

Introduction

Postherpetic neuralgia is debilitating, and many treatment modalities exist but with varying degrees of success. One month after the onset of shingles, 9 to 14.3% of patients develop postherpetic neuralgia, and at three months, this percentage becomes 5%. At one year, 3% of patients continue to have severe pain.² It is important to continue to search for the most effective treatment for these populations.

Case

A 72-year-old female presented with postherpetic neuralgia. She had a previous unsuccessful trial of Acyclovir, Gabapentin, and Medrol dose pack for five days. Six months later, she was evaluated in clinic and was initiated on Lyrica and Nortriptyline. One month later, the patient was reassessed due to continued pain. She subsequently had a failed thoracic epidural. One week later, she underwent a diagnostic intercostal nerve block, with cryoneurolysis. She had resolution of her symptoms for 3 to 4 months, and this was repeated on follow up. She exhibited an 80% reduction in her pain.

Cryoneurolysis¹

Effect: Cryoneurolysis is the direct application of cold temperatures, (approximately -70°C) to ablate the targeted nerve, resulting in reversible neuronal injury to the peripheral sensory nerve. The effect of cryoablation and the degree of tissue injury depends on the temperature of the cryoprobe. While mild temperature ($+10^{\circ}\text{C}$ to -20°C) causes little or no neuronal injury, reversible destruction of the axon, called Wallerian degeneration, occurs in temperatures between -20°C to -100°C . It is important to note that this degeneration includes the axon and myelin sheath but not the endoneurium, which is unaffected by the focused cold therapy. Wallerian degeneration occurs distally from the site of ablation, and the induced block lasts until axon regeneration.

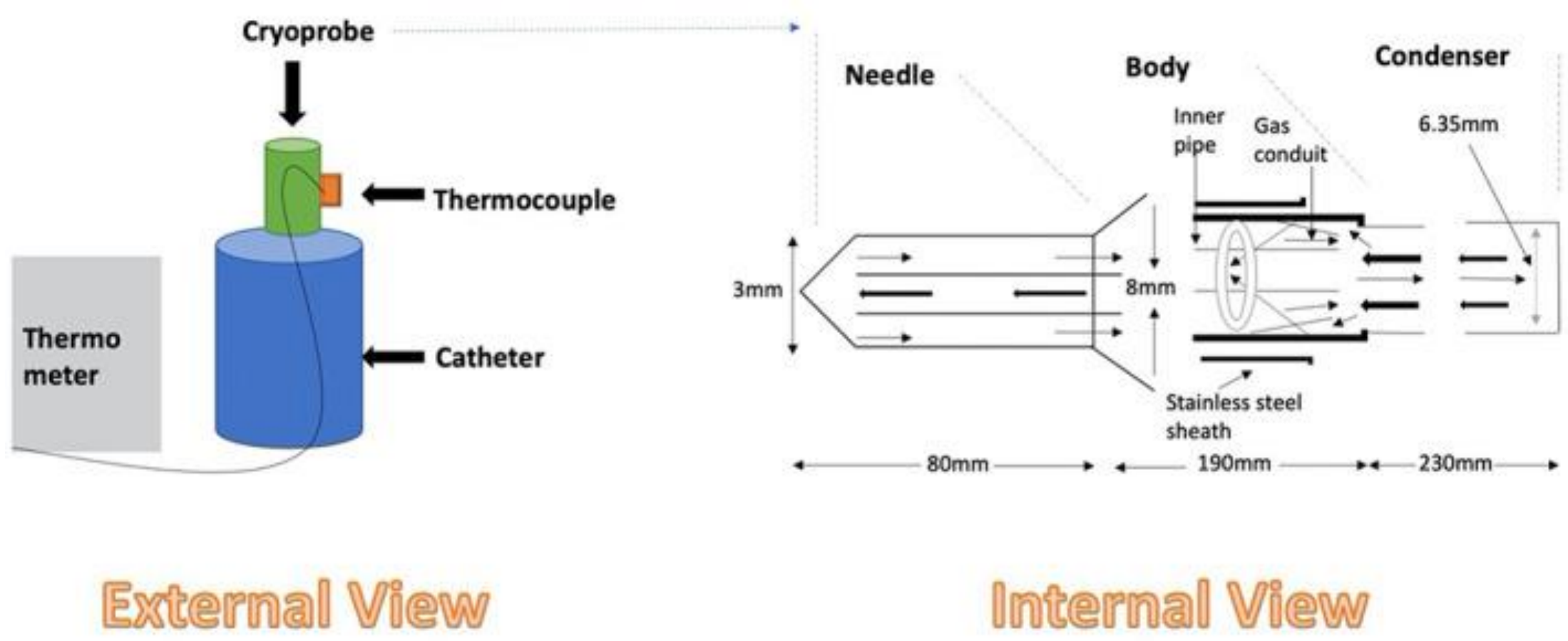
Axonal Regeneration: Generally, axonal regeneration occurs at a rate of approximately 1–2 mm per day, and once the axon has regenerated it reconnects with the sensory receptor, and conduction can start again. Regrowth of axons into the perineurium eventually restores sensation and the block functionally resolves. Thus, pain sensation may return over time (after weeks to months) and requires repeat administration of cryoneurolysis. Important to note, repeating cryoneurolysis in the same anatomic location for subsequent surgical procedures does not result in negative sequelae.

Joule-Thomson Effect: Modern cryoprobes utilize gas to generate extremely low temperatures. The cryoprobes consist of a hollow tube ranging from 1.4 mm to 2 mm. Inside the hollow tube is a smaller inner tube that injects pressurized gas (usually carbon dioxide or nitrous oxide) at 600 to 800 psi. The pressurized gas travels down the inner tube and is released through a very fine aperture into the larger outer tube at a much lower pressure (10–15 psi), allowing the gas to expand rapidly into the distal tip. As the gas moves from high to low pressure through the narrow aperture, the rapid expansion causes a dramatic decrease in temperature, forming an ice ball at the tip of the probe (the Joule-Thomson effect). The subsequent ice crystals formed in this process induce vascular damage to the vasa nervorum, producing severe endoneural edema, which results in long-term pain relief. The gas is then evacuated back to the machine through a large diameter tube located in the center of the shaft. This ensures that no gas enters the patient's tissues.

Procedure: The extent and duration of analgesia are the result of the degree of cold obtained and the duration of exposure. Also, the degree of coldness and tissue injury depends on the gas utilized because the temperatures produced by the probe cannot be lower than the boiling point of the gases (N_2O : -88°C ; CO_2 : -79°C). Thus, irreversible nerve damage is less likely to occur with these gases because it typically occurs with temperatures around -100°C . Furthermore, most nerve cryoprobes have a built-in nerve stimulator for localization of the nerve and a thermistor to detect the temperature at the tip. Together, these features provide a wide margin of safety for these devices. When performing cryoneurolysis, a series of two to three-minute freezes with 30 s of defrosting between each cycle is recommended. Adequate thawing of more than 20 s but less than 40 s allows subsequent freezes to increase the size of the freeze zone, optimizing the result. Of note: Cryoprobes for tumor ablation do not generally include nerve stimulators and use liquid nitrogen without the Thomas-Joule effect.

Images¹

Comparison of regional anesthesia and cryoanalgesia		
	Pros	Cons
Regional Anesthesia (continuous peripheral nerve blocks, epidurals/spinals)	Effective short-term analgesia	Short duration of analgesia lasting up to 1 week
	Well-studied	Continuous PNBs and epidurals require catheter/pump care
	Improved efficacy/safety with ultrasound	More complications associated with indwelling catheter (ie, infection, catheter migration, ineffectiveness)
	Generally easy to perform	
	Well-tolerated	
	Minimal side effects	
Cryoanalgesia	Quick onset of action	Unpredictable duration of analgesia
	Prolonged analgesia lasting weeks to months with significant reduction of opioid consumption.	
	Minimal side effects	Requires repeat treatments (~every 3 months or when pain returns)
	Easy to perform	Can lead to muscle weakness, which may be undesirable for certain procedures
	Well-tolerated	Limited use in current practice
	Quick onset of action	
Handheld cryoneurolysis devices, portable, and cost-effective		



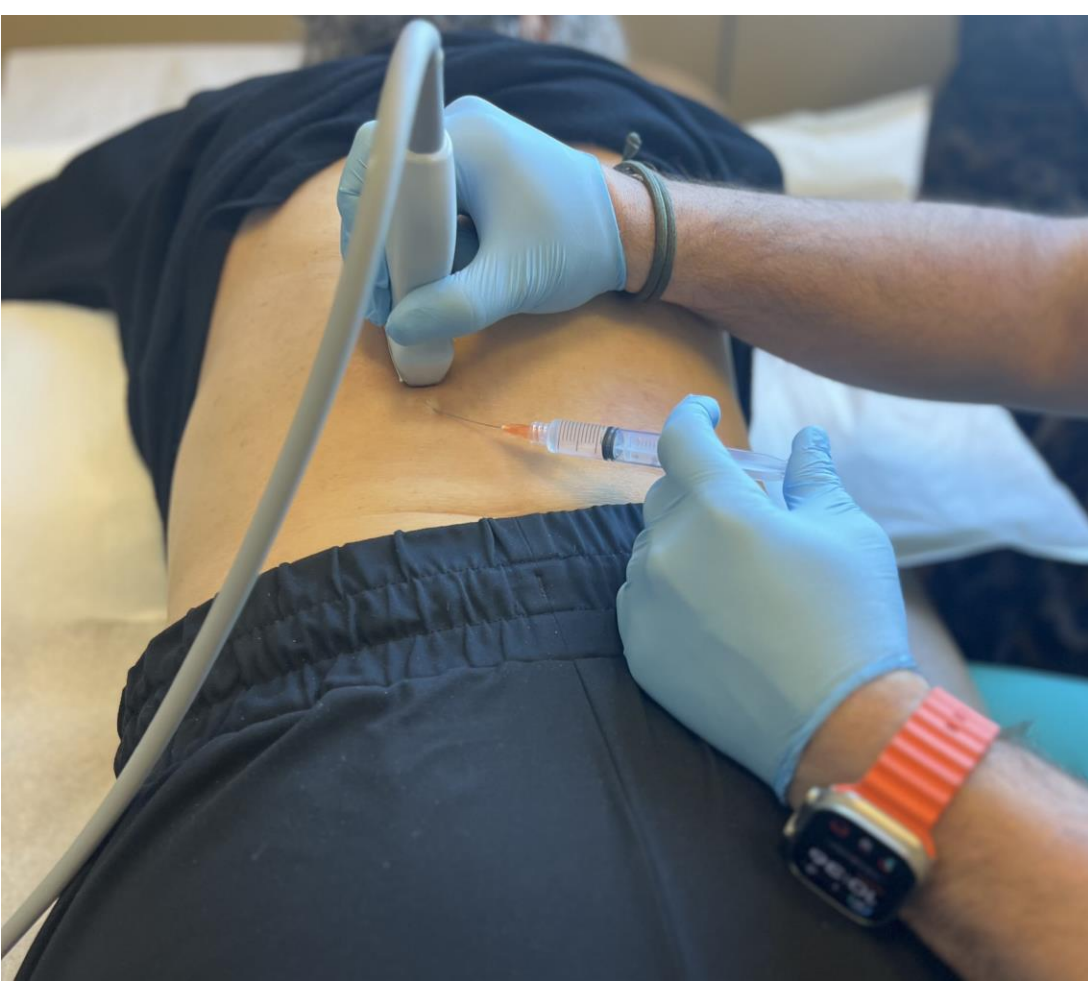
Discussion

Postherpetic neuralgia is a chronic neuropathic pain condition that persists for three or more months after an episode of herpes zoster. This condition results in severe patient suffering and reduced quality of life and is costly both to the individual and to the healthcare system to treat. Treatments range from transdermal lidocaine patches, capsaicin, non-steroidal anti-inflammatory drugs (NSAIDs), nerve blocks, antidepressants, anticonvulsants, and opioids.

Cryoneurolysis is a minimally invasive procedure that has demonstrated efficacy in acute pain management. Studies have explored the effectiveness and safety of cryoneurolysis in the setting of chest pain from cardiac surgery, rib fractures from trauma patients, and chronic refractory peripheral mononeuropathies. Cryoneurolysis also has less systemic and long-term effects when compared to pharmacological treatments such as opiate therapy.

To our knowledge, one case report details the use of cryoneurolysis for intercostal nerves for postherpetic neuralgia. Kalava et al describe a 58-year-old male who experiences right-sided T5, T6, T7, T8 dermatome and left-sided T6 dermatome pain. This pain was refractive to localized cryotherapy and class IV laser treatments. Diagnostic Intercostal blocks were performed bilaterally. Cryoneurolysis of the left T5 and T6 and right T9 intercostal nerves were performed. The patient experienced complete pain relief in the posterior thoracic wall but continued to have abdominal pain. It was thought that the residual pain was due to the limited application of cryoneurolysis due to financial constraints.

Our case aims to expand the growing literature of cryoneurolysis as a modality to treat postherpetic neuralgia. There were no complications from our case, nor from Kalava et al. Further studies are needed to determine the long-term effects and efficacy of cryoneurolysis for postherpetic neuralgia.



References

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