

Shoulder Injury Related to Vaccine Administration: A Rare Reaction

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Awareness of shoulder injury related to vaccine administration and a high index of suspicion are necessary to evaluate patients with shoulder concerns postvaccination.

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Localized reactions and transient pain at the site of vaccine administration are frequent and well-described occurrences that are typically short-lived and mild in nature. The most common findings at the injection site are soreness, erythema, and edema.¹ Although less common, generalized shoulder dysfunction after vaccine administration also has been reported. Bodor and colleagues described a peri-articular inflammatory response that led to shoulder pain and weakness.² A single case report by Kuether and colleagues described atraumatic osteonecrosis of the humeral head after H1N1 vaccine administration in the deltoid.³ In 2010, shoulder injury related to vaccine administration (SIRVA) was described by Atanasoff and colleagues as the rapid onset of shoulder pain and dysfunction persisting as a complication of deltoid muscle vaccination in a case series of 13 patients.⁴ In our report, we present a case of an active-duty male eventually diagnosed with SIRVA after influenza vaccination and discuss factors that may prevent vaccine-related shoulder injuries.

CASE PRESENTATION

A 31-year-old active-duty male presented to the Allergy clinic for evaluation of persistent left shoulder pain and decreased range of motion (ROM) following influenza vaccination 4 months prior. He reported a history of chronic low back and right shoulder pain. Although the patient had a traumatic injury to his right shoulder, which was corrected with surgery, he had no surgeries on the left shoulder. He reported no prior pain or known trauma to his left shoulder. He had no personal or family history of atopy or vaccine reactions.

The patient weighed 91 kg and received an intramuscular (IM) quadrivalent influenza vaccine with a 25-gauge, 1-inch needle during a mass influenza immunization. He recalled that the site of vaccination was slightly more than 3 cm below the top of the shoulder in a region correlating to the left deltoid. The vaccine was administered while he was standing with his arm extended, adducted, and internally rotated. The patient experienced intense pain immediately after the vaccination and noted decreased ROM. Initially, he dismissed the pain and decreased ROM as routine but sought medical attention when there was no improvement after 3 weeks.

Six weeks after the onset of symptoms, a magnetic resonance image (MRI) revealed tendinopathy of the left distal subscapularis, infraspinatus, supraspinatus, and teres minor tendon. These findings were suggestive of a small partial thickness tear of the supraspinatus (Figure 1), possible calcific tendinopathy of the distal teres minor (Figure 2), and underlying humeral head edema (Figure 3). The patient was evaluated by Orthopedics and experienced no relief from ibuprofen, celecoxib, and a steroid/lidocaine intra-articular injection. Laboratory studies included an unremarkable complete blood count and erythrocyte sedimentation rate. He was diagnosed with SIRVA and continued in physical therapy with incomplete resolution of symptoms 6 months postvaccination.

DISCUSSION

According to a 2018 report issued by the Centers for Disease Control and Prevention, local reactions following immunizations are seen in up to 80% of administered vaccine doses.¹

FIGURE 1 MRI Showing Small Partial Thickness Tear of the Supraspinatus (Coronal View)



FIGURE 2 MRI Showing Focal Moderate Tendinopathy of the Teres Minor Tendon With Possible Calcific Tendinopathy of the Distal Teres Minor (Axial View)

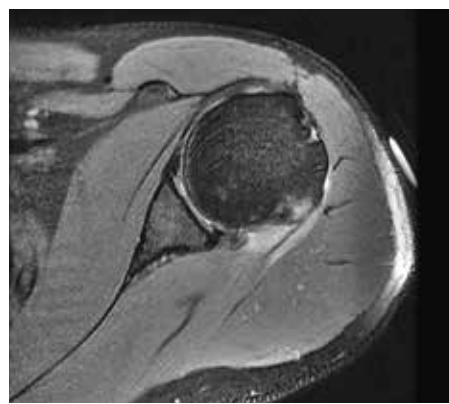
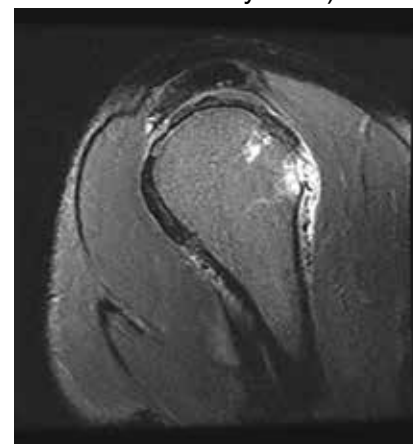


FIGURE 3 MRI Showing Underlying Humeral Head Edema (Sagittal Short T1 Inversion Recovery View)



Abbreviation: MRI, magnetic resonance image.

While most of these reactions are mild, transient, cutaneous reactions, rarely these also may persist and impact quality of life significantly. SIRVA is one such process that can lead to persistent musculoskeletal dysfunction. SIRVA presents as shoulder pain and limited ROM that occurs after the administration of an injectable vaccine. In 2011, the Institute of Medicine determined that evidence supported a causal relationship between vaccine administration and deltoid bursitis.⁵

In 2017, SIRVA was included in the Vaccine Injury Compensation Program (VICP), a federal program that can provide compensation to individuals injured by certain vaccines.⁶ A diagnosis of SIRVA can be considered in patients who experience pain within 48 hours of vaccination, have no prior history of pain or dysfunction of the affected shoulder prior to vaccine administration, and have symptoms limited to the shoulder in which the vaccine was administered where no other abnormality is present to explain these symptoms (eg, brachial neuritis, other neuropathy). Currently, patients with back pain or musculoskeletal complaints that do not include the shoulder following deltoid vaccination do not meet the reporting criteria for SIRVA in the VICP.⁶

The exact prevalence or incidence of SIRVA is unknown. In a 2017 systematic review of the literature and the Spanish Pharmacovigilance System database, Mar-

tín Arias and colleagues found 45 cases of new onset, unilateral shoulder dysfunction without associated neuropathy or autoimmune conditions following vaccine administration. They noted a female to male predominance (71.1% vs 28.9%) with a mean age of 53.6 years (range 22-89 y). Most of the cases occurred following influenza vaccine (62%); pneumococcal vaccine was the next most common (13%).⁷ Shoulder injury also has been reported after tetanus-diphtheria toxoids, human papilloma virus, and hepatitis A virus vaccines.^{4,7} The review noted that all patients had onset of pain within the first week following vaccination with the majority (81%) having pain in the first 24 hours. Two cases found in the Spanish database had pain onset 2 months postvaccination.⁷ Atanasoff and colleagues found that 93% of patients had pain onset within 24 hours of vaccination with 54% reporting immediate pain.⁴

The Vaccine Adverse Event Reporting System (VAERS) tracks reports of shoulder dysfunction following certain vaccinations, but the system is unable to establish causality. According to VAERS reporting, between 2010 and 2016, there were 1006 possible reports of shoulder dysfunction following inactivated influenza vaccination (IIV) compared with an estimated 130 million doses of IIV given each influenza season in the US.⁸

Bodor and Montalvo postulated that vaccine antigen was being over penetrated into the synovial space of the shoulder, as the subdeltoid/subacromial bursa is located a mere 0.8 to 1.6 cm below the skin surface in patients with healthy body mass index.² Atanasoff and colleagues expounded that antibodies from previous vaccination or natural infection may then form antigen-antibody complexes, creating prolonged local immune and inflammatory responses leading to bursitis or tendonitis.⁴ Martín Arias and colleagues hypothesized that improper injection technique, including wrong insertion angle, incorrect needle type/size, and failure to account for the patient's physical characteristics were the most likely causes of SIRVA.⁷

Proper vaccine administration ensures that vaccinations are delivered in a safe and efficacious manner. Safe vaccination practices include the use of trained personnel who receive comprehensive, competency-based training regarding vaccine administration.¹ Aspiration prior to an injection is a practice that has not been evaluated fully. Given that the 2 routinely recommended locations for IM vaccines (deltoid muscle in adults or vastus lateralis muscle in infants) lack large blood vessels, the practice of aspiration prior to an IM vaccine is not currently deemed necessary.¹ Additional safe vaccine practices include the selection of appropriate needle length for muscle penetration and that anatomic landmarks determine the location of vaccination.¹ Despite this, in a survey of 100 medical professionals, half could not name any structure at risk from improper deltoid vaccination technique.⁹

Cook and colleagues used anthropomorphic data to evaluate the potential for injury to the subdeltoid/subacromial bursa and/or the axillary nerve.¹⁰ Based on these data, they recommended safe IM vaccine administration can be assured by using the midpoint of the deltoid muscle located midway between the acromion and deltoid tuberosity with the arm abducted to 60°. ^{10,11} In 46% of SIRVA cases described by Atanasoff and colleagues, patients reported that the vaccine was administered "too high."⁴ The study also recommended that the clinician and the patient be in the seated position to en-

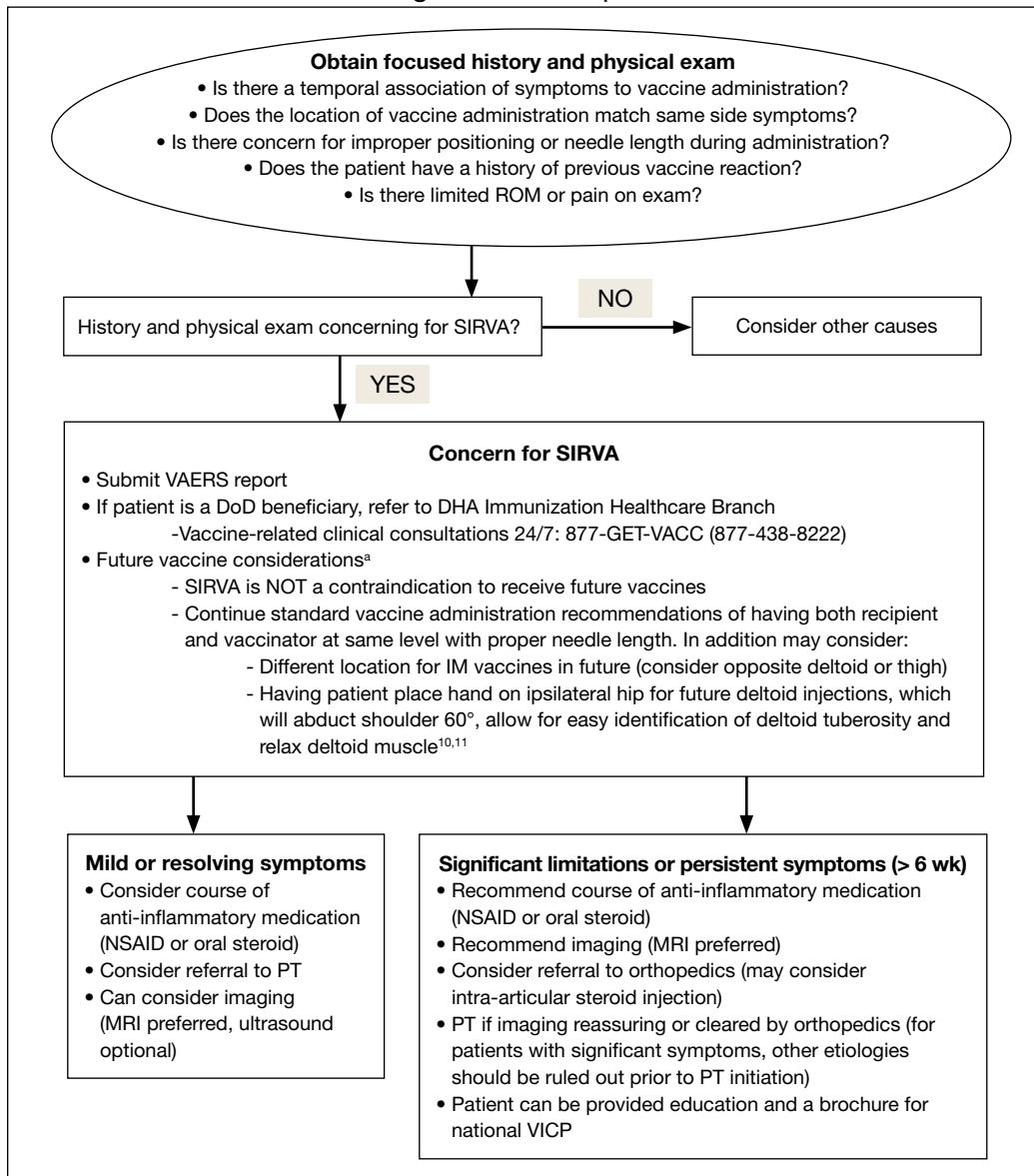
sure proper needle angle and location of administration.⁴ For most adults, a 1-inch needle is appropriate for vaccine administration in the deltoid; however, in females weighing < 70 kg and males < 75 kg, a 5/8-inch needle is recommended to avoid injury.⁷

Our 91-kg patient was appropriately administered his vaccine with a 1-inch needle. As he experienced immediate pain, it is unlikely that his symptoms were due to an immune-mediated process, as this would not be expected to occur immediately. Improper location of vaccine administration is a proposed mechanism of injury for our patient, though this cannot be confirmed by history alone. His prior history of traumatic injury to the opposite shoulder could represent a confounding factor as no prior imaging was available for the vaccine-affected shoulder. A preexisting shoulder abnormality or injury cannot be completely excluded, and it is possible that an underlying prior shoulder injury was aggravated postvaccination.

Evaluation and Treatment

There is no standardized approach for the evaluation of SIRVA to date. Awareness of SIRVA and a high index of suspicion are necessary to evaluate patients with shoulder concerns postvaccination. Laboratory evaluation should be considered to evaluate for other potential diagnoses (eg, infection, rheumatologic concerns). Routine X-rays are not helpful in cases of SIRVA. Ultrasound may be considered as it can show bursa abnormalities consistent with bursitis.² MRI of the affected shoulder may provide improved diagnostic capability if SIRVA is suspected. MRI findings vary but include intraosseous edema, bursitis, tendonitis, and rotator cuff tears.^{4,12} Complete rotator cuff tears were found in 15% of cases reviewed by Atanasoff and colleagues.⁴ While there is no recommended timing for MRI, 63% of MRIs were performed within 3 months of symptom onset.⁴ As SIRVA is not a neurologic injury, nerve conduction, electromyographic studies, and neurologic evaluation or testing are expected to be normal.

Treatment of SIRVA and other vaccine-related shoulder injuries typically have

FIGURE 4 Evaluation and Management of Suspected SIRVA

Abbreviations: DHA, Defense Health Agency; DoD, US Department of Defense; IM: intramuscular; MRI, magnetic resonance image; NSAID, nonsteroidal anti-inflammatory drug; PT, physical therapy; ROM, range of motion; SIRVA, shoulder injury related to vaccine administration; VAERS, vaccine adverse event reporting system; VICP, vaccine injury compensation program.

^aThere is no ACIP recommendations regarding future vaccine administration in patients with suspected SIRVA.

involved pain management (eg, non-steroidal anti-inflammatory agents), intra-articular steroid injections, and physical therapy, though some patients never experience complete resolution of symptoms.^{2,4,7} Both patients with vaccination-related shoulder dysfunction described by Bodor and colleagues improved after intra-articular triamcinolone injections, with up to 3 injections before complete resolution

of pain in one patient.² Orthopedics evaluation may need to be considered for persistent symptoms. According to Atanasoff and colleagues, most patients were symptomatic for at least 6 months, and complete recovery was seen in less than one-third of patients.⁴ Although the development of SIRVA is not a contraindication to future doses of the presumed causative vaccine, subsequent vaccination should include careful

consideration of other administration sites if possible (eg, vastus lateralis may be used for IM injections in adults) (Figure 4).

Reporting

A diagnosis or concern for SIRVA also should be reported to the VAERS, the national database established in order to detect possible safety problems with US-licensed vaccines. VAERS reports can be submitted by anyone with concerns for vaccine adverse reactions, including patients, caregivers, and health care professionals at vaers.hhs.gov/reportevent.html. Additional information regarding VICP can be obtained at www.hrsa.gov/vaccine-compensation/index.html.

Military-Specific Issues

The military values readiness, which includes ensuring that active-duty members remain up-to-date on life-saving vaccinations. Immunization is of critical importance to mobility and success of the overall mission. Mobility processing lines where immunizations can be provided to multiple active-duty members can be a successful strategy for mass immunizations. Although the quick administration of immunizations maintains readiness and provides a medically necessary service, it also may increase the chances of incorrect vaccine placement in the deltoid, causing long-term shoulder immobility that may impact a service member's retainability. The benefits of mobility processing lines can continue to outweigh the risks of immunization administration by ensuring proper staff training, seating both the administrator and recipient of vaccination, and selecting a proper needle length and site of administration specific to each recipient.

CONCLUSION

Correct administration of vaccines is of utmost importance in preventing SIRVA and other vaccine-related shoulder dysfunctions. Proper staff training and refresher training can help prevent vaccine-related shoulder injuries. Additionally, clinicians should be aware of this potential complication and maintain a high index of suspicion when evaluating patients with postvaccination shoulder complaints.

Author disclosures

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