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Abstract

Brachial plexopathy after vaccination is an uncommon but clinically important phenomenon, which can be diagnosed by electrodiagnostic studies. We describe the case of a 59 year old female who received a prophylactic influenza vaccination in her left deltoid and within days experienced painful dysesthesias predominantly in the sensory region supplied by the left axillary nerve. Due to progressive pain, she presented to our physiatric practice for evaluation ten weeks later. Electromyography (EMG) and nerve conduction studies revealed an incomplete left brachial plexopathy, predominantly involving the posterior cord. Left upper limb EMG abnormalities included spontaneous activity limited to the distribution of the left axillary and radial nerves, with normal paraspinal muscles. Motor nerve conduction studies of the bilateral axillary nerves, using surface pickup over the lateral deltoids, revealed normal and symmetric bilateral latencies, but an amplitude that was 44% less on the left than on the right. We present a discussion of post-vaccination neuropathies, including diagnosis, complications, and treatment. Physiatrists, neurologists, electromyographers and other clinicians should be aware of brachial plexopathy after vaccination, an uncommon but clinically important entity that can be most definitively diagnosed by electromyography and nerve conduction studies.

Background

Probably the most well known example of a neurologic complication of influenza vaccination was realized after the 1976 mass immunization program for influenza A/New Jersey/76 (swine flu) in the United States, when injected individuals showed a seven-fold increase in incidence of Guillain-Barre Syndrome (GBS). [1] The GBS cases attributed to swine flu vaccination were calculated to be approximately 1 case per 100,000 vaccinations. Cases of brachial plexopathy related to the 1976 swine flu vaccination were also reported, but (unlike the GBS cases) the brachial plexopathy cases could not be epidemiologically proven to represent a statistical significant increase in incidence. [2, 3, 4] Influenza vaccines are often changed from year to year, and subsequent influenza vaccines have not been clearly associated with any increased risk for GBS. Influenza vaccinations in general have been reported to be associated with a variety of other neurologic complications, including optic neuritis [5, 6, 7], peripheral polyneuropathy [8], and isolated hypoglossal nerve paralysis [9].

Of most importance in relation to the case we present here, brachial plexopathy has been reported to occur after other vaccines, in addition to those cases reported is association with the 1976 swine flu immunization program. Specifically, brachial plexopathy has been reported after vaccination for small pox [4, 10, 11] and diphtheria-pertussis-tetanus (DPT) [12]. Brachial plexopathy has been previously reported to occur after influenza vaccination. [2, 13, 14, 15]

However, the exact incidence of brachial plexopathy after influenza vaccination remains unknown, so there is no epidemiological verification that the occasional cases reported represent an increased risk that can be attributed to the preceding vaccinations. Conversely, the point can be made that statistics that fail to show an association do not guarantee that no association exists. For example, when the 1976 swine flu vaccine was tested on 5,000 individuals there were no cases of GBS to attribute to the vaccine. [16] This is no surprise in retrospect since GBS was later found to have an incidence of 1 case per 100,000 and thus even a relatively large sample size of 5,000 people would understandably fail to reveal an association. The mass immunization program that followed involved over 40 million vaccinations and the association with GBS became quite clear, to the point where the program was halted. Thus, with any vaccination program it remains important to report what may appear to be isolated cases, because such reports are needed to prompt and focus further statistical analysis of apparent associations.

We present a case of brachial plexopathy that appeared to be chronologically associated with a preceding influenza vaccine. While our single case report can not definitively prove causation, the chronologic association (symptom onset within just a few days after vaccination), combined with prior published medical literature on post-vaccination
neurologic complications, at least suggests that our patient’s neurologic condition was causally-related to the preceding vaccination.

**Clinical Presentation**

**Presenting History, symptoms:**
The patient was a 59 year old, right-handed, African-American female, who worked within an environmental services (housekeeping) department. She stated that she was in her usual state of good health until autumn 1997, when she received a prophylactic influenza vaccination in the left lateral deltoid. Within about 2-3 days after the injection she began having hot, burning, throbbing, dysesthesias, in the left upper lateral arm. She presented for her initial evaluation approximately 11 weeks later since her pain continued to progress. She denied and upper limb weakness or numbness. She denied any significant symptoms after previous flu shots which she received over the preceding few years. The 0.5 ml intra-muscular injection reportedly contained the subvirion vaccine for the influenza virus A/Johannesburg/82/96 (H1N1), A/Nanchang/933/95 (H3N2), and B/Harbin/07/94. Medications were limited to acetaminophen 1000mg by mouth three times-a-day, with minimal relief. Past medical history, surgical history, family history, social history, and review of systems were unremarkable. There were no known allergies to foods or medications.

**Physical Exam:**
Inspection: no redness, swelling, ecchymosis, atrophy of the left upper arm, nor elsewhere.
Palpation: there was positive tenderness to palpation at the left deltoid and upper traps, but not at the cervical paraspinals.
Motor: fully normal strength (5/5) in the bilateral supraspinatus, biceps, triceps, wrist extensors, grasps. Mild weakness (5-/5) at the left deltoid. Normal strength (5/5) in the bilateral lower limbs.
Muscle stretch reflexes: normal and symmetric bilateral upper limbs (2+ bilateral biceps, triceps, pronators).
Pinprick Sensation: intact bilateral upper limbs, including normal sensation over the symptomatic left deltoid region (normal sensation in the left axillary nerve sensory distribution).
Neck: normal active range of motion in all planes. No tenderness to palpation.
Spurling’s maneuver was bilaterally negative for cervical radiculopathy.
Left Shoulder musculoskeletal maneuvers: Negative sulcus sign. Negative drop arm test (negative for complete rotator cuff tear). Her baseline dysesthesias/symptoms in the left lateral shoulder region were only mildly affected by various shoulder maneuvers, such as tests for rotator cuff tendinitis/impingement (Hawkins, Neers, empty can sign), test for acromioclavicular joint pain (Scarf, or Crossed Adduction test), and testing for shoulder instability (Anterior Apprehension test), so overall these were all felt to be negative for their respective musculoskeletal pathologies. Palpation produced no tenderness at the left acromioclavicular joint, nor at the subacromial space.

**Differential Diagnoses: (at the initial evaluation)**

1.) **Possible Left brachial plexopathy or neuropathy of the left axillary nerve:** These seemed like the most likely diagnoses, based on her history of dysesthesias mainly in the left axillary nerve distribution and the mild, but detectable, left deltoid weakness. There were limited other positive physical examination findings. Admittedly, there was no apparent sensory loss over the left deltoid (left axillary nerve distribution).

2.) **Possible Left cervical radiculopathy:** This was also a consideration, although this seemed less likely since her muscle stretch reflexes were intact, pinprick sensation was intact, her Spurling’s maneuver was negative for cervical radiculopathy, and by history she lacked significant neck pain.

3.) **Possible musculoskeletal (rather than neurologic) etiology:** Left shoulder musculoskeletal etiologies were also considered, such as rotator cuff tendinitis, etc., but physical exam maneuvers for shoulder pathology did not reproducibly increase her symptoms. Thus, the musculoskeletal etiologies seemed significantly less likely in her case.

**Initial plan and follow-up:**
For medications, she was started on a nonsteroidal anti-inflammatory medication (oxaprozin 600mg by mouth twice a day, with food) for analgesia and potentially for anti-inflammatory effect. She continued acetaminophen 1000mg by mouth 3 times a day. She continued working full duty. When her symptoms and physical examination showed no improvement at her follow-up visit the following week, she was scheduled for upper limb electromyography (EMG) and nerve conduction studies (NCS) to evaluate for possible left brachial plexopathy, versus left axillary neuropathy, versus left cervical radiculopathy.

**Electrodiagnostic Test Results**
Electrodiagnostic testing was performed 3 months after the vaccination.

Nerve conduction studies:
Please see data from the nerve conduction studies, presented in Illustration 1. Bilateral upper limb nerve conduction studies showed normal latencies, amplitudes, and nerve conduction velocities in the left median nerve motor studies (including segmental study across the left shoulder region, via segmental stimulation at the axillary and also at ‘Erb's point’ just superior/posterior to the clavicle), and also normal left ulnar nerve motor studies (again including segmental study across the left shoulder region, via segmental stimulation at the axillary and also at ‘Erb's point’ just superior/posterior to the clavicle). Sensory nerve conduction studies were normal in the left radial nerve, bilateral median nerves, bilateral ulnar nerves, bilateral median antebrachial cutaneous (MAC) nerves, bilateral lateral antebrachial cutaneous (LAC) nerves. Bilateral axillary nerve motor studies (with surface pickup over the lateral deltoid) revealed normal and symmetric distal latencies (3.9 milliseconds on the left, 4.0 milliseconds on the right), and amplitudes that were within normal limits when compared with published reference it is, but when compared side-to-side were found to be 44% decreased on the symptomatic left side as compared with the non-symptomatic right side (4.0 millivolts on the left, compared with 7.2 millivolts on the right).

Needle electromyography (EMG) examination:
Please see Illustration 2 for details of the needle EMG muscles and results. A disposable monopolar needle was used in selected muscles of the left upper limb and left cervical paraspinal muscles. Motor unit shape, size and recruitment frequencies were within normal limits for all muscles tested. No muscles demonstrated any fasciculations or complex repetitive discharges. The specific left upper limb muscles tested included the following: deltoid, teres minor, extensor carpi radialis, biceps brachii, teres major, pronator teres, extensor indicis proprius, triceps, flexor carpi ulnaris, first dorsal interossei, and abductor pollicis brevis. Among these muscles, the only abnormalities were the presence of abnormal spontaneous activity (fibrillations and positive sharp waves) in the following three muscles: deltoid, teres minor, extensor carpi radialis (all three of which share in common innervation pathways via the posterior cord of the left brachial plexus). Left cervical paraspinal muscles (upper, middle and lower levels of left cervical paraspinals) were normal.

Electrodiagnostic Impressions:
1.) Left brachial plexopathy, predominantly involving the left posterior cord. This appeared to be an incomplete injury, sparing some posterior cord fibers (voluntary muscle action potentials were normal in all muscles tested, thus confirming that this patient's left posterior cord of the brachial plexus had at least some fibers and still intact). The impression/conclusion of left posterior cord brachial plexopathy was based on the distribution of needle EMG abnormalities (abnormalities in muscles that shared in common innervation patterns passing through the posterior cord of the plexus) and the left axillary motor nerve conduction studies, which revealed a 44% decrease in CMAP (compound muscle action potential) amplitude as compared with the right. Her electrodiagnostic findings were consistent with her presenting symptoms of dysesthesias predominantly in the left axillary nerve sensory distribution.

2.) No focal left axillary neuropathy. Specifically, the distribution of the abnormalities was beyond just the left axillary nerve, also including similar abnormalities in the extensor carpi radialis muscle (innervated by the radial nerve).

3.) No electrodiagnostic evidence of left cervical radiculopathy (left cervical paraspinal muscles were normal on needle electromyography).

4.) No electrodiagnostic evidence of left carpal tunnel syndrome, nor diffuse peripheral polyneuropathy in the involved left upper limb.

Clinical Course

The patient continued to report symptoms consistent with neurogenic pain in the left upper limb, which was treated with gabapentin for almost 2 months, during which time these dysesthesias improved. Her last office visit was 7 months after the vaccination, and at that time her dysesthesias had almost fully resolved and she had only minimal residual weakness of the left deltoid.

Conclusions

Here we have presented a case of electrodiagnostically-documented brachial plexopathy in a patient whose symptoms began within a few days of receiving an influenza vaccine in the affected arm. Her electrodiagnostic findings demonstrated axonal involvement of the left posterior cord, although some axons in the posterior cord were spared (incomplete
This case demonstrates the important role of needle EMG and nerve conduction studies in localizing brachial plexus lesions in a patient with an inconclusive history and physical examination. The site of pathology (posterior cord of the brachial plexus) would not be expected to be due to merely local trauma from the vaccine needle itself, since the needle path/trajecory would not have reached the posterior cord. Thus, this implies that the brachial plexopathy was a reaction to the substance injected, rather than due to local trauma from the needle itself. We readily acknowledge that a single case report can not definitively confirm a causal relationship between the vaccination and the subsequent brachial plexopathy. Still, the timing of the brachial plexopathy (within days after vaccination) raises the possibility of such a causal relationship, suggesting that further research in this area is warranted.

References


Acknowledgments

Scott F. Nadler, D.O., (deceased) Professor of Physical Medicine and Rehabilitation, New Jersey Medical School, previously contributed to a poster presentation version of this case report, presented at the American Academy of Physical Medicine and Rehabilitation (AAPM&R) annual assembly, Washington, D.C., United States.
Illustrations

Illustration 1

Upper limb nerve conduction studies (3 months after vaccination): normal except the left axillary nerve motor amplitude was 44% decreased as compared with the right.

<table>
<thead>
<tr>
<th>NERVE</th>
<th>DISTAL LATENCY</th>
<th>PROXIMAL LATENCY</th>
<th>NCV</th>
<th>AMPLITUDE</th>
<th>INTERPRETATIONS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cm</td>
<td>msec</td>
<td>cm</td>
<td>msec</td>
<td>Distal Latency</td>
<td>NCV</td>
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<td>Onset</td>
<td>Peak</td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>L Median Motor</td>
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<td>24.0</td>
<td>7.9</td>
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<td>19.0</td>
<td>6.1</td>
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<td>2.7</td>
<td>14.0</td>
<td>2.7</td>
<td>3.3</td>
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<tr>
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<td>1.2</td>
<td>1.7</td>
<td>14.0</td>
<td>2.5</td>
<td>3.1</td>
</tr>
<tr>
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<td>1.2</td>
<td>1.6</td>
<td>14.0</td>
<td>2.3</td>
<td>2.9</td>
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<tr>
<td>R Median Sensory</td>
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<td>1.2</td>
<td>1.6</td>
<td>14.0</td>
<td>2.5</td>
<td>3.1</td>
</tr>
<tr>
<td>R Ulnar Sensory</td>
<td>7.0</td>
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<td>1.6</td>
<td>14.0</td>
<td>2.4</td>
<td>3.1</td>
</tr>
</tbody>
</table>
Upper Limb Skin Temperature (Midline at distal wrist crease): Left wrist: 32.3°Celsius; Right wrist: 32.3°Celsius

Note: Sensory studies are antidromic unless otherwise noted.
Amplitudes are in mV for motor NCS and uV for sensory NCS unless otherwise stated.

Abbreviations used within the Table above:
- NL = within normal limits.
- MAC = medial antebrachial cutaneous nerve
- LAC = lateral antebrachial cutaneous nerve
- E-1 = electrode 1
- D3 = digit 3 (the long, or middle, digit) of the hand
- D5 = digit 5 (the small, or 'pinky' digit) of the hand
A disposable monopolar needle was used in selected muscles of the left upper limb and left cervical paraspinal muscles.

Motor unit shape, size and recruitment frequencies were within normal limits for all muscles tested.

No muscles demonstrated any fasciculations or complex repetitive discharges.

EMG revealed increased insertional activity and abnormal spontaneous activity (1+ fibrillations and/or positive sharp waves, of 100-300 uV amplitude) in the following left upper limb muscles:

- Deltoid (C5-6, axillary nerve) (posterior cord of plexus)
- Teres Minor (C5-6, axillary nerve) (posterior cord of plexus)
- Extensor Carpi Radialis (C6-7, radial nerve) (posterior cord of plexus)

EMG revealed NO abnormal spontaneous activity in the following left upper limb muscles:

- Biceps Brachii (C5-6, musculocutaneous nerve)
- Teres Major (C5, 6, 7 subscapular nerve)
- Pronator Teres (C6-7, median nerve)
- Extensor Indicis Proprius (C7-8 radial nerve) (posterior cord)
- Triceps (C7-8, T1 radial nerve) (posterior cord)
- Flexor Carpi Ulnaris (C8-T1, ulnar nerve)
- First Dorsal Interossei (C8-T1, ulnar nerve)
- Abductor Pollicis Brevis (C8-T1, median nerve)
- Left cervical paraspinal muscles: Upper, Middle and Lower.
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