

Transforaminal periradicular administration of onabotulinumtoxinA targeting the dorsal root ganglion environment for the treatment of refractory postherpetic neuralgia: case report and technical note

Summary

Introduction: Postherpetic neuralgia is one of the most debilitating forms of chronic neuropathic pain, and a significant percentage of patients experience persistent pain despite multimodal pharmacological treatment and conventional analgesic interventions. Although onabotulinumtoxinA has demonstrated efficacy via intradermal and subcutaneous injections, evidence regarding its periradicular administration through a transforaminal approach targeting the dorsal root ganglion is very limited.

Clinical case: We present the case of a 69-year-old woman with refractory postherpetic neuralgia in the left T6 dermatome of two years' duration, characterized by intense neuropathic pain (END 9/10; DN4 10/10), mechanical allodynia, hyperesthesia, and dysesthesia. The patient did not achieve a satisfactory clinical response after multiple pharmacological and interventional treatments, including gabapentinoids, antidepressants, opioids, intravenous analgesic infusions, an 8% capsaicin patch, subcutaneous infiltration of onabotulinumtoxinA, erector spinae plane block, and transforaminal block with local anesthetic.

Intervention: Fluoroguided periradicular administration was performed via a left thoracic transforaminal approach at the T6 level, administering 60 IU of botulinum toxin type A diluted in 0.2% ropivacaine, after confirming the periradicular distribution with contrast medium and ruling out vascular uptake.

Results: At eight weeks, pain intensity decreased from END 9/10 to 2/10, and the DN4 score decreased from 10 to 2. Near-complete resolution of allodynia, significant improvement in hyperesthesia and dysesthesia, an approximate 70% reduction in the daily methadone dose, and clinically relevant functional and sleep improvements were also observed. No procedure-related complications were recorded during the follow-up period.

Conclusion: Transforaminal periradicular administration of onabotulinumtoxinA targeting the dorsal root ganglion was technically feasible and was associated with clinically relevant improvement in this patient with refractory postherpetic neuralgia. Although this case does not allow us to establish causal relationships, this approach represents a potentially promising interventional strategy that warrants evaluation in prospective studies with a larger number of patients.

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Introduction

Postherpetic neuralgia (PHN) is one of the most debilitating forms of chronic neuropathic pain and the most frequent complication of varicella-zoster virus reactivation. Its pathophysiology involves peripheral neuronal damage, central sensitization, and persistent neuroinflammatory phenomena that promote hyperexcitability of the somatosensory system. Despite the availability of pharmacological and interventional treatments, a significant proportion of patients continue to experience persistent pain with a significant impact on their quality of life.

OnabotulinumtoxinA (BoNT-A) has emerged as a therapeutic alternative for various neuropathic pain syndromes. In addition to its well-known effect on the neuromuscular junction, it exerts analgesic actions by inhibiting the release of neurotransmitters and pronociceptive neuropeptides, such as glutamate, substance P, and

calcitonin gene-related peptide (CGRP), as well as by modulating peripheral and central sensitization processes. In postherpetic neuralgia, the available clinical evidence primarily supports its administration via intradermal or subcutaneous injections into the painful area.

Several experimental and clinical studies suggest that the dorsal root ganglion (DRG) plays a central role in the generation and maintenance of the ectopic activity characteristic of neuropathic pain, including postherpetic neuralgia. From this pathophysiological perspective, periradicular administration of onabotulinumtoxinA via a transforaminal approach could promote greater local exposure of the drug to the DRG environment compared to the superficial infiltrations described to date. However, this hypothesis remains underexplored in clinical practice. We present the case of a patient with refractory postherpetic neuralgia in the thoracic region treated with fluoroguided transforaminal periradicular administration of onabotulinumtoxinA

directed at the dorsal root ganglion area. In addition to describing the observed clinical course, we detail the technical aspects of the procedure and discuss its anatomical and pathophysiological basis as a potential interventional strategy for patients with limited therapeutic options.

Case presentation

We present the case of a 69-year-old woman with a history of type 2 diabetes mellitus and systemic hypertension, both under medical treatment. Two years prior, she had experienced an episode of herpes zoster affecting the left T6 dermatome, which was treated promptly with acyclovir. After the resolution of the skin lesions, she continued to experience localized pain in the same dermatome with neuropathic characteristics, leading to a clinical diagnosis of postherpetic neuralgia based on the temporal evolution and the findings of the physical examination.

For the next 24 months, the patient experienced continuous burning pain with paroxysmal exacerbations, accompanied by mechanical allodynia, hyperesthesia, and dysesthesia over the left T6 dermatome. This condition significantly disrupted sleep, limited activities of daily living, and made it impossible to tolerate the friction of clothing over the affected area. At the initial evaluation, the pain intensity was 9/10 on the Numerical Pain Rating Scale (NPRS), while the Douleur Neuropathique 4 (DN4) questionnaire yielded a score of 10/10, confirming a neuropathic pain phenotype.

During her treatment, she received multimodal pharmacological therapy in accordance with current therapeutic recommendations for neuropathic pain. Pregabalin (300 mg/day), gabapentin (up to 900 mg/day), duloxetine (120 mg/day), oral morphine with subsequent rotation to methadone, and intravenous infusions of lidocaine, magnesium sulfate, dexmedetomidine, and morphine were used, without achieving a clinically significant reduction in pain intensity or sustained functional improvement. As part of the interventional management, subcutaneous infiltration of onabotulinumtoxinA was performed using a checkerboard pattern, along with application of an 8% capsaicin patch, erector spinae plane (ESP) block, and transforaminal thoracic block with local anesthetic. None of these interventions produced clinically significant or sustained pain relief.

Given the persistent refractory pain and the failure of multiple pharmacological and interventional therapeutic strategies, the case was discussed in a multidisciplinary session. Although neuromodulation via dorsal root ganglion (DRG) stimulation was initially considered, this alternative could not be implemented due to a lack of institutional resources. Considering the available evidence on the analgesic effects of onabotulinumtoxinA and the pathophysiological role of the DRG in neuropathic pain, it was decided to perform a transforaminal, fluoroguided periradicular administration targeting the dorsal root ganglion at the left T6 level.

The decision to employ this approach was not due to routine use of onabotulinumtoxinA, but to the absence of available neuromodulation alternatives and the hypothesis that periradicular administration could increase local exposure of the drug to the microenvironment of the dorsal root ganglion, a structure widely implicated in the pathophysiology of neuropathic pain. The Table 1 summarizes the chronological sequence of therapeutic strategies employed in a 69-year-old patient with refractory postherpetic neuralgia in the left T6 dermatome over a two-year period. First-line pharmacological treatment was initiated with pregabalin, gabapentin, and duloxetine, in addition to opioids and intravenous infusions of lidocaine, magnesium sulfate, dexmedetomidine, and morphine, without achieving

significant clinical improvement. Furthermore, the capsaicin patch did not produce sustained analgesic benefit.

Interventional technique

After obtaining written informed consent, the procedure was performed in a fluoroscopy suite under sterile conditions and standard monitoring (continuous electrocardiography, non-invasive blood pressure, and pulse oximetry). The patient was placed in the prone position with a cushion under her chest to optimize exposure of the thoracic spine. Skin antisepsis was performed with an alcoholic chlorhexidine solution, and sterile drapes were applied before the procedure began.

The left T6 level was identified using fluoroscopy with vertebral bony landmarks. Subsequently, an ipsilateral oblique projection was obtained until adequate visualization of the pedicle and intervertebral foramen was achieved, allowing a safe path to be defined for advancing the needle into the periradicular space. A 22G × 90 mm Quincke spinal needle was introduced under continuous fluoroscopic guidance using a tunnel vision technique, advancing it progressively toward the lower third of the intervertebral foramen (Figure 1). The final position of the needle tip was confirmed by anteroposterior and lateral projections to verify its location in the periradicular space adjacent to the dorsal root ganglion.

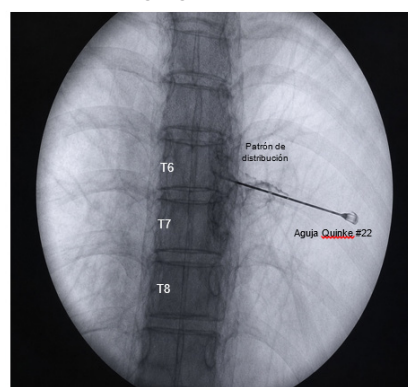


Figure 1 Anteroposterior fluoroscopic view showing needle placement via a transforaminal thoracic approach. Contrast medium administration delineates the periradicular space with opacification around the dorsal root ganglion, confirming adequate contrast distribution and ruling out intravascular diffusion before periradicular administration of onabotulinumtoxinA.

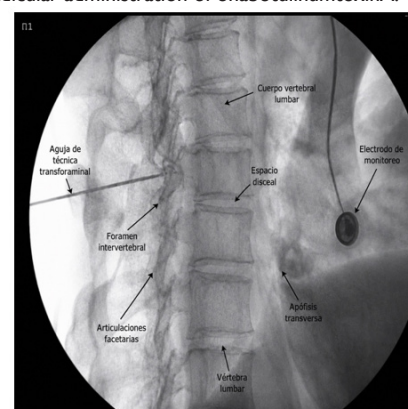


Figure 2 Lateral fluoroscopic projection during a transforaminal thoracic approach. The needle tip is located in the intervertebral foramen and the injection of contrast medium demonstrates a periradicular distribution with slight lateral epidural extension, confirming adequate diffusion before the administration of onabotulinumtoxinA.

Table 1 Chronology of treatments administered and analysis of the therapeutic response

CUADRO 1. CRONOLÓGICO Y ANÁLISIS DE FRACASOS TERAPÉUTICOS		
Paciente: Mujer de 69 años con Neuralgia Postherpética (NPH) Refractaria, Dermatóma T6 izquierdo		
Fecha / Línea de Tiempo	Esquema de Tratamiento Evaluado	Resultado / Fracaso de Tratamiento
Hace 2 años (Inicio)	Tratamiento antiviral oportuno con Aciclovir para episodio agudo de Herpes Zóster en dermatoma T6.	Resolución de lesiones cutáneas, pero persistencia de dolor neuropático severo crónico (NPH).
Últimos 24 meses (Farmacoterapia)	• Dolor Urente con exacerbaciones paroxísticas • Pregabalina 300 mg/día • Gabapentina hasta 900 mg/día • Duloxetine 120 mg/día	Fracaso terapéutico: Sin mejora clínica significativa; dolor persistió en ENA 9/10 + DN4 10 puntos.
Últimos 24 meses (Infusiones)	Infusiones intravenosas de Lidocaína, Sulfato de Magnesio, Dexmedetomidina y Morfina.	Fracaso terapéutico: Sin mejora clínica sostenida.
Últimos 24 meses (Tópico)	Aplicación de Parche de Capsaicina.	Fracaso terapéutico: Sin respuesta clínica satisfactoria.
Propuesta de Neuromodulación	Neuromodulación mediante estimulación del ganglio de la raíz dorsal (DRG).	Fracaso por barrera de acceso: No disponible institucionalmente.
Día del Procedimiento Actual	Infiltración periradicular transforaminal torácica T6 fluoroguiada: • OnabotulinumtoxinA (60 UI) • Ropivacaína 0.2% (Volumen final: 1.6 mL).	ÉXITO CLÍNICO (A las 8 semanas): • Reducción del dolor: ENA de 9/10 a 2/10. • Reducción DN4: de 10 a 2 puntos. • Desaparición de alodinia y reducción >70% de la dosis de metadona.

After confirming the fluoroscopic position, careful aspiration was performed to rule out return of blood or cerebrospinal fluid. Subsequently, a small amount of non-ionic contrast medium was administered under real-time fluoroscopy. The observed distribution was consistent with a periradicular pattern, with no evidence of unwanted intravascular, intrathecal, or epidural opacification; therefore, the drug was administered. One vial of onabotulinumtoxinA (100 IU) was reconstituted with 1 mL of 0.9% saline solution, yielding a final concentration of 100 IU/mL. Sixty IU (0.6 mL) were withdrawn and mixed with 1 mL of 0.2% ropivacaine, resulting in a total volume of 1.6 mL. The choice of a reduced volume was intended to promote a predominantly periradicular distribution and limit extensive epidural diffusion. The solution was administered slowly into the periradicular space after confirming again the absence of vascular uptake. During the injection, continuous communication was maintained with the patient to detect early onset of intense paresthesia, radicular pain, or any other symptoms suggestive of intraneural or intravascular injection. Once the administration was complete, the needle was withdrawn, and the patient remained under clinical observation without any immediate complications.

The transforaminal approach was chosen because it allows anatomical access to the periradicular space where the dorsal root ganglion is located, facilitating focal drug delivery with a reduced volume. This strategy aimed to maximize local exposure of onabotulinumtoxinA to the ganglion microenvironment, while minimizing diffusion to other epidural compartments.

Results

The clinical evaluation performed eight weeks after the procedure showed a significant improvement in pain intensity and neuropathic symptoms. Pain intensity decreased from 9/10 to 2/10 on the Numerical Pain Scale (NPS), while the DN4 questionnaire score decreased from 10/10 to 2/10, findings consistent with a substantial decrease in the neuropathic component. The physical examination revealed almost complete resolution of the mechanical allodynia, with marked improvement of the previously documented hyperesthesia and dysesthesia.

Clinical improvement allowed for an approximately 70% reduction in the daily methadone dose, without compromising pain control. The patient also reported a significant improvement in sleep quality, increased tolerance for activities of daily living, and functional recovery compared to baseline. During the eight-week follow-up, no adverse events related to the procedure were documented, including

neurological, infectious, vascular complications or motor deficits attributable to the periradicular administration of botulinum toxin.

Discussion

Refractory postherpetic neuralgia continues to pose a significant therapeutic challenge, particularly in patients who do not achieve adequate pain control with multimodal pharmacological treatment or conventional analgesic interventions.¹ In this case, transforaminal periradicular administration of onabotulinumtoxinA was associated with a clinically relevant reduction in pain intensity, improvement in neuropathic symptoms, decreased opioid consumption, and functional recovery, with no procedure-related adverse events during the eight-week follow-up. While a case report does not allow for establishing a causal relationship or demonstrating efficacy, these findings support the technical feasibility of the approach and generate a clinical hypothesis that warrants evaluation through prospective studies.

The available evidence on the use of onabotulinumtoxinA in postherpetic neuralgia comes primarily from randomized clinical trials, systematic reviews, and meta-analyses that have evaluated its administration via intradermal or subcutaneous injections into the painful area. Taken together, these studies show significant reductions in pain intensity, improvements in quality of life, and a favorable safety profile, leading to the consideration of botulinum toxin as a therapeutic alternative in patients with refractory focal neuropathic pain.²⁻⁶ However, virtually all of this evidence pertains to superficial injections, while periradicular administration via a transforaminal approach has been scarcely described in the literature.

The pathophysiological basis of this approach lies in the role of the dorsal root ganglion (DRG) as a key site in the pathophysiology of neuropathic pain. Following varicella-zoster virus-induced injury, the DRG develops a microenvironment characterized by activation of satellite glial cells, persistent release of proinflammatory cytokines, alterations in ion channel expression, and generation of spontaneous ectopic activity, promoting peripheral sensitization and contributing to the maintenance of central sensitization.^{7,8} From this perspective, periradicular administration could promote greater local exposure of the drug to the DRG environment compared to purely cutaneous infiltrations; however, this hypothesis requires experimental and clinical confirmation.

The analgesic mechanisms of onabotulinumtoxinA are likely multifactorial. In addition to blocking the release of acetylcholine at the neuromuscular junction, the neurotoxin inhibits the exocytosis of neurotransmitters and pronociceptive neuropeptides, including glutamate, substance P, and calcitonin gene-related peptide (CGRP), by cleaving the SNAP-25 protein. Furthermore, experimental studies suggest that it can modulate neuroinflammation and reduce neuronal hyperexcitability in both peripheral nerve endings and the dorsal root ganglion.^{8,9} These mechanisms could at least partially explain the clinical improvement observed in our patient; however, the present case does not allow us to determine which of them played a predominant role.

From a technical standpoint, the transforaminal thoracic approach requires meticulous execution due to the proximity of critical neural and vascular structures. In this context, the use of biplanar fluoroscopy, systematic aspiration, and pre-administration of contrast medium to rule out intravascular or intrathecal distribution are essential measures to minimize the risk of complications.¹⁰ In our patient, no immediate adverse events or adverse events were recorded during follow-up, which supports the technical feasibility of the procedure when performed by operators experienced in spinal intervention. However,

the safety observed in a single case does not allow for extrapolating the risk profile of this technique to other populations.

This report has several limitations. First, it is based on the experience of a single patient, so the results cannot be generalized, nor can a causal relationship be established between the intervention and clinical improvement. Second, the distribution pattern of the contrast medium is only an indirect marker of the administration site and does not confirm the diffusion of onabotulinumtoxinA into the dorsal root ganglion area. Finally, follow-up was limited to eight weeks, so the duration of the analgesic effect and the need for repeat procedures remain unknown.

Conclusion

In conclusion, transforaminal periradicular administration of onabotulinumtoxinA targeting the dorsal root ganglion environment was technically feasible and was associated with clinically relevant improvement in this patient with refractory postherpetic neuralgia. Although these findings should be interpreted with caution due to the inherent limitations of a case report, they support the need for prospective studies evaluating the efficacy, safety, optimal dosage, and reproducibility of this strategy as a potential interventional alternative for patients with limited therapeutic options.

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