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1 ***Case study***

2 Ultrasound-assisted pulsed radiofrequency targeting the dorsal root ganglion for 3 intractable postherpetic neuralgia with lumbar radicular pain

4

5 ## ABSTRACT

Aims: We report the successful use of ultrasound-assisted pulsed radiofrequency (RF) treatment of the L2 dorsal root ganglion (DRG) for intractable post-herpetic neuralgia (PHN) with lumbar radicular pain, wherein ultrasound-guided pulsed RF targeting of the lumbar DRG was effective in providing satisfactory pain relief.

Case presentation: An 86-year-old man suffering from intractable PHN for over a year was referred to our pain clinic. The chronic pain radiated into the superior medial thigh of the right leg ever since the onset of herpes zoster. Physical examination revealed dynamic allodynia with scarred skin on the right medial thigh. In spite of repeat epidural blocks, the duration of therapeutic effect was not prolonged. Therefore, we decided to attempt ultrasound-assisted RF treatment of the L2 DRG for intractable PHN with lumbar radicular pain. Ultrasound-guided pulsed RF targeting of the lumbar DRG provided satisfactory pain relief. Following the procedure, the visual analogue pain score decreased from 7 to 1 and remained constant even after 6 months.

Conclusion: Pain physicians should consider pulsed RF for lumbar DRG since this method appears to offer long-lasting therapeutic effects for intractable PHN with lumbar radicular pain.

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7 ***Key Words:*** *Dorsal root ganglion; Lumbar radicular pain; Postherpetic neuralgia; Pulsed radiofrequency;*

8 *Ultrasound.*

9

10 1. INTRODUCTION

11

12 Postherpetic neuralgia (PHN) is a type of nerve pain resulting from damage caused by the varicella zoster

13 virus (VZV) [1]. Approximately 20-30% of people will be afflicted by herpes zoster (HZ) during their life time

14 [1]. The prevalence of PHN has been reported to range from 10% to 34% in patients with HZ, depending on

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the definition [2,3]. The initial treatment for PHN should be conservative, with oral medications, exercise, and physiotherapy. However, conservative treatments, including systemic analgesics, often do not provide satisfactory pain relief for PHN. When conservative treatments fail, epidural steroid injection (ESI) and other interventional treatments should be considered [1]. Although ESI is effective in reducing short-term pain in most patients, it is associated with side effects such as headache, flushing, water retention, metabolic and endocrine changes, including glucose intolerance, and adrenal suppression [4]. In some cases, treatment of PHN brings complete pain relief. However, despite the various therapeutic efforts mentioned above, most people still experience some pain, and a few patients do not experience any relief. Therefore, an alternative therapeutic method for PHN that could provide effective, long-term pain relief with few side effects is needed.

In recent years, anecdotal reports have emerged regarding the benefits of pulsed radiofrequency (RF) for management of chronic and intractable pain [5]. The effectiveness of pulsed RF in neuropathic pain and its safety have been clearly demonstrated in both animal and humans studies [6]. Various studies have also indicated the effectiveness of this technique specifically in alleviation of lumbar radicular pain, including that related to herniated disks and spinal stenosis [7,8]. However, no report has described ultrasound-guided pulsed RF targeting of the dorsal root ganglion (DRG) for treatment of intractable PHN with lumbar radicular pain.

We report the successful use of ultrasound-assisted pulsed RF treatment of the L2 DRG for intractable PHN with lumbar radicular pain, wherein ultrasound-guided pulsed RF targeting of the lumbar DRG was effective in providing satisfactory pain relief.

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2. CASE PRESENTATION

An 86-year-old man suffering from intractable PHN for over a year was referred to our pain clinic. The chronic pain radiated into the superior medial thigh of the right leg ever since the onset of HZ. Physical examination revealed dynamic allodynia with scarred skin on the right medial thigh. Based on medical history and clinical examination, a diagnosis of PHN involving the right L2 spinal segments was made. The patient did not have any underlying disease except hypertension. Magnetic resonance imaging findings of the lumbar spine demonstrated no lesions related to the clinical symptoms of the patient.

The patient was prescribed specific oral anti-neuropathic therapy (pregabalin 150 mg/12 h; Pfizer, USA) and milnacipran (25 mg/day; Bukwang Pharm., Korea) as first-line treatment and was assessed after 2 weeks. When he failed to exhibit improvement (50% reduction in pain score) after 2 weeks, tricyclic antidepressant therapy (amitriptyline, Whanin pharm., Korea; 10 mg at night) and MypolTM (codeine 10 mg, acetaminophen 250 mg, and ibuprofen 200 mg per day; Sungwon Adcock pharm., Korea) were prescribed. After 1 month, when the patient was re-evaluated to assess improvement, he complained of side effects, such as dizziness and drowsiness, without any reduction in pain. Subsequently, he was administered lumbar epidural block once and right L2 transforaminal epidural block twice with a mixture of 0.5% lidocaine hydrochloride and 5 mg dexamethasone at 4-week intervals. However, epidural block was effective for pain relief for only 7–10 days. In spite of repeat blocks, the duration of therapeutic effect was not prolonged. The patient then requested alternative treatment with a longer therapeutic effect. Upon administration of

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fluoroscopically guided diagnostic selective right L2 nerve root block with 1 mL bupivacaine (0.25%), the patient exhibited positive response. Therefore, we decided to attempt pulsed RF treatment.

Full informed consent was obtained from the patient prior to the procedure. The patient was positioned prone, with a pillow under the abdomen. The lower dorsal and lumbosacral area was sterilized with betadine and draped with sterile towels. The patient was connected to a three-lead electrocardiograph, non-invasive blood pressure monitor, and pulse oximeter for continuous monitoring. Fluoroscopy was initially employed to identify the desired lumbar level and target area. After fluoroscopically guided localization of L2 in the direct anteroposterior view, the L2 end plates were aligned. A 22-gauge blunt straight RF needle with a 10-mm active tip was inserted through the entry point and advanced under ultrasound guidance to the targeted DRG. Using a curvilinear ultrasound probe (LOGIQ P6®, GE medical systems, USA), scanning was initiated in the transverse plane until the inferior edge of the transverse process and the lamina were visualized. Using an in-plane technique, the RF cannula was advanced at an angle of 30–45° from the sagittal plane and directed toward the inferolateral edge of the transverse process. The cannula was then walked caudally off the transverse process and advanced toward the target point (Fig. 1). Upon reaching the lamina, the cannula was no longer visible because of the acoustic shadow created by the bone. Thus, cannula placement was completed using fluoroscopy. Fluoroscopic views were then obtained to confirm proper placement of the needle tip at the foramen, dorsal to the epidural space. Injection of 1 mL nonionic contrast material revealed epidural spread and excluded intravascular injection (Fig. 2). Then, sensory stimulation of nerve roots was tested by eliciting paresthesia in the dermatomal distribution of the affected nerve using an RF generator

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(Pain management RF generator Ver. 4, Kimberly-Clark, USA) at 50 Hz and 0.4–0.6 V. Motor stimulation was then tested at 2 Hz and at voltage double the sensory threshold but at least at 1 V to elicit contractions in the paraspinal muscles and upper thigh for L2 nerve roots. Further, 1 mL lidocaine (2%) was injected into the nerve root, and after allowing a minute to reduce patient discomfort, 2 cycles of pulsed RF were administered to the DRG at 42°C for 120 s each. After the procedure, the patient was shifted to the recovery area for monitoring, observation, and management of any side effects. All procedures were performed without any complications.

Our patient was evaluated for pain severity using a visual analogue scale (VAS, score range: 0–10) before the block (basal), at 30 min post-procedure in recovery, at 2 and 4 weeks post-procedure, and at 3 and 6 months after the block. The VAS scores were 7 before the block, 0 at 30 min post-procedure in recovery, and 1 at 2 and 4 weeks as well as 3 and 6 months after the block. While repeated pulsed RF blockade is allowed at VAS scores > 3 [10], in our patient, repeated pulsed RF blockade was not administered because the VAS score remained at 1.

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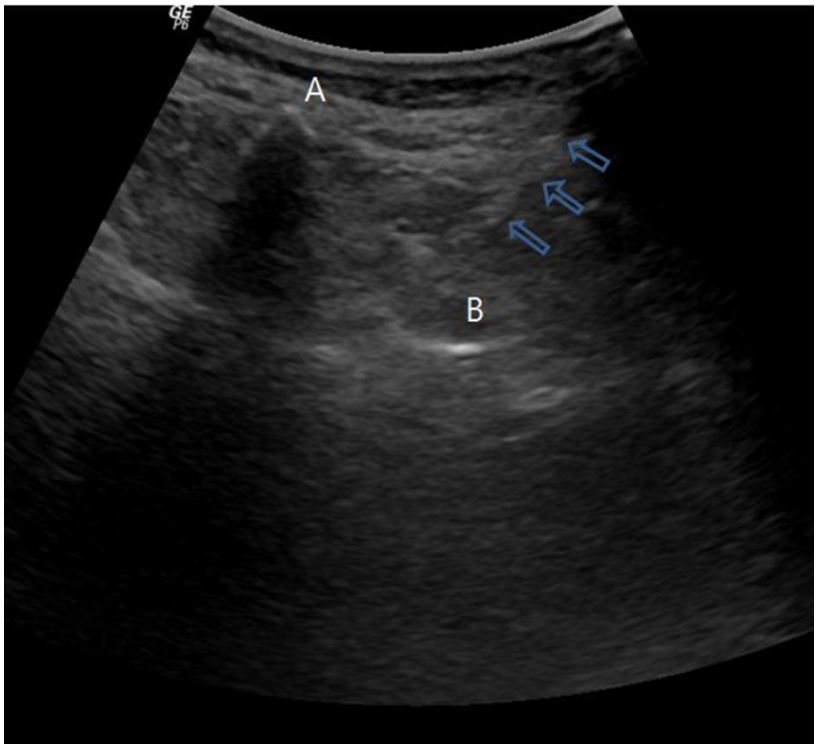

Fig. 1.Transverse ultrasound image of dorsal root ganglion radiofrequency ablation at the L2 level.

Arrow indicates the pulsed radiofrequency probe; (A) spinous process; (B) transverse process.

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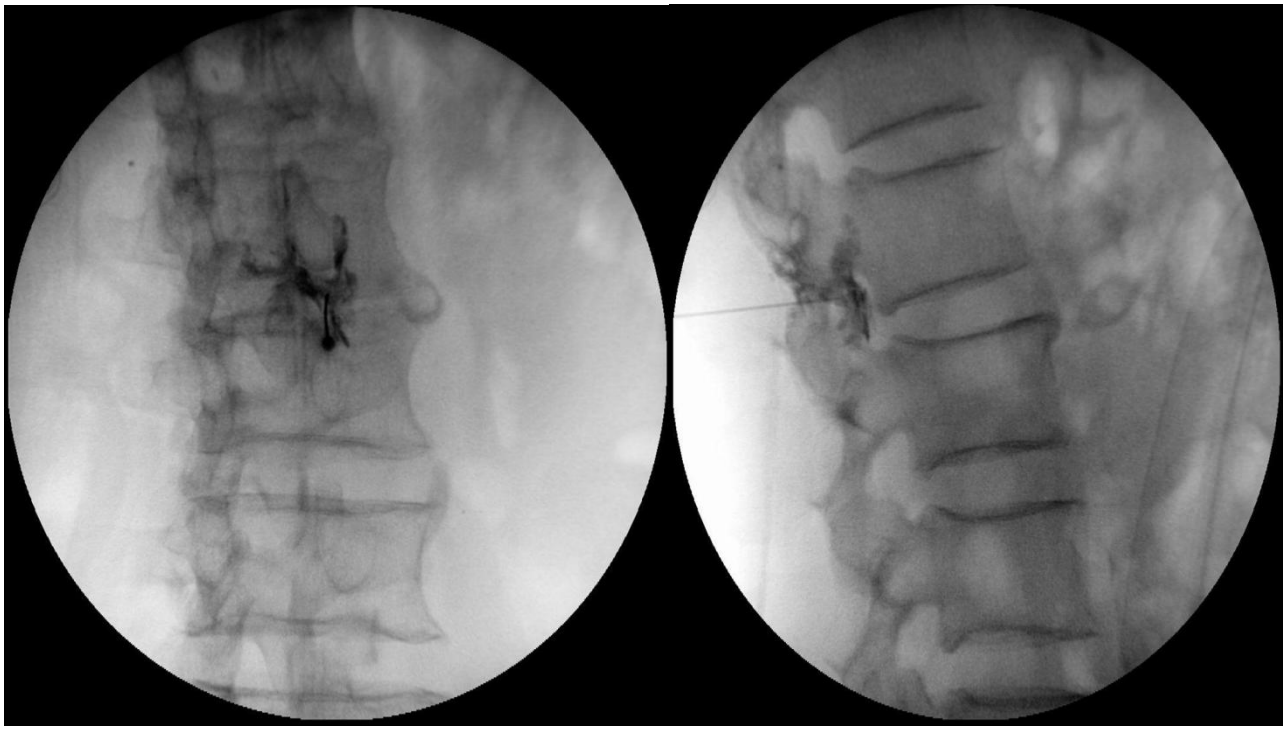

Fig. 2. Oblique (A) and lateral (B) images after confirmation of dye spread to the epidural space. (A) The oblique view shows L2 transforaminal epidural injection. (B) The lateral view shows the needles in the foramen with anterior epidural spread of the dye.

The needles are positioned close to the dorsal root ganglion, and epidural spread of dye can be noted at the L2 level.

3. Discussion

Postherpetic neuralgia, a type of chronic neuropathic pain, is the most troublesome side effect associated with HZ. Typically, the neuralgia is confined to a specific dermatome and follows an outbreak of HZ affecting

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the same dermatome [1]. It is often very difficult to treat. Early diagnosis and treatment with antiviral and intervention therapies are believed to reduce the duration and severity of acute HZ and minimize the risk of PHN. Prophylactic vaccination against VZV is possibly the best option for preventing and reducing the incidence of PHN [1,9].

However, unfortunately, some patients with PHN suffer from severe and refractory pain, with no relief despite various treatments. Postherpetic neuralgia is often resistant to current analgesic treatments such as antidepressants, anticonvulsants, nonsteroidal anti-inflammatory drugs, opioids, and topical agents, including lidocaine patches and capsaicin cream. Unfortunately, the symptoms of PHN can persist for several years [1]. Moreover, oral anti-neuropathic drugs have their own limitations, including side effects at high doses as well as efficacy issues. In the present case, the patient refused an increase in drugs dosage because of side effects such as dizziness and drowsiness. Although oral medications are effective in the management of PHN in some patients, pain related to PHN is one of the most refractory forms of pain. Thus, if conservative management fails, alternative analgesic techniques should be considered [1]. In the present case, following ESI and transforaminal epidural block, the patient experienced temporary pain relief lasting approximately a week. We, therefore, decided to administer pulsed RF targeting the L2 DRG for long-lasting therapeutic effect.

Concerning the mechanism of PHN, it is known that, after resolution of primary VZV infection, the virus remains latent in the spinal DRG [10]. When cell-mediated immunity against VZV decreases, the virus replicates in the spinal DRG and spreads along the peripheral nerves to the skin, leading to painful

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erythematous rashes in the affected dermatome. In a study of spinal nerves of patients who had experienced HZ, atrophy of the DRG was found only in patients with PHN [1,10]. The DRG has been implicated in the pathogenesis of PHN — it is considered to give rise to abnormal impulse generation as a result of irritation, direct compression, and sensitization. Neurotrophins within the DRG trigger persistent mechanical allodynia, indicating that ganglia-derived neurotrophins are a source of nociceptive stimuli for neuropathic pain. This change may be sufficient to trigger the sprouting of sympathetic fibers within the DRG and, thus, contribute to the neuropathic pain of PHN. However, it is often difficult to identify the specific nerve injury responsible for symptoms in a patient because nerves are derived from overlapping nerve roots, and nerve supply to the skin shows significant anatomical variability. Therefore, in this case, we administered diagnostic selective right L2 nerve root block for definite identification of the specific nerve root responsible for PHN.

The safety and effectiveness of pulsed RF in neuropathic pain has been demonstrated in animal and human studies [7,8,11,12]. Various studies have demonstrated its possible mechanisms of action, including non-thermal effects on the DRG, selective inhibition of pain-carrying fibers, and activation of c-Fos [11,12]. Recently, a few studies concerning the application of pulsed RF to the DRG in patients with herniated disks and spinal stenosis have been published [7,8,13]. The present findings demonstrated that application of pulsed RF to the DRG provided significantly longer lasting pain relief than selective nerve root blockade with a local anesthetic and/or steroid. Thus, pulsed RF appears to be a safe and effective treatment modality for chronic neuropathic pain. In previous studies, the mean VAS and numeric rating scale (NRS) scores after administration of pulsed RF to the lumbar DRG in patients with herniated disks and spinal stenosis were

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138 approximately at the 5-point mark at 3 months post-procedure [7,8]. Interestingly, after pulsed RF to the
139 lumbar DRG in patients with chronic inguinal neuralgia, the mean VAS score was approximately 1 at 6
140 months post-procedure. In the present case, after administration of pulsed RF to the lumbar DRG in a patient
141 with intractable PHN, the VAS score reduced from 7 before the procedure to 1 at 3 months post-procedure.
142 After application of pulsed RF to the DRG, our patient showed good results, similar to those obtained in
143 previous studies in patients with chronic inguinal neuralgia but better than those in patients with lumbar
144 radicular pain. The better outcome in the present case, in comparison with that in patients with lumbar
145 radicular pain, may be attributed to the positive diagnostic nerve root block and the patient's advanced age.
146 Van Boxem et al. reported that positive diagnostic nerve root block and age ≥ 55 years were predictive
147 factors for successful outcome of pulsed RF treatment in patients with intractable lumbosacral radicular pain,
148 while disability was a negative predictor [14].
149 Our patient had intractable pain unresponsive to oral medications. Moreover, this pain did not respond to
150 the same oral anti-neuropathic therapy started after resolution of the analgesic effect of the first block.
151 Despite repeat blocks, the duration of therapeutic effect was not prolonged. Consequently, the patient
152 requested alternative treatment with longer therapeutic effect. Therefore, we attempted pulsed RF treatment
153 and obtained good results. Evidence for the effects of pulsed RF targeting of the DRG in patients with PHN
154 with lumbar radiculopathy is fairly limited. We consider that the present case offers preliminary evidence for
155 attempting pulsed RF to the lumbar DRG in lumbar radiculopathy caused by PHN. Pulsed RF can protect
156 patients from unacceptable adverse effects caused by systematically administered drugs as well as the

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157 serious adverse effects of ESI. No major or significant side effects related to pulsed RF have been reported
158 to date. Pain physicians should consider temporary but possibly long-lasting alternatives such as pulsed RF
159 in patients with intractable PHN-related pain, especially if this technique is reproducible and shows durable
160 pain relief with a low risk of complications.
161

162 4. CONCLUSION

163 In conclusion, PHN is the most common complication associated with HZ and is often very difficult to treat.
164 In the present case of intractable PHN in the medial thigh, i.e., PHN with lumbar radicular pain, the
165 ultrasound-assisted pulsed RF procedure targeting the lumbar DRG provided satisfactory pain relief. Pain
166 physicians should consider the therapeutic option of pulsed RF to the DRG for long-lasting therapeutic
167 effects in such patients.
168

169 CONSENT

170 As per international standard or university standard, patient's written consent has been collected and
171 preserved by the authors.

172 ETHICAL APPROVAL

173 It is not applicable.

174 COMPETING INTERESTS

175 Authors have declared that no competing interests exist.

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