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Case Report

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Cryoneurolysis for shoulder pain: A case series

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Abstract

Treating musculoskeletal pain in patients with medical comorbidities which limit treatments is challenging. However, in-office ultrasound and improvements in cryoneurolysis equipment expand its potential as a non-pharmacological and minimally invasive treatment for shoulder pain. Cryoneurolysis targets the suprascapular nerve, a major contributor to sensory innervation of the shoulder. While this has been demonstrated in small case reports, this larger series of eight patients explores better the role of cryoneurolysis in treating shoulder pain. Patients were English-speaking and of the Rocky Mountain Regional Veterans Affairs Medical Center Spinal Cord Injuries/Disorders inpatient unit and outpatient clinics. All had shoulder pain attributed primarily to glenohumeral degeneration and/or chronic rotator cuff tendinopathy. Thirteen total shoulders were treated with suprascapular nerve cryoneurolysis with an 85% (11/13) success rate in achieving > 75% pain relief. In conclusion, we suggest that suprascapular nerve cryoneurolysis may serve as an adjunctive or alternative treatment for shoulder pain.

Keywords: Cryoneurolysis, peripheral nerve block, shoulder pain, spinal cord injury.

Treating musculoskeletal pain in patients with medical comorbidities presents a challenge for clinicians. Often, clinicians must treat pain in the context of medical conditions which limit available treatments. However, availability of in-office ultrasound and improvements in cryoneurolysis equipment have expanded the potential of cryoneurolysis as a non-pharmacological and minimally invasive technique to manage musculoskeletal conditions such as shoulder pain.[1,2]

Cryoneurolysis is the application of cold temperature to peripheral nerves to induce Wallerian degeneration and stop transmission of pain signals for several months.[1,3,4] As Wallerian degeneration is reversible, pain is inhibited until axons are regenerated.[3,4] Modern cryoprobes typically consist of a hollow, closed outer tube that contains a smaller inner tube.[1,2,4] Relatively high-pressure nitrous oxide or carbon dioxide is passed from a reservoir down the smaller inner tube to the needle tip where it rapidly expands into the space within the needle tip.[1,2,4] Temperature drops dramatically via the Joule-Thomson effect, forming an ice ball at the tip of the closed needle.[1,2,4] The gas is, then, vented out the larger tube.[1,2,4]

Shoulder pain is the third most common musculoskeletal complaint in primary care.[5,6]

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The shoulder is innervated by several peripheral nerves including the suprascapular and axillary nerves posteriorly and the lateral pectoral nerve anteriorly.[5] However, the suprascapular nerve innervates approximately 70% of the shoulder, including the glenohumeral joint capsule and humeral head that comprise common pain generators.[5,6] The suprascapular nerve can be ablated safely using ultrasound-guided cryoneurolysis just superior to the suprascapular notch, improving pain as demonstrated by small case reports.[7]

In the present article, we report a case series of eight patients to better characterize the role of cryoneurolysis in the treatment of shoulder pain.

CASE SERIES

All patients were English-speaking from the Rocky Mountain Regional Veterans Affairs Medical Center Spinal Cord Injuries/Disorders inpatient unit and outpatient clinics. Patients had shoulder pain attributed primarily to glenohumeral degeneration and/or chronic rotator cuff tendinopathy that failed conservative therapy. Follow-up periods varied based on appointment scheduling. This case series was determined to be exempt from Institutional Review Board (IRB) review (September 9, 2025). This manuscript adheres to the CARE guidelines for case reports.

Two attending physicians experienced in using cryoneurolysis performed or directly supervised rehabilitation residents performing the procedures. Techniques varied, and the preferred technique described below was developed through experience. Patient characteristics, failed conservative measures and deviations from this technique are described in Table 1.

Using a curvilinear ultrasound probe, the suprascapular notch was identified. Doppler mode confirmed the suprascapular artery and adjacent nerve. A 25-gauge, 1.5″ needle delivered 2 mL of 1% lidocaine subcutaneously to anesthetize the tract toward the superior transverse scapular ligament. A 22-gauge, 4″ spinal needle was advanced past the ligament into the notch and 4 mL of a 1:1 solution of 0.25% bupivacaine and 1% lidocaine was injected with ultrasound visualization. The shoulder was passively ranged to test for improved pain. Relief supported the assumption that the pain was mediated by the suprascapular nerve. An 18-gauge needle created a dermal portal for the cryoneurolysis probe, which was advanced to the notch. Five cryoneurolysis cycles (106 sec each) were performed with probe repositioning between cycles. Figure 1 depicts the procedure.

Case 1– A 63-year-old male patient with bilateral rotator cuff tendinopathy sustained C4 American Spinal Injury Association (ASIA) Impairment Scale (AIS) C spinal cord injury (SCI) and traumatic brain injury (TBI) from polytrauma. Magnetic resonance imaging (MRI) showed bilateral infraspinatus, supraspinatus tears, biceps tendon tears and acromial clavicular (AC) joint osteoarthritis. Clinical examination revealed supraspinatus atrophy, pain with active movement plus positive Neer's and Speed's tests bilaterally. Multiple prior subacromial bursa and AC joint steroid injections failed to provide durable pain relief.

Suprascapular nerve cryoneurolysis provided complete, immediate pain relief lasting six months. Active and passive range of motion (ROM) improved. Cryoneurolysis was repeated to achieve four more pain-free months, then repeated again with similar, complete pain relief at two-week follow-up.

Case 2– An 82-year-old male patient with C1 AIS C incomplete tetraplegia experienced recurrent autonomic dysreflexia (AD) from right shoulder pain. Oral bladder antispasmodics and bowel regimen were optimized. Infection, wounds, and other noxious stimuli were ruled out. Clinical examination was notable for positive Neer's test and shoulder tenderness with passive ROM. Radiographs revealed glenohumeral osteoarthritis.

Treatment options were limited due to medical comorbidities. Therapies caused pain and AD. Acetaminophen and topical analgesics were ineffective. Non-steroidal anti-inflammatory drugs (NSAIDs) were contraindicated due to chronic kidney disease (CKD). Corticosteroid injection was deferred due to sensitivity to medications, dementia and encephalopathy requiring intubation after a small dose of baclofen.

Suprascapular nerve cryoneurolysis was performed with immediate, 100% pain relief. Passive ROM was painless. Of particular

Table 1. Summary of eight cases

Case	Age/Sex	SCI level (AIS)	Primary shoulder pathology	Associated conditions	Failed/contraindicated conservative measures	Intervention & technique deviations[a]	Outcomes[b]
1	63 / M	C4 (AIS C)	Bilateral irreparable supraspinatus & infraspinatus tears, biceps tendon tears, AC-joint OA; supraspinatus atrophy. Chronic bilateral rotator-cuff tendinopathy.	TBI & polytrauma, hypertension, hyperlipidemia, type 2 diabetes.	Multiple prior subacromial-bursa and AC-joint corticosteroid injections without durable relief.	Bilateral SSN cryoneurolysis over 3 sessions (6 mo apart). Deviation: 2 freeze cycles (*vs* 5) on the right; no provocative block testing.	Complete, immediate relief lasting ~6 months; ROM improved. Re-treated at 6 months with 4 months relief. Third session with complete relief at 2-week follow-up.
2	82 / M	C1 (AIS C)	Right glenohumeral osteoarthritis; shoulder pain triggering recurrent autonomic dysreflexia.	Recurrent AD; CKD; dementia; prior encephalopathy/ intubation after low-dose baclofen, medication sensitivity.	Acetaminophen & topical analgesics ineffective; NSAIDs contraindicated (CKD); corticosteroid injection deferred (medication sensitivity, dementia, encephalopathy risk); PT/OT provoked pain & AD.	Right SSN cryoneurolysis. Deviation: 2 freeze cycles (*vs* 5); no provocative block testing.	Immediate 100% relief; painless passive ROM. AD resolved for the remaining 10 days of hospitalization.
3	72 / F	C1 (AIS D)	Full-thickness tears of left infraspinatus & supraspinatus; partial tears of subscapularis and long head of biceps. Chronic, refractory left shoulder pain.	Fibromyalgia, depression, C3-T2 fusion revision 1 week prior.	Refractory to NSAIDs, ice/heat, topical diclofenac, lidocaine patches, methocarbamol; corticosteroid injections avoided (recent fusion revision).	Left SSN cryoneurolysis. Deviation: Block with 2.5 mL 1% lidocaine + 2.5 mL 0.25% bupivacaine; 4 freeze cycles (*vs* 5); no provocative block testing.	Transient relief during anesthetic phase only. Full return of pre-procedure pain within hours, persisting through admission.
4	76 / M	T5 (AIS D)	Bilateral RC tendinosis w/ painful subluxation. Left: large chronic retracted supraspinatus and near-complete infraspinatus tears. Right: full-thickness supraspinatus/infraspinatus/ subscapularis tears w/ fatty atrophy, GH arthrosis, labral degeneration.	Recent urosepsis/septic shock, deconditioning limiting rehab.	Acetaminophen, oxycodone, topical analgesics failed; bilateral corticosteroid injections approximately every 3 months for years with safer alternative sought after sepsis.	Bilateral SSN cryoneurolysis; provocative block testing performed (pain abolished). Deviation: 5 mL of 1:1 0.25% bupivacaine/1% lidocaine block (*vs* 4 mL).	100% relief bilaterally w/ increased active ROM that was sustained at 2-day and 1-month follow-up.
5	71 / M	C3 (AIS D)	Bilateral AC joint arthritis and degenerative GH changes with positional shoulder pain limiting wound off-loading.	Multiple myeloma on chemotherapy and high-dose steroids, sacral shearing wound.	Max-dose acetaminophen, topical diclofenac, and PRN oxycodone/lidocaine ineffective; dry needling ineffective; therapy limited by pain; corticosteroid injections relatively contraindicated (needed concurrent high-dose steroids with chemotherapy).	Bilateral SSN cryoneurolysis. Deviation: Block with 3 mL 1:1 mix (*vs* 4 mL); 4 freeze cycles right / 3 left (*vs* 5); extra local anesthetic needed before advancing the left cryoprobe; no provocative block testing.	Left: total relief w/ passive movement and tolerated 3 hours of pain-free side-lying for 3 weeks with improved wound off-loading. Right: only 25-50% improvement; tolerated 30-60 min of side-lying (partial responder).
6	81 / M	T7 (AIS A)	Chronic bilateral shoulder and back pain with positive impingement testing plus lateral and posterior right-shoulder tenderness.	Osteoporosis	Acetaminophen and PT failed; managed on multi-drug opioid regimen; corticosteroid injections avoided (osteoporosis).	Bilateral SSN cryoneurolysis. Deviation: 14-gauge angiocatheter used to form one probe tract; 2 freeze cycles per shoulder (*vs* 5).	Immediate bilateral relief with significantly increased ROM in all planes that was sustained at next-day follow-up.

Table 1. Continued

Case	Age/Sex	SCI level (AIS)	Primary shoulder pathology	Associated conditions	Failed/contraindicated conservative measures	Intervention & technique deviations[a]	Outcomes[b]
7	59 / M	T12 (AIS A)	Right biceps and supraspinatus tendinopathy with subacromial bursitis causing chronic right shoulder pain impeding transfers & sleep.	TBI	Dry needling, physical therapy, acetaminophen, topical diclofenac with insufficient relief.	Right SSN cryoneurolysis per preferred Methods protocol. Deviation: None.	Immediate 80% relief, improved active ROM and near-total relief at discharge 4 days later.
8	58 / M	T9 (AIS A)	Left: post-reconstruction surgical changes (prior humerus fracture with nail and plate repair), heterotopic ossification of GH joint limiting ROM, severe pain with external rotation. Right: biceps and supraspinatus pain	TBI, CKD Stage V on hemodialysis, chronic Stage IV sacral pressure injury, recent acute hypoxic respiratory failure and metabolic encephalopathy.	NSAIDs contraindicated (CKD); opioids limited to cautious hydromorphone (encephalopathy); topical diclofenac only mildly helpful.	Bilateral SSN cryoneurolysis per preferred Methods protocol. Deviation: Block = 4 mL 1% lidocaine alone (*vs* 4 mL of 1:1 0.25% bupivacaine/1% lidocaine).	Left: rest pain 0/10, biceps palpation 0/10, passive ER & lateral palpation ~75% improved. Right: total relief w/ increased ROM. New mild weakness on initiation of right shoulder abduction

SCI, spinal cord injury; AIS, American Spinal Injury Association (ASIA) Impairment Scale; AC, acromioclavicular; OA, osteoarthritis; TBI, traumatic brain injury; SSN, suprascapular nerve; ROM, range of motion; AD, autonomic dysreflexia; CKD, chronic kidney disease; NSAID, nonsteroidal anti-inflammatory drug; ER, external rotation; GH, glenohumeral; PT/OT, physical/occupational therapy; RC, rotator cuff; [a], Deviations are relative to the preferred technique in Methods (ultrasound-guided block with 4 mL of 1:1 0.25% bupivacaine/1% lidocaine, provocative confirmation, then 5 cryoneurolysis cycles of 106 sec with repositioning (see Figure 1); [b], Responder defined as > 75% pain relief: 11 of 13 shoulders met this threshold. Case 5 experienced 25-50% pain relief in the right shoulder, whereas Case 3 did not respond to treatment.

significance, pain relief was durable, and AD was resolved for the remaining 10 days of hospitalization.

Case 3– A 72-year-old female patient with C1 AIS D SCI, fibromyalgia and history of fall with full thickness tears of the left infraspinatus and supraspinatus plus partial tear of the subscapularis and long head of biceps tendon presented with chronic left shoulder pain refractory to NSAIDs, ice, heat, topical diclofenac, lidocaine patches and methocarbamol. Corticosteroid injections were avoided due to her C3-T2 fusion revision one week prior.

Left suprascapular nerve cryoneurolysis was performed. She experienced pain relief during the anesthetic phase. Unfortunately, her pain returned several hours later and persisted throughout her hospitalization.

Case 4– A 76-year-old male patient with T5 AIS D SCI and chronic bilateral rotator cuff tendinosis was admitted to the rehabilitation unit for deconditioning after urosepsis. He had painful subluxation of bilateral shoulders, pain with passive abduction and positive Hawkin's tests. Left shoulder MRI revealed large, chronic retracted tears of supraspinatus tendon and most of the infraspinatus. Right shoulder MRI showed full thickness supraspinatus, infraspinatus, and subscapularis tears, glenohumeral arthrosis and labral degeneration. Pain limited his participation in therapy, and he received bilateral corticosteroid injections every three months for years after acetaminophen, oxycodone and topical analgesics all failed.

As a safer alternative to corticosteroid injections soon after urosepsis, suprascapular nerve cryoneurolysis was performed resulting in total pain relief and increased active ROM that persisted at one-month follow-up.

Case 5– A 71-year-old male patient with C3 AIS D SCI was admitted for sacral wound healing. Pressure off-loading by side-lying was limited due to positional shoulder pain bilaterally. Clinical examination was notable for diffuse shoulder tenderness, pain with passive flexion and abduction plus positive Hawkin's. Bilateral shoulder radiographs demonstrated AC joint and glenohumeral arthritis. Acetaminophen, topical diclofenac, oxycodone, lidocaine, and dry

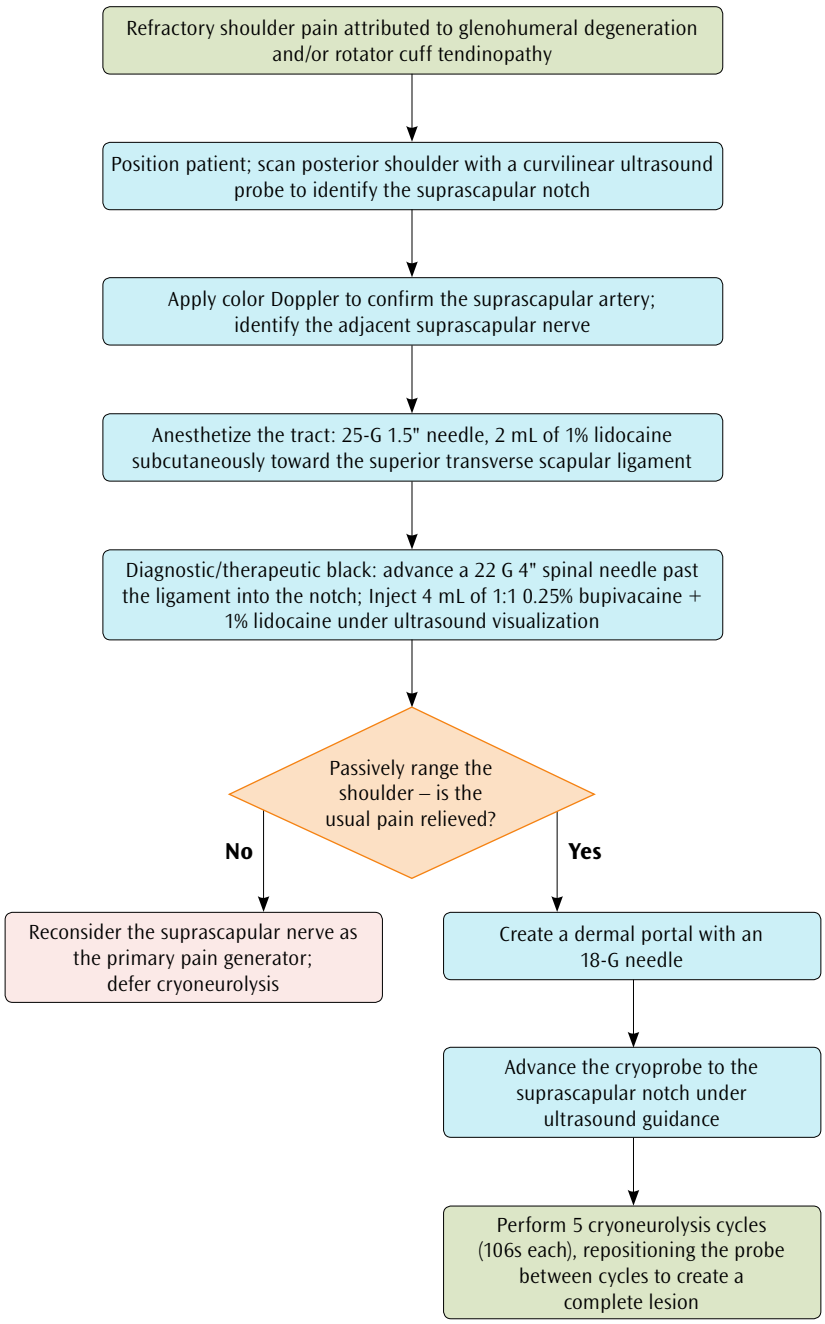


Figure 1. Preferred technique for ultrasound-guided suprascapular nerve cryoneurolysis. A diagnostic local-anesthetic block with provocative testing precedes cryoneurolysis to confirm that the patient's usual pain is mediated by the suprascapular nerve. Needle gauges, injectate, and freeze parameters reflect the standard protocol developed across the series.

needling were ineffective. Therapies were limited by pain. Corticosteroid injections were relatively contraindicated due to concomitant high dose steroids prescribed with chemotherapy.

Suprascapular nerve cryoneurolysis was performed with immediate and appreciable pain relief in both shoulders but total pain relief on the left with passive movement. He tolerated

side-lying for pressure relief for hours more. After three weeks, his left shoulder remained pain-free.

Case 6– An 81-year-old male patient with T7 AIS A SCI reported chronic bilateral shoulder pain. Clinical examination showed positive Hawkin's and Neer's tests plus pain with active shoulder ROM, and tenderness on the lateral and posterior right shoulder. Corticosteroid injections were avoided due to osteoporosis. Conservative measures failed, and he was on a multi-drug opioid regimen. Cryoneurolysis achieved immediate, bilateral pain relief and significantly increased ROM that continued at next day's follow-up.

Case 7– A 59-year-old male with T12 AIS A SCI, biceps and supraspinatus tendinopathy plus subacromial bursitis that impeded transfers and sleep. Dry needling, physical therapy (PT), acetaminophen, and topical diclofenac were insufficient. Cryoneurolysis to the right suprascapular nerve yielded immediate, 80% pain relief with improved active ROM that persisted until discharge four days later.

Case 8– A 58-year-old male patient with T9 AIS A SCI and left shoulder pain from prior humerus fracture, chronic Stage IV sacral pressure injury and CKD Stage V was admitted for wound healing. The clinical course was complicated by metabolic encephalopathy requiring intensive care unit (ICU) transfer.

Imaging demonstrated surgical changes and heterotopic ossification of the glenohumeral joint. Left shoulder examination was notable for limited ROM, severe pain with external rotation plus pain with palpation of lateral shoulder and biceps tendon. Right shoulder examination revealed painful active ROM, positive Neer's and Speed's tests plus pain with bicipital tendon palpation. In addition, NSAIDs were contraindicated due to CKD. Opioids required caution given recent metabolic encephalopathy. Topical diclofenac mildly improved biceps tendinitis. Pain remained his primary concern and limited therapy participation.

Bilateral suprascapular nerve cryoneurolysis completely relieved left shoulder pain at rest. Pain with passive external rotation and palpation of lateral shoulder was 75% improved. Right shoulder had total pain relief and increased ROM. He did report new-onset, mild weakness during initiation of right shoulder abduction.

DISCUSSION

In this case series, we report 13 shoulders of eight patients. In 11 of these shoulders (85%), treatment resulted in > 75% pain relief with an additional patient reporting 25 to 50% relief. Follow-up intervals varied, limiting conclusions regarding the durability of pain relief; however, patients followed for at least one month continued to report sustained pain relief.

This case series yielded several technical insights. Using an angiocatheter instead of an 18-gauge needle to create a dermal port facilitated the cryoprobe easily passing through the dermis but was not as well tolerated, and needle maneuverability was limited near the suprascapular notch. Performing a suprascapular nerve block followed by provocative maneuvers allows practitioners to verify pain was mediated by the nerve before proceeding. Additional freeze cycles were well tolerated, and repositioning between cycles created a more extensive lesion; consequently, five freeze cycles were adopted as the standard protocol.

Needle visualization was optimal when the needle was positioned nearly parallel to the probe. However, the probe must be angled steeply (> 45 degrees) to allow liquid nitrous oxide to flow down the cryoneurolysis probe lumen. A curvilinear probe provided the most optimal balance of sufficient resolution and consistent needle tracking. As the suprascapular notch was often deeper than 4 cm, heel-toeing the probe improved visibility around the nerve.

Patients with SCI required weight shifts during the procedure to prevent pressure injury, as the procedure could last up to 45 min. The first shift was performed after the anatomical scan, while medications were drawn for the nerve block. A second weight shift was performed after the nerve block, and an additional shift was added after the first shoulder for bilateral treatments.

In our case series, suprascapular nerve cryoneurolysis was well tolerated. However,

potential risks specific to cryoneurolysis include *(i)* rare myonecrosis, *(ii)* permanent injury to the target nerve or surrounding tissues, and *(iii)* skin discoloration if the cannula is retracted prior to fully thawing the ice ball.[8] Other risks are similar to those of any needle-based procedures and include bleeding, bruising, and infection.[8] Contraindications include Reynaud syndrome, cryoglobulinemia and cold urticaria.[8] The only complication observed in this series was mild supraspinatus weakness in one patient.

Unfortunately, one patient (Case 3) did not experience sustained pain relief. This may be attributable to centrally mediated pain, given her comorbid fibromyalgia, depression, and chronic pain refractory to multiple classes of medication. Her overall presentation was consistent with nociplastic pain and central sensitization rather than a discrete peripheral pain generator.[9] When pain is amplified and maintained within the central nervous system, denervation of a single peripheral nerve is expected to underperform, as cryoneurolysis removes only one peripheral input while the dominant central mechanism persists.[9] Some of her pain may also have originated outside the sensory territory of the suprascapular nerve.[5,6] Her imaging showed a partial tear of the subscapularis, an anterior structure innervated by the subscapular nerves and therefore not treated with suprascapular cryoneurolysis regardless of lesion adequacy. Still, this case highlights the importance of appropriate patient selection, as suprascapular nerve cryoneurolysis is most likely to benefit patients whose pain localizes to its sensory distribution and is not dominated by central sensitization.

Furthermore, these results should also be considered in the context of alternative treatment modalities. However, evidence specifically addressing shoulder pain in patients with SCI remains limited. Non-invasive interventions including PT have been shown to improve both function and quality of life, although studies do not detail measures of pain relief.[10] Ultrasound-guided steroid injections significantly improve Visual Analog Scale (VAS) scores by almost 5 points through two months in SCI patients with impingement.[11] Although data for platelet rich plasma (PRP) in SCI patients is limited, in one pilot study including six patients, shoulder PRP injections yielded a reduction in Wheelchair User's Shoulder Pain Index (WUSPI) scores by 69.9%, and 49.6% reduction in Numeric Rating Scale (NRS) pain at 24 weeks.[12] These results are consistent with the present report.

This case series demonstrates the utility of cryoneurolysis to treat shoulder pain. Providers should consider it among alternatives such as PRP or steroid injections, if PT and other conservative measures fail. Ultimately, individualized patient factors guide decision making when selecting interventions. In general, steroid injections are a practical first-line interventional option, as they are less expensive and provide adequate relief.[11] However, cryoneurolysis may be considered a first-line option in patients with poorly controlled diabetes or when concerns about potential chondrotoxicity limit the use of other interventions.[13,14]

The main limitations of this case series include limited generalizability, as the cases were drawn from a single center and involved a relatively homogeneous population of older Veterans with SCI, and the inability to establish causality in the absence of a control group. The series was also subject to observer and selection bias, and a placebo effect could not be excluded, as all patients were aware of the treatment and its intended pain-relief outcomes. In addition, cryoneurolysis techniques varied across cases, and follow-up intervals were heterogeneous, reflecting individual outpatient follow-up schedules.

In conclusion, this case series suggests that suprascapular nerve cryoneurolysis may be a safe and effective alternative for managing shoulder pain, particularly when other modalities are contraindicated. It may also indirectly help mitigate SCI-related complications, such as AD and pressure injuries. Larger prospective studies are needed to further evaluate its safety and efficacy.

Declaration of Conflicting Interests

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Author Contributions

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AI Disclosure

The authors declare that artificial intelligence (AI) tools were not used, or were used solely for language editing, and had no role in data analysis, interpretation, or the formulation of conclusions. All scientific content, data interpretation, and conclusions are the sole responsibility of the authors. The authors further confirm that AI tools were not used to generate, fabricate, or 'hallucinate' references, and that all references have been carefully verified for accuracy.

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