Don’t aim too high: Avoiding shoulder injury related to vaccine administration

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Background

Shoulder injury related to vaccine administration (SIRVA) is a previously described phenomenon that is the result of improper vaccine delivery. Appropriate injection technique for administration of intramuscular vaccinations can reduce the risk of shoulder injury.

Objective

In this article, we describe the cases of two patients who developed SIRVA. A literature review was conducted to find and describe other cases of shoulder injury that developed post-vaccination.

Discussion

SIRVA has previously been described in the world literature. Seventeen cases in women and five cases in men were found. Pain and reduction in the range of movement within a few hours of vaccination were cardinal signs of a shoulder injury. This included injuries to the soft tissues of the shoulder as well as injuries to bone and joint. SIRVA can be avoided with correct vaccination technique as described.

Vaccination infrequently causes severe, persistent shoulder pain and prolonged restriction of function.[1] We describe two cases of persistent shoulder pain following vaccination, and discuss mechanisms by which it occurs and how to reduce the risk of shoulder injury related to vaccine administration (SIRVA). Both cases were referred to an infectious diseases unit in metropolitan Melbourne to rule out the possibility of septic arthritis as a cause of the injury. Both cases were reported to Surveillance of Adverse Events Following Vaccination (SAEFVIC; www.saefvic.org.au), the Victorian immunisation safety service. A literature review was conducted to find and describe other cases of shoulder injury developing post-vaccination.

Case 1

A woman, 82 years of age, developed severe left shoulder pain and marked reduction in range of motion two hours after receiving 23-valent pneumococcal polysaccharide vaccine (PPSV23) in the left deltoid region. Her past history included osteoarthritis, bilateral total hip replacements, osteoporosis and hypothyroidism. She had last received PPSV23 eight years previously. Her temperature was 37.7°C, and her left shoulder was red, warm and tender without joint effusion.

The vaccination site was noted to be 1 cm inferior to the acromion. Ultrasonography showed a complete tear of the left supraspinatus tendon and a moderate sub-deltoid bursa collection that communicated with the shoulder joint. Peripheral blood white cell count was 9.0 x 10^9/L. C-reactive protein (CRP), tested three days after presentation, was raised at 363 mg/L. The bursal collection was percutaneously drained and microscopy revealed 98,000 x 10^6/L polymorphs, 420 x 10^6/L red blood cells, with no crystals present.

A surgical joint washout was performed and empirical intravenous flucloxacillin was commenced. No organisms were visible on Gram stain, and culture of the aspirated bursa fluid and intraoperative joint fluid were negative. A repeat ultrasound performed 10 days after joint washout showed persistent sub-deltoid bursitis and biceps tendonitis. In view of concern regarding possible septic arthritis, intravenous flucloxacillin was continued for three weeks. The patient received outpatient physiotherapy on discharge. One month post-admission, she had no pain and regained full range of movement in her shoulder.

Case 2

A woman, 23 years of age, developed left shoulder pain with limited range of motion, which commenced 24 hours after receiving the dTpa (adult diphtheria, tetanus, acellular pertussis) vaccine in the left deltoid region. She had no past medical history and had received routine childhood immunisations. The shoulder pain was severe for two to three days. On examination, she had painful

arc on shoulder abduction with no shoulder joint inflammation or effusion. An ultrasound showed subacromial bursal thickening and bunching that was consistent with subacromial bursitis. The pain persisted for six weeks despite the use of non-steroidal anti-inflammatory drugs (NSAIDs). She subsequently received a single subacromial corticosteroid injection, with resolution of pain and functional improvement. At a three-month follow-up visit, she was pain free and had full range of shoulder movement.

Discussion

The development of symptoms after vaccination, and absence of microbiological evidence of infection, suggest that these were probable cases of SIRVA.[1,2] Appropriate injection technique for administration of intramuscular vaccinations can reduce the risk of shoulder injury.

A search was conducted of the English language literature in the PubMed databases of the National Library of Medicine at US National Institutes of

Table 1. Previous reports of SIRVA

Ref	Age and sex	Vac	Onset	Imaging	Management	Outcome
1	n = 13 (11 female, 2 male), age range: 26–83	8 flu, 2 DT, 2 dTpa, 1 HPV	7 immediate, 5 within 24 hours, 1 at 4 days	MRI: bursitis, tendinitis, rotator cuff tears	NSAIDS, corticosteroid injection, physiotherapy	31% resolution, 69% improvement
3	22 female	Flu	2 hours	US/MRI: supraspinatus tear, bursitis, bony contusion	Physiotherapy	Improvement at 11 weeks
9	59 female	PPSV23	2 hours	MRI: supraspinatus tear, bursitis	Antibiotics initially, physiotherapy	Improvement at 12 weeks
7	36 female	Hepatitis A	Unknown	US: normal	Distension arthrography, physiotherapy	Improvement at 3 months
7	54 male	Flu	Unknown	US: bursitis	Distension arthrography, physiotherapy	Resolution at 3 months
7	73 female	Tetanus	Unknown	US: calcification of greater tubercle	Distension arthrography + physiotherapy	Resolution at 4 weeks
10	73 female	PPSV23	2 hours	Intraoperative: rotator cuff tear, biceps tendon rupture	Antibiotics initially, physiotherapy	Improvement at 2 weeks
2	71 female	PPSV23	2 days	Unknown	Lidocaine, corticosteroid injection, physiotherapy	Resolution at 6 months
2	89 male	Flu	2 days	Unknown	Lidocaine, corticosteroid injection, physiotherapy	Resolution at 3 months
14	76 male	Flu	Immediate	US: subacromial bursitis	Corticosteroid injection	Resolution at 1 month
4	n = 4 (2 female, 2 male), age range: 36–66	Flu	1 immediate, 1 within 3 hours, 1 within 6 hours, 1 at 2 days	MRI: subacromial bursitis, deltoid inflammation, bone marrow oedema	NSAIDS, physiotherapy	Resolution 1–6 months

DT, diphtheria and tetanus toxoids combined vaccine; dTpa, adult diphtheria + tetanus + acellular pertussis vaccine; flu, influenza vaccine; HPV, human papillomavirus vaccine; MRI, magnetic resonance imaging; NSAIDS, non-steroidal anti-inflammatory drugs; PPSV23, 23 valent pneumococcal polysaccharide vaccine; US, ultrasound.

Health using the following keywords in combination: 'shoulder injury', 'shoulder dysfunction', 'shoulder pain', 'vaccination', 'vaccine related', 'subacromial bursitis', 'pseudoseptic arthritis' and 'SIRVA'. When appropriate, the cited bibliographies were also reviewed for further analysis.

Atanasoff et al[1] described 13 cases of shoulder injury that developed post-vaccination and coined the term SIRVA. Shoulder injuries described included bursitis, tendonitis, rotator cuff tears, fluid accumulation in the deltoid or rotator cuff, adhesive capsulitis and subcortical bone osteitis.[1,3,4] There have also been associated reports of nerve injuries, including the anterior branch of the axillary nerve, C6 radiculopathy and complete radial nerve palsy from nerve injury.[2,5,6] Previous reports of SIRVA in the English literature are summarised in Table 1.

SIRVA has been reported in 19 women and seven men aged between 22 and 89 years. Injuries of the subacromial bursa, subdeltoid bursa, tendons and muscles of the rotator cuff, especially the supraspinatus muscle, were common. Damage to the subchondral humerus was also reported in four patients. Most patients developed pain and reduced range of movement within a few hours of vaccination, although it can be delayed by up to four days. Fever, a raised white cell count and raised inflammatory markers were common findings. SIRVA can occur with monovalent or polyvalent vaccines. Influenza vaccines were the most commonly reported cause of SIRVA, probably reflecting the wide use of this vaccine.

SIRVA occurs as a consequence of vaccines being delivered into the sub-deltoid bursa or within the joint space.[7] Atanasoff et al[1] reported that in six out of 13 cases the vaccine was given 'too high', and the exact site was not specified in the remaining cases. In our first case, the injection site was only 1 cm from the acromion. Ultrasonography of 21 healthy adult volunteers showed that the subacromial bursa extended distal to the acromion by 3–6 cm, permitting a vaccine delivered in the top one-third of the deltoid area to pierce the subacromial bursa.[2,3]

A slim build may predispose an individual to developing SIRVA.[1,3] The smaller muscle bulk of the deltoid muscle and deltoid fat pat in women, compared with men, may place them at greater risk.[5,8] This may account for the greater number of women with SIRVA, although this is confounded by differences in vaccine uptake between men and woman. Other studies have shown that body mass index (BMI) is not a good predictor of risk and in the largest reported series, the mean BMI of patients was 27.7 kg/m^2.[1,9,10]

Shoulder injury from vaccination is greater than would be expected from a simple needle trauma. An immune-mediated reaction to the adjuvant, antigenic or non-antigenic (preservatives or carrier particles) components of the vaccine have been implicated.[3,4,11] A robust and prolonged reaction may be the response of a sensitised population who have had antigenic exposure from previous vaccination or previous infection.[1,7] The multivalent composition of some vaccines may produce more significant immunogenic responses.[1,9,10] In a study of antigen-specific response following intra-articular injection of influenza vaccine, all six patients developed joint swelling and stiffness, which resolved within a few days.[1,11]

SIRVA is a diagnosis that should be considered only after septic arthritis has been excluded. Management of SIRVA may include physiotherapy and intra-articular corticosteroid injections. Distension arthrography has been used with some success.[1,7] Surgery may be needed for repair/reconstruction when significant joint damage occurs.[1,3] Improvement can take many weeks to months, and some patients have residual pain and limited joint movement for years.[2,3]

The largest case series of SIRVA arose from the Vaccine Injury Compensation Program (VICP) reported in the US between 2006 and 2010.[1] Similar no-fault compensation schemes exist in several countries in Europe as well as in Japan, Korea, Taiwan and Europe, but not in Australia.[12]

Some authors suggest varying the length of the needle used for intramuscular vaccination in men and women depending on weight.[3,8] SIRVA is avoidable with correct vaccination technique. Section 2.2.8 of the *Australian immunisation handbook* describes good vaccination technique,[13] which is summarised in Box 1 and Figure 1.

Box 1. Tips to avoid SIRVA[1,5,13]

- Patient and vaccinator should be in a seated position to avoid high delivery of the vaccine.
- Expose arm completely – consider alternative site in patients with reduced deltoid muscle bulk.
- Patient should abduct shoulder by 60 degrees and place hand on the ipsilateral hip (Figure 1).
- Locate the acromion and deltoid insertion at the middle of the humerus. Draw an inverted triangle below the shoulder tip using identified anatomical markers. The site for injection is in the middle of the triangle (Figure 2.2.8 from the *Australian immunisation handbook*).

Figure 1. Abducted shoulder (60 degrees) with hand on ipsilateral hip

Conclusion

In this report, we presented two cases of shoulder injury that developed post-vaccination. SIRVA should be considered as part of the differential diagnosis in patients presenting with persisting acute shoulder pain and reduced range of movement within a few hours of vaccination. Imaging such as magnetic resonance imaging (MRI) or musculoskeletal ultrasonography can assist with diagnosis. Treatment is often limited to physiotherapy and intra-articular steroid injections, although surgery has been needed in severe cases. Risks of complications can be reduced by using proper injection technique.

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