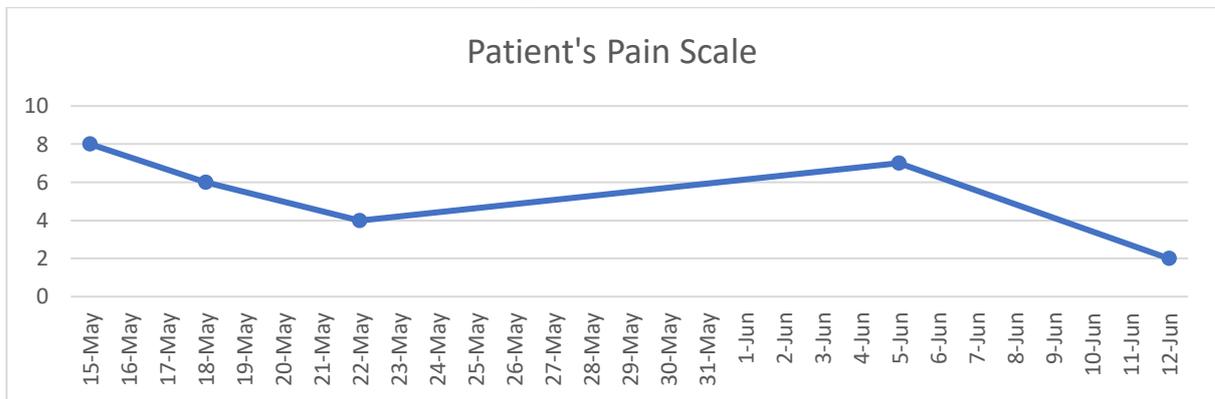
There is still no definitive treatment protocol for PHN. Commonly used first-line treatment is gabapentin or pregabalin plus a topical therapy such as a lidocaine patch or capsaicin cream. Antidepressant therapy such as amitriptyline and opioids such as oxycodone can be given as a second line treatment. If pain persists, more invasive therapy can be given, such as epidural block, intercostal nerve block, intrathecal steroid injection, or neuroablation surgery.<sup>7</sup> Severe PHN generally decreases from 58% to 17% during the first 4 weeks of treatment and from 13.3% to 9% during 8 weeks of treatment. However, there were 4.5% of cases where PHN persisted for more than 60 days despite treatment.<sup>8</sup>

## Case Report

An 83 years old male Dutch complained pain on his back that radiates to the right chest. This pain have been felt since June 2016. Initially, the pain started with the appearance of lesions in the form of vesicles. The lesions were start from the back, then slowly appear around to the right side of the body and to the right chest. He went to the doctor and diagnosed with herpes zoster. The patient was given acyclovir which was taken 2 times a day, but forgot the dose. The vesicles have disappeared about 1 year later.



**Figure 1.** Pain areas on the patient's body. His right back looks dirty dan scaly because he cannot clean it due to the pain. Marked area as the most severe pain location (red arrow)



**Figure 2.** The patient's pain scale during 5 times of high-intensity laser therapy. At the end of the 5<sup>th</sup> treatment, the pain scale in down to 2/10.



**Figure 3.** A) High-intensity laser therapy device. B) High-intensity laser therapy on the painful area. The laser is directly applied to painful skin area

Even though the vesicles are completely gone, the pain is still persistent and worse in the evening and at night. There are periods of time when the pain is so severe that the patient can't do anything for about 5 minutes. The patient describes the pain like his internal organs are being squeezed. When there is an attack of severe pain, it is said to be on an 8/10 pain scale, and if under normal conditions it is said to be on a 4-5/10.

The pain is aggravated by touch, including touch with clothing, and even with the wind. The patient could not take a bath for years because his right back and chest would be very painful when exposed to water. Pain improves with taking medication. Initially, the patient routinely took gabapentin at a dose of 2x300 mg, but about 1 year ago the drug was changed to pregabalin 1x150 mg. The patient routinely consumes pregabalin every night. If he does not take the drug, he will not be able to sleep because of the pain. During sleep the patient will always lie on the left side of the body.

The patient said he had a general checkup 1 year ago, with normal laboratory results including complete blood, blood sugar, kidney function, liver function, lipid profile, and uric acid all within normal limits. He had never had chickenpox before, but had received the varicella vaccine as a child.

Based on physical examination, the patient was compositus with stable hemodynamics. There is hyperalgesia and allodynia in the right-sided T4-T8 dermatome. The patient marks with a black marker the areas where the pain is maximum. In this area, the skin looks dirty and scaly compared to other areas of the body because the patient has not dared to bathe / clean the area for years. (Figure 1)

The patient started high-intensity laser therapy on May 15, 2021 with an interval of 1-2 weeks. There was a significant improvement with a decrease in the frequency of attacks starting from 3-5 times per day before therapy, to only 1 time per day after 5 times of therapy. Pain intensity is also said to be reduced from 8/10 to 2-4/10 during an attack (Figure 2).

Before starting laser therapy, the patient's skin is sprayed with anesthetic spray to reduce pain when touched. The high-intensity laser therapy that the patient underwent was divided into 2 stages, analgesia and biostimulation. During the analgesia stage, 3 Watts of power was given with a power of 10 J/cm<sup>2</sup> with a duration of 5 minutes 30 seconds. Therapy was continued with the biostimulation stage with a power of 7 Watts, a power of 60 J/cm<sup>2</sup> with a duration of 3 minutes 30 seconds (Figure 3).

## Discussion

Post-herpetic neuralgia (PHN) is pain that persists after herpes zoster infection. Herpes zoster infection occurs due to reactivation of the varicella virus that exists after a person has chickenpox. The patient stated that he had never had chickenpox before, but had received the varicella vaccine as a child. Based on this, there are 2 possible mechanisms in this patient that could explain the appearance of herpes zoster. There is a case report in a 20-month-old baby diagnosed with herpes zoster as evidenced by the presence of IgG and confirmed by PCR. In the article it was explained that previously asymptomatic chickenpox infection could occur or chickenpox infection could also occur during the patient's pregnancy.<sup>9</sup> There is also evidence showing that the

varicella vaccine can cause herpes zoster in children, where the vaccine used is live attenuated organisms that still have the virulence to cause symptoms, even in immunocompetent patients.<sup>10</sup>

Post-herpetic neuralgia is hard to treat condition with a long average duration of pain. This creates a significant burden cost and is increasing every year. Based on a study conducted in Canada by Friesen et al, there was an increase in the cost of treating cases of herpes zoster and PHN from 1997 to 2014. In 2011-2012 the total cost per episode of PHN pain reached 566.08 CAD per year. Most of these costs are the cost of NSAIDs and anticonvulsants, which have limited efficacy.<sup>11</sup>

The proportion of the number of PHN sufferers will increase with age. The highest incidence is in the age group > 70 years.<sup>5</sup> The incidence of PHN in the age group < 50 years is only about 2%, but in the age group > 50 years it increases to 20%, and to about 35% in the age group > 80 years.<sup>3</sup>

The limited efficacy of conventional treatment in PHN has led to the emergence of several interventional therapies that have better efficacy in managing pain. Some therapies have begun to be commonly used, but there are also therapeutic options that are still rarely used, especially in Indonesia.<sup>12</sup>

There are case reports of the use of cryoneurolysis therapy and topical gallium maltolate cream which was successful in significantly reducing pain in PHN patients.<sup>13,14</sup> Interventional treatments that can be performed in cases of refractory PHN include epidural injection with metiprednisolone and bupivacaine, paravertebral nerve block, sympathetic nerve block, and ozone therapy.<sup>12</sup> In addition to invasive interventional treatments, there are also non-invasive interventional therapies that can be used to treat PHN pain such as the use of lasers.

In this case the patient had been experiencing pain due to PHN for 5 years and did not improve with pharmacotherapy in the form of gabapentin and pregabalin. The patient stated that his pain had improved after undergoing laser therapy. Laser therapy used is a high-intensity laser.

The efficacy of laser therapy in treating PHN was successfully proven by a study conducted on 15 patients, where the sample was PHN patients who were refractory to various drugs for 1 month – 1 year. The results of this study found that 11 of 15 patients who received laser therapy for 16 sessions in 8 weeks stated that they were pain free and the remaining 4 reported significant pain reduction (more than 50%). The therapy used in this study was low-intensity laser therapy with a wavelength of 650 nm and a power of 3.6 J/cm<sup>2</sup> for 1 minute at the pain area.<sup>15</sup>

Wavelength in laser therapy is also very important because it determines the depth of laser penetration into the tissue which is also affected by the absorption and scattering of light in the tissue. When irradiated on the skin, the laser light will interact with the main chromophores, namely hemoglobin, melanin, water, and fat. The wavelength with a low absorption rate on the chromophores will be better because it can penetrate deeper into the tissue. The recommended wavelength is 600-1100 nm so that it can penetrate through the layers of the epidermis, dermis, and hypodermis to reach blood vessels and nerves.<sup>15</sup>

According to the FDA, laser classification is divided based on the power released by a device. Class III lasers have a

power of less than 0.5 Watts, while class IV lasers have a power output of more than 0.5 Watts. In the use of lasers as medical therapy, class III lasers are also known as low-intensity laser therapy and class IV lasers are known as high-intensity laser therapy. Both types of lasers can produce a photobiostimulating effect that can reduce inflammation in peripheral nerve endings. However, high-intensity laser therapy will be able to cause a faster effect because it can cause higher radiation to the nervous tissue so that photobiostimulation can occur. This is explained by the law of energy (Joules) = power (watts) x time (seconds), so the higher the power of a laser, the shorter the time required to obtain the same energy.<sup>16</sup>

Laser photobiostimulation can reduce chronic pain through various mechanisms such as normalizing nerve ion channels, reducing bradykinin sensitivity, reducing mechanical hypersensitivity associated with peripheral nerve injury, and increasing beta endorphins in the dorsal horn of the spinal cord. High-intensity lasers also has a specific effect on central sensitization associated with the association between C-fibers and NMDA receptors. C-fibers have a direct input pathway to NMDA receptors in the spinal cord. NMDA receptors can amplify pain in the central nervous system. In chronic pain, C-fibers continuously provide input that causes increased amplification of pain signals through NMDA receptors in the brain. High-intensity laser therapy can reduce the input of C-fibers to the NMDA receptor so as to limit the emergence of nociceptive signals from the peripher.<sup>16</sup>

High-intensity lasers can be delivered in two ways: intermittently and continuously. Intermittent method can cause analgesia, microcirculation stimulation, and anti-inflammatory effect. Continuous methods can produce biostimulating effects, thermal effects, and muscle relaxation. The analgesia effect is given by means of a high-intensity laser which is irradiated rapidly at a very high repetition rate to generate a pressure which then stimulates free nerve endings and causes pain relief. The biostimulating effect of the continuous method can stimulate mitochondria to produce more ATP from oxygen resulting in faster healing and reduction of edema.<sup>17</sup>

A systematic review article stated that the use of high-intensity laser therapy was indicated as an effective non-invasive therapy in helping to treat musculoskeletal pain. There was also an article comparing the effectiveness of high and low-intensity laser therapy in cases of low back pain, the results obtained similar effectiveness in reducing pain significantly in these patients. In patients who were treated with high-intensity laser therapy, it took less time, namely 15 minutes/session compared to low-intensity laser therapy, which was 30 minutes/session.<sup>18,19</sup>

There is a study that proves that high-intensity laser therapy has also been shown to be effective in neuropathic pain. A study by Prasun et al, found that high-intensity laser therapy significantly reduces pain and improves the quality of life of elderly people with diabetic neuropathic pain.<sup>20</sup>

High-intensity laser therapy for the treatment of PHN is not common. However, based on its mechanism of action, the use of high-intensity laser therapy in neuropathic pain can be considered given the excellent effectiveness of low-intensity laser therapy in treating PHN. It has a shorter treatment time,

coupled with almost no side effects except the sensation of heat on the skin.<sup>15,21</sup>

## Conclusion

Chronic pain management in PHN is difficult. In some cases, the pain persists despite of various therapies. In this case, the patient was given high-intensity laser therapy which was quite effective in reducing pain intensity by more than 50% and reducing the frequency of attacks of severe pain. The ultimate goal of relieving the patient of pain has not yet been achieved. Combination treatment with other interventional therapies may be considered because drug therapy has low effectiveness in cases of refractory PHN.

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## Conflict of Interest

The authors have nothing to disclose.

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