Cureus
Part of SPRINGER NATURE

Open Access Case Report

Pseudoseptic Arthritis of the Shoulder Following Pneumococcal Polysaccharide Vaccine Injection to the Deltoid: A Case Report

Celest Seah [1], Joshua Lim [1], Nazrul Nashi [1]

1. Orthopedic Surgery, National University Health System, Singapore, SGP

Corresponding author: Celest Seah, celestseah@gmail.com

Review began 11/05/2026
Review ended 11/14/2026
Published 11/16/2026

© **Copyright** 2026
Seah et al. This is an open access article distributed under the terms of the Creative Commons Attribution License CC-BY 4.0., which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

DOI: 10.7759/cureus.119800

Abstract

Pseudoseptic arthritis is an acute inflammatory joint reaction that clinically mimics septic arthritis and must be distinguished from broader vaccine-associated periarticular conditions. Although pseudoseptic shoulder arthritis following pneumococcal polysaccharide vaccination has been reported, subsequent delayed progression of rotator cuff pathology remains poorly understood. A 70-year-old man with no prior shoulder symptoms developed severe right shoulder pain and swelling one day after receiving pneumococcal polysaccharide vaccination in the right deltoid. He was afebrile but exhibited markedly elevated inflammatory markers. MRI demonstrated deltoid myositis, subacromial/subdeltoid bursitis, and a partial high-grade bursal-sided supraspinatus tear. Following clinical deterioration and rising C-reactive protein, he underwent open shoulder arthrotomy and washout. Intraoperative cultures were negative, and histopathology showed non-specific chronic inflammation, supporting a diagnosis of probable pseudoseptic arthritis. At four weeks, he developed severe loss of active range of motion with preserved passive motion. Repeat MRI at three months demonstrated progression to retracted full-thickness supraspinatus and subscapularis tears. Arthroscopic repair was performed at four months. Nine months post-repair, persistent dysfunction and ultrasound-confirmed supraspinatus retear were observed. Reverse shoulder arthroplasty was performed 12 months post-repair, with complete retears noted intraoperatively. At two months following arthroplasty, active forward flexion and abduction improved to 170° and 175°, respectively. The progression from a high-grade partial-thickness supraspinatus tear to complete multi-tendon failure demonstrates a notable temporal association with severe local inflammation, although causality cannot be established given confounding age-related degeneration, heavy smoking, and myelodysplastic syndrome. Subsequent repair failure and reverse shoulder arthroplasty underscore the clinical impact of progressive cuff dysfunction. Severe inflammatory shoulder reactions post-vaccination present a diagnostic challenge mimicking septic arthritis. Appropriate evaluation is essential to distinguish infectious arthritis from pseudoseptic reactions. Progressive rotator cuff dysfunction may emerge during follow-up, although its causal relationship to initial inflammation remains uncertain. Accurate deltoid injection landmarking and needle selection remain vital preventive measures.

Categories: Orthopedics
Keywords: case report, pneumococcal vaccines, pseudoseptic arthritis, rotator cuff injuries, shoulder injury related to vaccine administration (sirva), vaccines

Introduction

Pseudoseptic arthritis of the shoulder is defined as an acute, severe, joint-specific inflammatory reaction that clinically mimics true septic arthritis with marked local signs and systemic inflammatory response, yet yields no causative microorganism on microbiological evaluation [1-3]. Because laboratory markers and imaging studies often overlap with bacterial infection, it remains fundamentally a diagnosis of exclusion [1,4-6]. Importantly, pseudoseptic arthritis must be distinguished from shoulder injury related to vaccine administration (SIRVA), vaccine-associated bursitis, and isolated deltoid myositis. While SIRVA encompasses a broader spectrum of persistent shoulder pain and dysfunction typically driven by antigenic injection into the subacromial-subdeltoid bursa [7-14], pseudoseptic arthritis represents a fulminant intra-articular inflammatory flare, whereas myositis and bursitis remain confined to extra-articular muscular or bursal compartments. Two prior case reports have described pseudoseptic arthritis following suspected inadvertent intra-articular deposition of the pneumococcal polysaccharide vaccine (PPV) [1,6]. Although McColgan and Borschke hypothesised that an occult rotator cuff tear might facilitate intra-articular tracking from the subdeltoid space [1], this mechanism remains unproven. An isolated bursal-sided partial-thickness tear does not ordinarily establish a patent anatomical conduit to the glenohumeral joint unless breached by high-pressure injection, degenerative progression, or severe local inflammation. To our knowledge, this is the first report of probable pseudoseptic arthritis following PPV administration temporally associated with delayed progression of rotator cuff pathology to multi-tendon failure, failed arthroscopic repair, and subsequent reverse shoulder arthroplasty.

Case Presentation

A 70-year-old male presented to the emergency department with a five-day history of severe pain and swelling in his right shoulder, accompanied by marked restriction of movement. Symptoms began one day after a family physician administered a PPV injection into his right deltoid. He remained afebrile throughout. His medical history included transfusion-dependent myelodysplastic syndrome with multilineage dysplasia (MDS-MLD) and well-controlled type 2 diabetes mellitus. He was a 100-pack-year ex-smoker, was not taking immunosuppressants, and reported no prior right shoulder pain or functional deficits.

On examination, erythema, warmth, tenderness, and swelling were present over the right deltoid without a clinically discernible joint effusion (Fig. *1*).

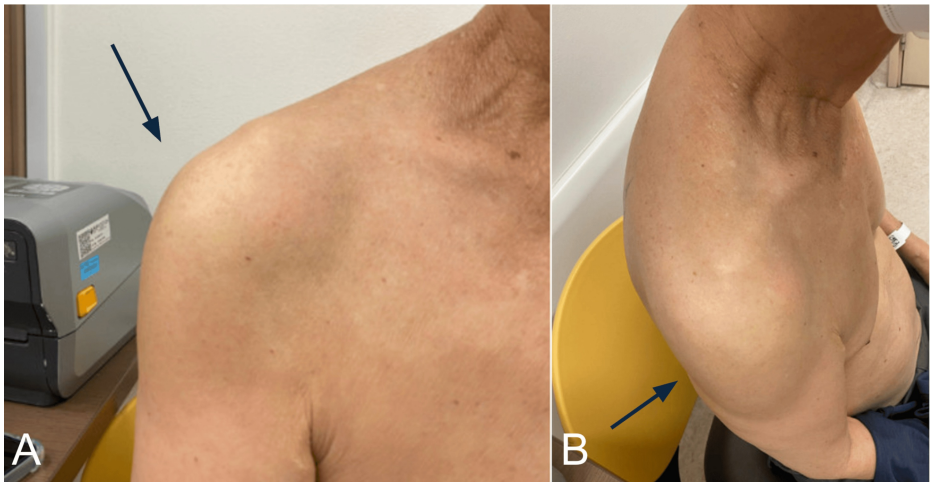


FIGURE 1: Clinical photograph of the right shoulder on presentation, demonstrating diffuse erythema, warmth, and soft-tissue swelling over the deltoid region without a focal fluctuant collection. (A) Front view. (B) Top view.

Both passive and active range of motion (ROM) were uniformly restricted by pain (forward flexion: 90°, abduction: 90°, external rotation: 40°, internal rotation: S1) (Tables *1*, *2*).

Physical examination	Initial presentation	Four weeks post-index operation	Three months post-index operation	Nine months post rotator cuff repair	Two months post reverse shoulder arthroplasty (latest follow-up)
Active range of motion (°)					
Flexion (0-180°)	90	0	20	30	170
Abduction (0-180°)	90	0	20	30	175
External rotation (0-90°)	40	40	60	60	80
Internal rotation (0-70°)	30	30	40	50	60
Passive range of motion (°)					
Flexion (0-180°)	90	100	140	150	170
Abduction (0-180°)	90	90	140	150	175
External rotation (0-90°)	40	40	60	60	80
Internal rotation (0-70°)	30	30	40	50	60

TABLE 1: Quantitative physical examination findings for the right shoulder at various intervals.

Physical examination	Initial presentation	Four weeks post-index operation	Three months post-index operation	Nine months post rotator cuff repair	Two months post reverse shoulder arthroplasty (latest follow-up)
Rotator cuff muscles strength					
Supraspinatus	Limited by pain	Weak	Weak	Weak	Not tested
Infraspinatus	Limited by pain	Strong	Strong	Strong	Not tested
Subscapularis	Limited by pain	Weak	Weak	Strong	Not tested
Drop-arm test	Not tested	Positive	Positive	Positive	Not tested

TABLE 2: Qualitative physical examination findings for the right shoulder at various intervals.

Laboratory investigations revealed a white blood cell (WBC) count of 23.24 × 10^9/L (reference range: 4.0-11.0 × 10^9/L; patient baseline: 16.0 × 10^9/L secondary to MDS-MLD), C-reactive protein (CRP) of 112.1 mg/L (reference: <10.0 mg/L), and erythrocyte sedimentation rate (ESR) of 70 mm/hr (reference: <20 mm/hr)

(Table 3).

Day	White blood cell (x10^9/L) (n < 11 x10^9/L)	C-reactive protein (mg/L) (n < 10 mg/L)	Erythrocyte sedimentation rate (mm/hr) (n < 20 mm/hr)
1	23.24	112.1	70
2	13.09	49.8	74
3	19.02	36.8	65
5	22.20	257.5	NA
6 (operation day)	NA	NA	NA
7	18.16	186.9	NA
9	15.03	149.6	NA
11	19.75	90.3	NA
13 (day of discharge)	18.16	43.8	51
Four weeks follow-up	11.05	2.6	54

TABLE 3: White blood cell counts and inflammatory markers trend over the various intervals.

Serial blood cultures obtained on admission were negative. Right shoulder radiographs excluded fractures, subcutaneous gas, bony erosions, or inferior humeral head subluxation (Fig. 2).

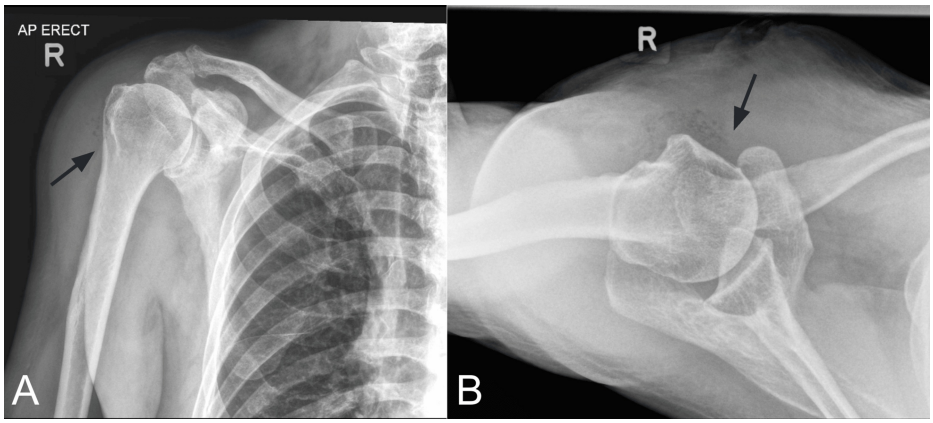


FIGURE 2: Radiograph of the right shoulder showing preserved glenohumeral joint space without fractures, bony erosions, subcutaneous gas, or inferior humeral head subluxation. (A) Anteroposterior view. (B) Axillary view.

He was admitted to the orthopaedic surgery department with a provisional diagnosis of right shoulder cellulitis. Differential diagnoses included septic arthritis, deltoid myositis/cellulitis, acute crystal arthropathy, and acute structural rotator cuff pathology. Empirical intravenous (IV) Augmentin (1.2 g every eight hours, days 1-9) and analgesia were initiated. Contrast-enhanced MRI on day 2 demonstrated no abscess or significant glenohumeral effusion, but revealed deltoid myositis, long head of biceps tenosynovitis, subacromial-subdeltoid bursitis, and a high-grade (>50% tendon thickness) bursal-sided tear of the anterior-to-mid supraspinatus footprint without full-thickness retraction (Fig. 3A). The infraspinatus and subscapularis footprints were intact (Fig. 3B), and diffuse marrow infiltration consistent with MDS-MLD was noted. Diagnostic arthrocentesis was deferred due to the absence of a clinically discernible effusion or safe targetable fluid collection on examination and radiographs.

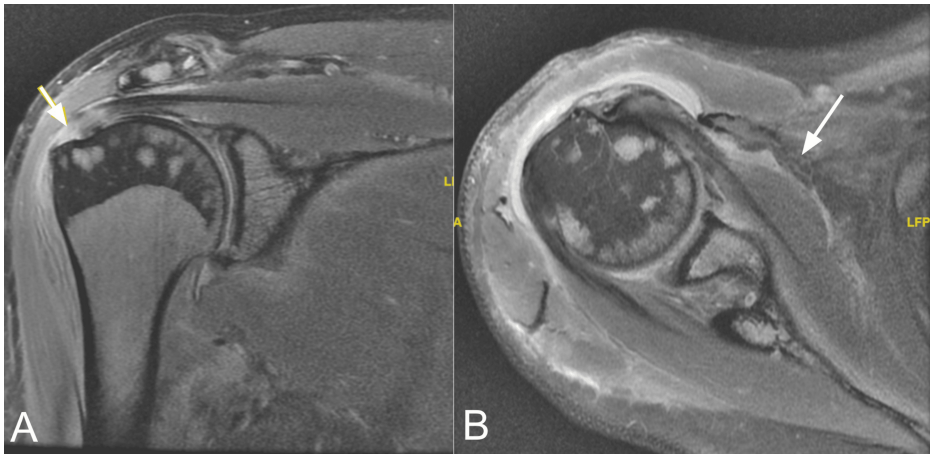


FIGURE 3: Initial contrast-enhanced MRI of the right shoulder (day 2). (A) Coronal T2-weighted fat-suppressed view demonstrating deltoid myositis, subacromial-subdeltoid bursitis, and a high-grade (>50% thickness) bursal-sided tear of the anterior-to-mid supraspinatus footprint without full-thickness retraction. (B) Axial view confirming intact infraspinatus and subscapularis tendon insertions.

Although CRP initially decreased to 36.8 mg/L on day 3, the patient clinically deteriorated on day 5 with worsening pain and a sharp CRP rebound to 257.5 mg/L (Table *3*), prompting urgent open arthrotomy and washout via a deltopectoral approach on day 6. Both the glenohumeral joint and subacromial-subdeltoid space were independently explored. No frank purulence was found, but a friable inflammatory soft-tissue mass occupied both the subdeltoid region and the glenohumeral joint space (Fig. *4*).

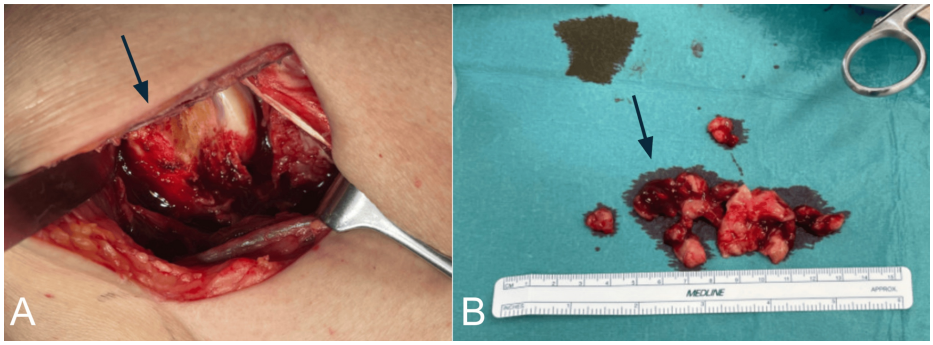


FIGURE 4: (A) Intraoperative photograph via the deltopectoral approach demonstrating friable, non-purulent inflammatory soft tissue occupying the subdeltoid space and extending into the glenohumeral joint; histopathology confirmed chronic non-specific inflammation and fibrinoid debris. (B) Soft tissue removed.

Intraoperative inspection confirmed that the high-grade supraspinatus defect provided a direct communication channel between the subdeltoid bursa and glenohumeral joint, whereas the infraspinatus and subscapularis footprints were visually intact. Extensive surgical debridement of the friable tissue from both compartments and copious lavage were performed. Multiple intraoperative tissue and fluid cultures yielded no aerobic or anaerobic growth. Histopathological examination of the excised friable mass demonstrated non-specific chronic inflammation, granulation tissue, and fibrinoid debris, with no malignancy, granulomas, or acute purulent infection. Given the sterile cultures, absence of purulence, and intra-articular involvement, a diagnosis of probable pseudoseptic arthritis was established, acknowledging that prior empirical antibiotic therapy precluded absolute exclusion of infection. Crystal arthropathy was deemed unlikely given the absence of crystalline deposits.

Postoperatively, pain improved, and CRP steadily declined to 43.8 mg/L by discharge on day 13 without

further antibiotics (Table 3). At discharge, he retained the ability to initiate active abduction and forward flexion with a negative drop-arm test (Table 2).

At the four-week outpatient follow-up, the surgical wound was healed, the patient was pain-free and afebrile, and CRP had normalised to 2.6 mg/L. However, he exhibited severe functional pseudoparalysis, characterised by an inability to initiate active forward flexion or abduction despite full preserved passive ROM and a newly positive drop-arm test (Table 1). Repeat MRI at three months demonstrated progression to a complete, retracted full-thickness tear of the subscapularis tendon with medial subluxation of the long head of the biceps (Fig. 5A), alongside a full-thickness tear of the supraspinatus tendon with retraction to the humeral head apex (Fig. 5B), while the infraspinatus remained intact.

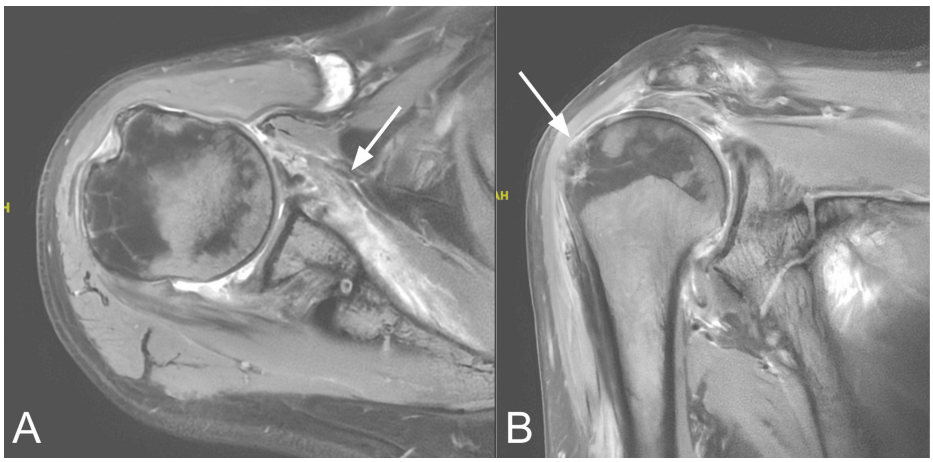


FIGURE 5: Follow-up MRI of the right shoulder at three months. (A) Axial view demonstrating a complete full-thickness tear of the subscapularis tendon with medial retraction and medial subluxation of the long head of the biceps tendon. (B) Coronal view showing progression to a complete full-thickness tear of the supraspinatus tendon with retraction of the tendon stump to the level of the humeral head apex.

At four months post-washout, arthroscopic rotator cuff repair was selected over conservative management to restore active elevation and dynamic glenohumeral stability. Arthroscopy confirmed retracted full-thickness supraspinatus and subscapularis tears with poor, friable subscapularis tissue quality; both tendons were repaired using three SR SCOI sutures and one HL3-Bio anchor each.

Nine months post-repair, active forward flexion and abduction remained limited to 30° despite 150° passive elevation, and ultrasound confirmed a supraspinatus retear. Twelve months after the repair, the patient underwent reverse shoulder arthroplasty (RSA). Intraoperatively, complete retears of both the supraspinatus and subscapularis with extensive scarring were noted, which were attributed to poor baseline tissue quality, advanced age, heavy smoking, and impaired healing secondary to MDS-MLD. Two months post-RSA, active forward flexion and abduction improved to 170° and 175°, respectively. A chronological summary of the clinical course is described in Table 4.

Timepoint	Findings / management
Day -1	Administered by family physician
Day 0	Developed severe right shoulder pain and swelling
Day 1	Afebrile; WBC 23.24 x 10^9/L, CRP 112.1 mg/L, ESR 70mm/hr; admitted with provisional diagnosis of cellulitis/septic arthritis; started on IV Augmentin
Day 2	Showed deltoid myositis, long head of the biceps tenosynovitis, high-grade bursal-sided supraspinatus tear, and subacromial/subdeltoid bursitis; no abscess or joint effusion
Days 3–5	Laboratory inflammatory markers showed improvement
Day 5	Deterioration in clinical status with rising inflammatory markers
Day 6	Underwent right shoulder arthrotomy and washout
Day 13	Discharged well without antibiotics; pain improved, limited range of motion noted
Four weeks after index operation	Pain-free and afebrile, inflammatory markers normalised; persistent inability to initiate forward flexion/abduction, positive drop arm test
Three months after index operation	Repeat MRI showed complete subscapularis tear and full-thickness supraspinatus tear; patient counselled and keen for rotator cuff repair
Four months after index operation	Underwent right shoulder arthroscopic subscapularis and supraspinatus repair
Nine months after cuff repair	No improvement in function of the right shoulder, and ultrasound confirmed right SSP retear; patient counselled and keen for reverse shoulder arthroplasty.
12 months after cuff repair	Underwent right reverse shoulder arthroplasty.

TABLE 4: A chronological summary of the clinical course.

Written informed consent was obtained from the patient for publication of this case report and accompanying images. Institutional Review Board approval was waived per National Healthcare Group Domain Specific Review Board (DSRB) policy.

Discussion

Establishing a definitive diagnosis of pseudoseptic arthritis remains challenging because it is inherently a diagnosis of exclusion [1-3]. In this patient, initial synovial fluid aspiration was precluded by the absence of a discernible joint effusion, and empirical broad-spectrum antibiotics administered before surgery may have confounded intraoperative microbiological cultures. Furthermore, baseline leukocytosis from underlying MDS-MLD complicated the interpretation of serial WBC counts. Nevertheless, the diagnosis of a probable pseudoseptic inflammatory reaction, rather than isolated bursitis or bacterial sepsis, is supported by the afebrile clinical course, negative blood and tissue cultures, non-purulent chronic inflammatory histopathology, and direct intraoperative visualisation of friable inflammatory tissue extending within the glenohumeral joint [1,2,6]. The marked rebound in CRP from 36.8 mg/L on day 3 to 257.5 mg/L on day 5 despite intravenous antibiotics likely reflected a non-infectious immune-mediated hyper-inflammatory cascade triggered by antigenic exposure, rather than uncontrolled bacterial proliferation.

When evaluating the mechanism of subsequent rotator cuff failure, it is essential to distinguish between temporal association, biological plausibility, and proven causality. Several confounding factors preclude attributing multi-tendon failure exclusively to the post-vaccination inflammatory episode. First, no pre-vaccination MRI was available to establish baseline cuff integrity; the initial scan was obtained after symptom onset. Second, asymptomatic degenerative rotator cuff pathology is highly prevalent in 70-year-old individuals (40.7%) [15] and is strongly associated with heavy smoking (100 pack-years) [16]. Thus, natural age-related degenerative progression cannot be excluded. Iatrogenic subscapularis injury during the initial deltopectoral arthrotomy was also considered, but is highly unlikely because the subscapularis insertion was visually confirmed intact intraoperatively, no tendon detachment or lesser tuberosity instrumentation occurred, and the patient retained active elevation immediately post-washout. While direct causality cannot be proven, the striking discrepancy between preserved passive motion and loss of active elevation at follow-up correlated with rapid conversion from a partial supraspinatus tear to complete supraspinatus and subscapularis failure within three months. It is biologically plausible that a severe intra-

articular and subacromial inflammatory microenvironment, potentially amplified by chronic immune dysregulation in MDS-MLD [17], accelerated structural degradation of already compromised, smoking-damaged tendons, consistent with broader systemic vulnerabilities reported in similar haematological presentations [18].

Similarly, the subsequent failure of arthroscopic rotator cuff repair and eventual need for reverse shoulder arthroplasty cannot be attributed solely to the initial vaccine reaction. Rather, postoperative retear is multifactorial, driven by poor intrinsic tendon quality observed at arthroscopy, advanced age, 100 pack-year smoking history, and impaired tissue healing associated with myelodysplastic syndrome [19]. Regardless of aetiology, immunocompromised haematological patients should continue receiving pneumococcal vaccination per guidelines [20], with close clinical follow-up to detect adverse inflammatory reactions early.

Several limitations warrant consideration. First, findings from a single case cannot be generalised. Second, the absence of pre-operative synovial fluid analysis and prior antibiotic exposure limits absolute diagnostic certainty. Third, the proposed route of inadvertent intra-articular vaccine tracking via a partial supraspinatus tear remains a clinical hypothesis inferred from temporal sequence rather than direct observation. Finally, validated patient-reported shoulder outcome scores were not systematically recorded, and the 2-month follow-up after reverse shoulder arthroplasty is too brief to establish long-term prosthetic durability.

Conclusions

Severe inflammatory shoulder reactions following pneumococcal vaccination present a significant diagnostic challenge because their acute clinical and biochemical presentation closely mimics septic arthritis. Thorough clinical, radiological, and microbiological evaluation is necessary to distinguish infectious arthritis from probable pseudoseptic inflammatory reactions and periarticular conditions such as SIRVA or bursitis. While progressive rotator cuff dysfunction may become apparent during follow-up, the causal relationship between the initial inflammatory episode and subsequent tendon failure remains uncertain given confounding degenerative and systemic factors. Accurate deltoid injection landmarking and appropriate needle selection remain essential preventive strategies during vaccination.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Celest Seah, Nazrul Nashi

Acquisition, analysis, or interpretation of data: Celest Seah, Joshua Lim

Drafting of the manuscript: Celest Seah, Joshua Lim

Critical review of the manuscript for important intellectual content: Celest Seah, Nazrul Nashi

Supervision: Joshua Lim, Nazrul Nashi

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. **AI use statement:** The authors have declared that no AI tools were used during the work or in the drafting of this article. The authors take full responsibility for the work. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

1. McColgan BP, Borschke FA: Pseudoseptic arthritis after accidental intra-articular deposition of the pneumococcal polyvalent vaccine: a case report. Am J Emerg Med. 2007, 25:864.e1-3. 10.1016/j.ajem.2007.02.021
2. Oppermann BP, Cote JK, Morris SJ, Harrington T: Pseudoseptic arthritis: a case series and review of the literature. Case Rep Infect Dis. 2011, 2011:942023. 10.1155/2011/942023
3. Eberst-Ledoux J, Tournadre A, Mathieu S, Mrozek N, Soubrier M, Dubost JJ: Septic arthritis with negative bacteriological findings in adult native joints: a retrospective study of 74 cases. Joint Bone Spine. 2012, 79:156-9. 10.1016/j.jbspin.2011.04.019

4. Page F, Chadwick S, Banerjee B: Pseudoseptic arthritis resulting in joint destruction . BMJ Case Rep. 2015, 2015:10.1136/bcr-2014-208269
5. Tahiri L, Benbouazza K, Amine B, Hajjaj-Hassouni N: Acute pseudoseptic arthritis after viscosupplementation of the knee: a case report. Clin Rheumatol. 2007, 26:1977-9. 10.1007/s10067-007-0598-x
6. Floyd MW, Boyce BM, Castellan RM, McDonough EB: Pseudoseptic arthritis of the shoulder following pneumococcal vaccination. Orthopedics. 2012, 35:e101-3. 10.3928/01477447-20111122-31
7. Slette E, Rohrback M, Ring D: Persistent shoulder pain after vaccine administration is associated with common incidental pathology: a systematic review. Clin Orthop Relat Res. 2022, 480:1251-8. 10.1097/CORR.0000000000002191
8. Miller ER, Marquez P, Aynalem G, et al.: Atypical shoulder pain and dysfunction after vaccinations reported to the Vaccine Adverse Event Reporting System (VAERS) January 1, 2018, through October 31, 2022. Pharmacoepidemiol Drug Saf. 2026, 35:e70397. 10.1002/pds.70397
9. Yuen WL, Loh SY, Wang DB: SIRVA (Shoulder Injury Related to Vaccine Administration) following mRNA COVID-19 vaccination: case discussion and literature review. Vaccine. 2022, 40:2546-50. 10.1016/j.vaccine.2022.03.037
10. Bass JR, Poland GA: Shoulder injury related to vaccine administration (SIRVA) after COVID-19 vaccination . Vaccine. 2022, 40:4964-71. 10.1016/j.vaccine.2022.06.002
11. MacMahon A, Nayar SK, Srikumaran U: What do we know about shoulder injury related to vaccine administration? An updated systematic review. Clin Orthop Relat Res. 2022, 480:1241-50. 10.1097/CORR.0000000000002181
12. Jenkins P, Duckworth A: SIRVA: shoulder injury related to vaccine administration . Bone Joint J. 105:839-42. 10.1302/0301-620X.105B8.BJJ-2023-0435
13. Mackenzie LJ, Bushell MA, Newman P, Bousie JA: Shoulder injury related to vaccine administration (SIRVA): what do we know about its incidence and impact?. Explor Res Clin Soc Pharm. 2022, 8:100183. 10.1016/j.rcsop.2022.100183
14. Atanasoff S, Ryan T, Lightfoot R, Johann-Liang R: Shoulder injury related to vaccine administration (SIRVA). Vaccine. 2010, 28:8049-52. 10.1016/j.vaccine.2010.10.005
15. Kim HM, Teefey SA, Zelig A, Galatz LM, Keener JD, Yamaguchi K: Shoulder strength in asymptomatic individuals with intact compared with torn rotator cuffs. J Bone Joint Surg Am. 2009, 91:289-96. 10.2106/JBJS.H.00219
16. Tashjian RZ: Epidemiology, natural history, and indications for treatment of rotator cuff tears . Clin Sports Med. 2012, 31:589-604. 10.1016/j.csm.2012.07.001
17. Barreyro L, Chlon TM, Starczynowski DT: Chronic immune response dysregulation in MDS pathogenesis . Blood. 2018, 132:1553-60. 10.1182/blood-2018-03-784116
18. Fujikawa H, Miyazato Y, Ebisuda K, Saito M: Severe inflammatory response in myelodysplastic syndrome and trisomy 8 following 23-valent polysaccharide pneumococcal vaccine administration. Turk J Haematol. 2021, 38:92-4. 10.4274/tjh.galenos.2021.2020.0664
19. Toma A, Fenaux P, Dreyfus F, Cordonnier C: Infections in myelodysplastic syndromes . Haematologica. 2012, 97:1459-70. 10.3324/haematol.2012.063420
20. Girmenia C, Candoni A, Delia M, et al.: Infection control in patients with myelodysplastic syndromes who are candidates for active treatment: expert panel consensus-based recommendations. Blood Rev. 2019, 34:16-25. 10.1016/j.blre.2018.10.002