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Ultrasound-Guided Percutaneous Intercostal Cryoneurolysis for Anterior Cutaneous Nerve Entrapment Syndrome: A Case Report

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Background: Anterior cutaneous nerve entrapment syndrome (ACNES) is an underdiagnosed and undertreated chronic abdominal pain condition.

Case Report: An 18-year-old man with ACNES reported 4 years of diffuse, constant abdominal pain and cramping that severely impacted his quality of life. Prior interventions of ultrasound-guided abdominal trigger point injections and transversus abdominis plane blocks only provided minimal pain relief. At our clinic, he received bilateral ultrasound-guided T9-T11 intercostal cryoneurolysis and reported complete pain relief for 5 months.

Conclusions: Cryoneurolysis may be an option for ACNES in refractory cases prior to considering a surgical approach.

Key words: Cryoneurolysis, ultraound, anterior cutaneous nerve entrapment syndrome, abdominal pain

BACKGROUND

Chronic abdominal wall pain (AWP) can arise from a variety of etiologies, including hernias, thoracic radiculopathies, xiphoidalgia, lower rib pain syndromes, herpes zoster, rectus sheath hematoma, and endometriosis (1). The most common cause of chronic AWP, however, is anterior cutaneous nerve entrapment syndrome (ACNES) (2). This often underrecognized and undertreated condition occurs due to the entrapment of the anterior cutaneous branches of the lower thoracic nerves (T7-T12), as they pass through a fibrous ring on the lateral border of the rectus abdominis at a 90° angle (3). It can cause severe, refractory chronic AWP. Treatment strategies in the past have included medical management, trigger point injections (TPIs), ultrasound-guided blocks, chemical neurolysis, radiofrequency ablation, botulinum toxin injection, and surgical neurectomy and mesh reinforcement (4-15). In this case report, we discuss a percutaneous analgesic intervention option for ACNES that has been minimally described, and may serve as an option in refractory cases prior to considering a surgical approach. We present a case of an 18-year-old man diagnosed with AWP due to ACNES who was successfully treated with ultrasound-guided percutaneous intercostal cryoneurolysis. The patient provided informed written consent for performance of the procedure and publication of the materials presented.

CASE REPORT

An 18-year-old man diagnosed with ACNES presented to our clinic for evaluation and treatment of his chronic AWP. He reported that the pain had been ongoing for about 4 years with no obvious inciting event. The pain

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was described as a nonradiating, constant throbbing, cramping, and burning sensation in all 4 quadrants of his abdomen and rated between 8-9 out of 10 on the Numeric Rating Scale. Any activity that activated his core muscles aggravated the pain, while sitting, lying down, and applying heat to his abdomen alleviated the pain. The patient also had a history of depression with one prior hospitalization due to suicidal ideation. He reported that his abdominal pain worsened his depressive symptoms. At the height of his pain, he would miss up to 3 weeks per month of school.

Prior to presentation at our clinic, the patient had been seen by various specialists at a neighboring institution. He was seen by both pediatric and adult gastroenterologists and a pain management specialist, as well as Psychiatry and Psychology. He underwent an extensive workup of his abdominal pain, including abdominal ultrasound, computed tomography abdomen/pelvis, magnetic resonance imaging spine survey, and upper endoscopy. None of these imaging studies resulted in any pertinent findings. He was treated for potential gastritis with a proton-pump inhibitor trial, neither of which alleviated his pain. He was also referred to physical therapy to work on his core muscles, which helped improve overall function but not his AWP. Acupuncture was also recommended, which yielded pain relief for up to 6 hours after treatment. He did not take any other medications for his pain.

Prior procedural interventions for his AWP included an ultrasound-guided abdominal TPI with 0.25% bupivacaine only, which yielded 100% pain relief for 30 minutes after treatment before his pain returned to baseline. Later, he received 3 bilateral transversus abdominis plane (TAP) blocks over the course of a year, each containing 0.25% bupivacaine and 40 mg triamcinolone. With these blocks, the patient reported 100% pain relief for up to 6 hours after procedure completion with a gradual return to baseline; however, his functionality was noted to improve for up to several weeks after each block. The blocks also reduced his diffuse abdominal pain to only the area surrounding his umbilicus.

Upon presenting to our clinic, about one year after his last TAP block, the patient reported that his pain continued to be an issue and his functionality had declined. He underwent a repeat ultrasound-guided abdominal TPI, which yielded > 50% pain relief for 2 weeks. The patient subsequently underwent diagnostic bilateral T9 paravertebral nerve blocks with ropivacaine 0.25% and dexamethasone. After the procedure, the patient reported the pain was completely resolved. He reported feeling the best he had felt since the onset of his pain. This relief lasted for about 24 hours. Thus, at a subsequent outpatient visit, the patient underwent bilateral ultrasound-guided percutaneous T9-T11 intercostal cryoneurolysis.

For this procedure, the patient was placed in the prone position. The skin was prepped with chlorhexidine, and sterile drapes were applied. The skin and soft tissues were anesthetized with 1% lidocaine at each site. The intercostal levels from T9 to T11 were identified via ultrasound. Beginning at left-sided T11, a 14G angiocatheter introducer was placed with the tip proximal to the intercostal nerve. The cryoneurolysis probe was inserted through the catheter and placed inferior to the 11th rib. Two cycles of 2 minutes of cooling at -70°C and one minute of thawing were applied. The probe was removed, and this procedure was repeated for T10 and T9, with both levels being accessed through the same angiocatheter. This was then repeated for the right side. The patient reported complete pain relief immediately after the procedure and continued to report complete analgesia at one-month and at five-month follow-up. He did not experience any complications related to the procedure. He was able to return to school and increase his physical activity.

DISCUSSION

ACNES is the most common cause of chronic AWP. The estimated prevalence of this syndrome is 1 in 1,800 worldwide. Cases occur most frequently in the age ranges of 15-20 and 35-45 years, and women are 4 times more likely to be affected than men (16-18). The pain often presents acutely, then transitions to a persistent, dull ache that fluctuates with time and activity level and type, being aggravated especially by engagement of core muscles (19). Pain signals from the skin of the abdominal wall are transmitted by the anterior cutaneous intercostal nerve branches (T7-T12) (20), making the intercostal nerves an appropriate target for intervention. In our patient's case, a diagnostic block at the T9 paravertebral space bilaterally provided the patient with the greatest amount of relief he had experienced since the onset of his symptoms.

ACNES can only be diagnosed once other possible etiologies of abdominal pain have been ruled out. The exclusionary diagnosis of ACNES may prolong the time it takes for patients to get the relief they seek in

a timely manner. For example, in our patient, it took 4 years from the onset of symptoms to achieve complete pain relief through cryoneurolysis treatment. Not only is the workup extensive, but a patient's response to treatment also varies greatly, making ACNES—like other chronic pain conditions—a challenge to treat. A variety of interventions have been tested for the treatment of ACNES with mixed results. These interventions include systemic pharmacotherapy, TPIs, ultrasound-guided blocks, chemical neurolysis, radiofrequency ablation, botulinum toxin injection, and surgical neurectomy and mesh reinforcement (4-15). This case is the first reported of a patient with ACNES successfully treated with ultrasound-guided percutaneous intercostal cryoneurolysis.

Cryoneurolysis achieves peripheral nerve blockade by utilizing extremely low temperatures to reversibly ablate the target nerves. The effect is transitory as the nerves undergo Wallerian degeneration initially but then regenerate gradually, varying based on the freeze cycle used (21). As a result, the patient may require future blocks, depending on symptoms after block resolution. Compared to the effects of peripheral nerve blockade with local anesthetics that last for hours to days, the effects of cryoneurolysis last much longer—up to weeks or months—without exposing patients to potential systemic side effects of local anesthetics or, in the case of nerve catheters, risk of infection (22). Additionally, intercostal nerve blockade with local anesthetic puts the patient at the highest risk of local anesthetic systemic toxicity compared to other block sites. With cryoneurolysis, there is no such risk. Also inherent with any chest wall nerve blockade is the rare risk of pneumothorax, which is mitigated by use of ultrasound and is not increased with use of cryoneurolysis. Our patient tolerated the procedure well and reported the greatest pain relief he had experienced since the onset of his symptoms. We anticipate this relief will last for several weeks or months, and we hope it will improve not only his functionality but also his depressive symptoms and overall quality of life.

CONCLUSIONS

Ultrasound-guided percutaneous intercostal cryoneurolysis may be an effective modality in the treatment of ACNES and an additional option for patients seeking relief from this chronic condition. More studies, including appropriately powered randomized, controlled clinical trials, are required to demonstrate and quantify its risks, benefits, and scope of use.

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