American Academy of Physical Medicine and Rehabilitation

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EMG Case No. 83, December 2006

Presenting Symptom(s):

Left arm weakness and pain

This case is no longer available for CME Credit.

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Disclosures: D. Bradley, None; A. Patel, None.

Appropriate Audience: Residents and practicing physicians.

Learning Objectives: After completing this educational activity, participants will be able to: (1) Formulate differential diagnosis for arm weakness; (2) Formulate a plan for electrodiagnostic evaluation to aid in diagnosis; (3) Describe EMG findings consistent with brachial plexopathy.

Level of Difficulty: Intermediate.

History

A 49 year old white male presented to the physical medicine and rehabilitation department with complaint of L upper extremity pain, weakness, and numbness. An automobile struck him while riding his lawnmower and he sustained an anterior shoulder dislocation. The dislocation was reduced in the emergency room and his shoulder was placed in a sling by an orthopedic surgeon. On follow-up with his orthopedic physician a few weeks later he noticed shoulder pain with attempted range of motion, weakness in his shoulder and wrist extensors, and numbness and tingling throughout his arm.

- Prior to continuing, please develop a differential diagnosis and list each possible diagnosis in order of likelihood.
- Is there any additional information regarding the clinical history that might be helpful in clarifying your differential list or changing its order of priority?

Commentary I

At this point, the differential diagnosis includes:

- Brachial Plexopathy
- Rotator Cuff Tendinopathy
- Myofascial Pain Syndrome
- Adhesive Capsulitis
- Thoracic Outlet Syndrome
- Complex Regional Pain Syndrome

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- Brachial Plexitis
- Cervical radiculopathy

The most important findings, thus far, are the patient's complaint of pain, numbness and tingling, and weakness in the left upper extremity. With this information we can begin to focus on the most likely cause of his problem. If this is more of a structural problem like adhesive capsulitis, there would be pain with movement in the shoulder region. But this entity doesn't cause numbness or tingling in the extremity. Rotator cuff tear or tendinopathy can give shoulder pain and refer pain into the neck or arm. But weakness in the wrist is not likely from this. Myofascial Pain Syndrome can result with pain in one or more muscle groups. Usually it is associated with trigger points causing pain referral and numbness and muscle weakness can also be present. At this point the history fails to mention anything about trigger points. Another possibility is Thoracic Outlet Syndrome. This disease process involves a progressive onset of discomfort in the shoulder girdle with atrophy of the intrinsic muscles of the hand. The patient will generally have parasthesias along the medial aspect of the forearm and hand. There is little mentioned at this point about the patients intrinsic muscles or his medial forearm and hand. If this was a Complex Regional Pain Syndrome the patient would have spontaneous pain, hyperalgesia, impairment of motor function, swelling, changes in sweating, and vascular abnormalities in his affected extremity. At this point there was no mention of vasomotor abnormalities or hyperalgesia.

If the source of the patient's problem is more of a neurogenic nature then one of the causes that has to be looked into is a brachial plexopathy. This will give problems with muscle weakness, numbness and tingling, and pain. Given that the patient had an anterior shoulder dislocation makes him susceptible to an axillary nerve injury and even affecting the radial nerve or posterior cord. The extent of a brachial plexus injury is hard to discern without the physical exam. However, given the extent of the patient's pain, it is questionable whether his weakness might be secondary to pain inhibition. Cervical radiculopathy might be plausible as the patient has tingling and numbness throughout his arm suggesting radicular pain. He also complains of weakness involving his shoulder and wrist extensors. Weakness of these muscles might be involving the C5 and C6 roots. This could also be a polyradiculopathy involving several cervical roots. However, the extent of his injury needs to be evaluated in more detail at this point. Brachial Plexitis usually is a non-traumatic occurrence which involves a sudden onset of upper arm and shoulder pain followed by weakness.

History, continued

The patient presented to physiatry a week later and explained that after the accident he felt weak in bending his elbow and gripping objects, as well as, feeling numb on the back of his hand. He mentioned that his shoulder feels unstable and that his neck is beginning to bother him. He remembered that after removing the shoulder sling he was able to move his arm very little as it felt weak throughout.

Commentary II

Looking at the differential diagnoses, the most plausible reason for this patients' symptoms would be a brachial plexus injury. With an anterior shoulder dislocation there can be injury to the posterior cord which would explain why he has weakness in the shoulder and wrist

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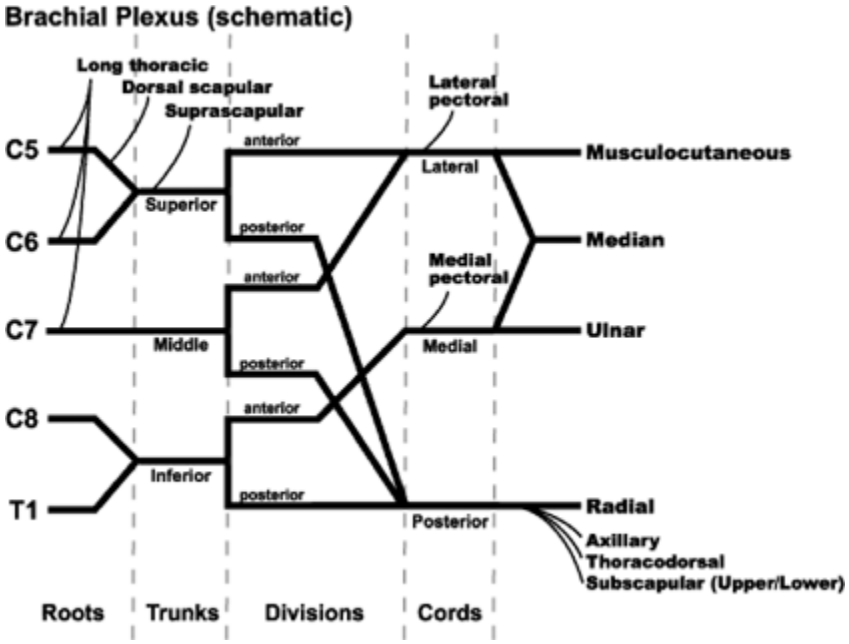
extensors. Weakness in the elbow flexors would indicate musculocutaneous nerve involvement which can also be injured with an anterior shoulder dislocation. Numbness on the medial, dorsoradial aspect of the hand might suggest medial cord involvement. Finger flexor weakness would suggest the medial and lateral cords are possibly involved.

Figure 1



Cervical radiculopathy or a polyradiculopathy would be second in the differential diagnosis. He has proximal limb weakness which could manifest itself when significant motor root compromise is present. He has tingling and numbness throughout his arm which could be a radicular type pattern. Although a detailed physical exam might help with localization of the cervical roots.

The patients' musculoskeletal causes are now much less likely due to the in-depth involvement of muscle weakness.

Physical Examination

Observation of the left upper extremity musculature revealed a positive sulcus sign of the shoulder. There was noted atrophy of the deltoid. His left arm was held in an adducted position, flexed at the elbow, wrist and fingers. Passive range of motion revealed left shoulder discomfort with all directions of movement and severe pain with greater degree of abduction. With active range of motion he was reduced in the shoulder, elbow and wrist. No atrophy of the pectoralis muscle or any scapular winging was found.

Manual muscle strength on the left revealed biceps brachii to be 1/5; deltoid was 0/5; wrist extensors and triceps yielded 1/5; and finger flexors revealed 3/5.
Sensory exam to light touch revealed deficits to digits 3, 4, 5 of left hand, deficits to lateral

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aspect of the arm and posterior forearm, and intact sensation to the lateral aspect of the shoulder.

Deep tendon reflexes were decreased for biceps, triceps, and brachioradialis.

- At this point, review your differential diagnosis and revise as appropriate.
- Are there additional observations on physical examination that might be helpful in narrowing your differential list?

Commentary III

At this point the patient most likely has a brachial plexopathy. The extent of muscle weakness appears to involve C5 to C8 levels with weakness found in the triceps, biceps brachii, deltoid, flexor and extensor bundles. Cervical radiculopathy is not entirely ruled out, but the extent of the injury makes a polyradiculopathy of this nature less likely. There might be a coexisting rotator cuff injury or adhesive capsulitis but, this is not the main issue at hand. The electrodiagnostic exam should focus on locating the lesion. There should be sampling of muscles that focus on the various terminating branches of the brachial plexus. Starting distally and working proximally with selected muscles will differentiate whether this is a cord versus trunk plexopathy and which cords or trunks are involved. There should also be sampling of the paraspinals to help differentiate if there is root involvement. We can also get an idea of the extent of nerve damage and the potential of recovery. Nerve conduction studies can also help with the diagnosis. The sensory portion of nerve conduction studies will look for nerve involvement distal to the dorsal root ganglion. The motor portion will help us with nerve involvement which will help with muscle selection on EMG

Physical Examination, continued

Currently a repeat EMG by neurology is pending. No labs or other studies have been ordered.

- If necessary, revise your differential diagnosis based on the additional physical findings.
- Design your approach to the electrophysiologic examination based on the existing data.

Electrophysiologic Data

NR = no response

MOTOR NERVE CONDUCTION STUDIES							
NERVE	**SIDE**	**STIM SITE**	**RECORD**	**cm**	**AMPL**	**LAT**	**CV**
Median Motor	L	Wrist	APB	6	3.7	4.6	
Ulnar Motor	L	Wrist	ADQM	6	5.2	3.3	
Deltoid Motor	L	Erb's point	Deltoid		NR	NR	
Musculocut. Motor	L	Erb's point	Biceps Brachii		2.8	5.7	

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Median Motor	R	Wrist	APB	6	8.3	4.2	
Ulnar Motor	R	Wrist	ADQM	6	8.9	3.8	
Deltoid Motor	R	Erb's point	Deltoid		8.2	4.2	
Musculocut. Motor	R	Erb's point	Biceps Brachii		10.6	5.2	

SENSORY NERVE CONDUCTION STUDIES

NERVE	SIDE	STIM SITE	RECORD	cm	AMPL	LAT	CV
Median Sensory	L	Palm	Wrist	8	20.0	2.3	
Ulnar Sensory	L	Palm	Wrist	8	8.0	2.5	
Median Sensory	L	Wrist	Thumb	10	6.0	1.5	
Radial Sensory	L	Wrist	Thumb	10		NR	
Median Sensory	R	Palm	Wrist	8	55.0	2.1	
Ulnar Sensory	R	Palm	Wrist	8	18.0	2.1	
Median Sensory	R	Wrist	Thumb	10	20.0	1.6	
Radial Sensory	R	Wrist	Thumb	10	10.0	2.0	

NEEDLE ELECTROMYOGRAPHY

INSERtional activity: N, sust, unsust
FIB: 0, 1+, 2+, 3+, 4+
OTHer: 0 or fascic, myotonia, myokymia
EFFort: N, dec
RECruitment: N, inc or dec 1+, 2+, 3+, 4+
AMPlitude: N, inc or dec 1+, 2+, 3+, 4+
DURation: N, inc or dec 1+, 2+, 3+, 4+
POLyphasia: N, inc or dec 1+, 2+, 3+, 4+

R/L	MUSCLE	INSER	FIB	OTH	EFF	REC	AMP	DUR	POL
L	Deltoid, middle	Sust	3+	0	dec	dec	N	N	1+
L	Biceps Brachii	Sust	2+	0	dec	N	N	N	1+
L	Pronator Teres	Sust	2+	0	dec	N	N	N	N
L	Triceps	Sust	3+	0	dec	dec	N	N	N
L	First Dorsal Interosseous (hand)	Sust	3+		dec	dec	N	N	N
L	Supraspinatus	N	0	0	N	N	N	N	N
L	Paraspinals, mid cerv	N	0	0	N	N	N	N	N

- On the basis of both the clinical and electrophysiologic evaluations, formulate your diagnostic impression. List the most likely diagnosis first and follow in order with the

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other possibilities that are not excluded by the data. Eliminate those diagnoses not supported by the data.

- Are there additional electrophysiologic data that you feel would further delineate the diagnosis? (Remember, collecting data that are not needed for the diagnosis is costly and uncomfortable for the patient.)

Electrophysiologic Data, continued

Slightly prolonged latency existed when testing the median and ulnar sensory nerve. The amplitudes were reduced in both median and ulnar nerves which is suggestive of axonal damage to the nerve. When the median and radial sensory nerves were tested to the thumb, there was an absent response for superficial radial sensory. This is fairly specific for a posterior cord involvement. The motor conduction of median and ulnar amplitudes was reduced signifying axonal damage. Axillary stimulation to the deltoid from Erb's point was absent which suggests severe damage to the axillary nerve or posterior cord. Musculocutaneous nerve motor conduction revealed normal latency and amplitude on the right. On the left side, the musculocutaneous latency was within normal limits but, the amplitude was reduced.

On electromyography, the patient had presence of large positive waves (400 microvolt potentials) suggesting this as an acute axonal injury with wallerian degeneration. There was also decreased motor recruitment evident with only one motor unit found firing in the triceps and deltoid. The deltoid and biceps brachii muscles revealed reinnervation by the presence of polyphasic potentials. Electromyographic studies of the deltoid, biceps brachii, pronator teres, and triceps revealed an acute neuropathic process with evidence of reinnervation. Studies of the supraspinatus and cervical paraspinals were unremarkable. When taking a closer look at the results you can see the diffuse damage that this patient sustained. The patient has biceps brachii involvement which means the musculocutaneous nerve is affected. With the abnormal sensory nerve conduction to the superficial radial, the abnormal triceps and deltoid confirm that the posterior cord is involved. Abnormalities in the first dorsal interosseous confirm injury to the medial cord. The pronator teres is predominantly C6, 7 innervation from the median nerve and involves the lateral cord along with the abnormal evidence found in the biceps brachii. Normal supraspinatus means that the injury did not extend up to the trunk level and the absence of abnormality in the cervical paraspinals means the roots were spared.

- Make the final revisions of your diagnostic impression(s).

Diagnostic Impression

The abnormalities of this electrodiagnostic study reveal that this is severe acute pan-brachial plexus injury that involves the medial, lateral, and posterior cord. The normal supraspinatus finding suggests that the trunks were spared.

- What other diagnostic procedures (laboratory tests, etc.), if any, are needed?
- What treatment would you recommend?

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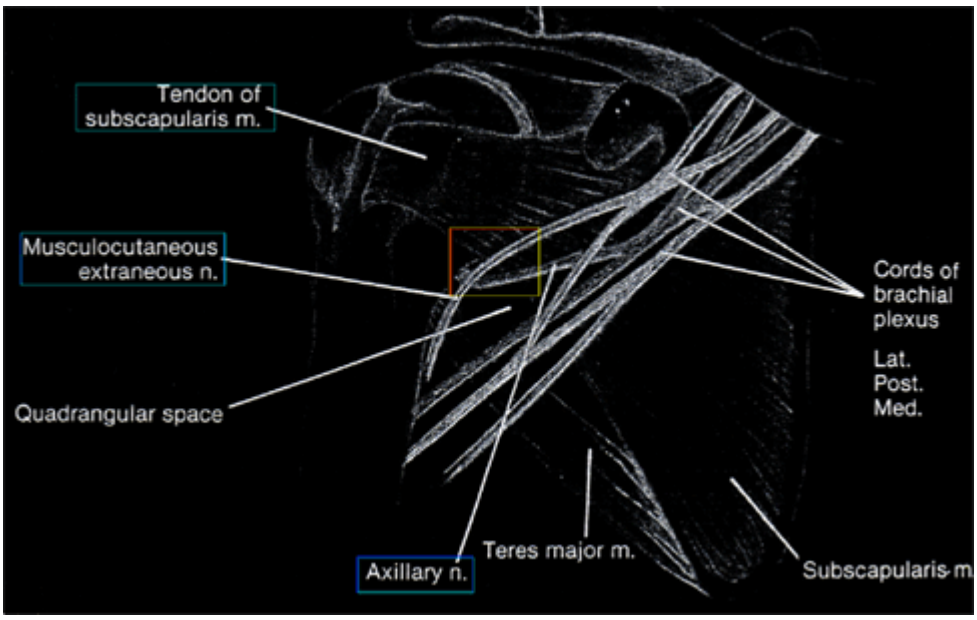
Commentary IV

Brachial plexus lesions can be classified as open or closed. Open would be from penetration of a sharp object, whereas, closed would be from traction or compression. Traction lesions are the most common type of brachial plexus injury. Usually, this is seen with violent trauma and sport-related injuries resulting in a traction type injury. Anterior dislocation can cause damage most commonly to the axillary and musculocutaneous nerves. The axillary nerve courses anteriorly to the subscapularis muscle through the quadrangular space. It winds around the humerus posteriorly and attatches into the deltoid. (Figure 2) When the humerus dislocates anteriorly the subscapularis muscle also displaces anteriorly causing an increased stress on the axillary nerve. Other ways the brachial plexus becomes injured are stingers and burners in sports, rucksack paralysis, gunshot wounds, and neck or shoulder surgery.

Figure 2



The overall prognosis for functional recovery is good. Comparing the CMAP amplitudes from the injured to uninjured side can provide the electromyographer with a rough approximation of how much axonal loss occurred. There is evidence of good functional recovery for the medial and lateral cord plexus nerve lesion based on the producible CMAP amplitudes of the biceps brachii, abductor pollicus brevis and abductor digiti minimi. Side to side amplitude comparisons of the distal CMAP tested indicates the axonal lesion is incomplete. Prognosis for good functional recovery from the posterior cord plexus nerve lesion is poor. Side to side amplitude comparisons of the deltoid CMAP indicates a complete axonal lesion. However in severe postganglionic injuries to proximal muscles, reinnervation may be quite successful. Given sufficient time for nerve growth approximation is 1 mm per day, the CMAP could be present and increase with progressing reinnervation which is already present. However poor prognosis of recovery of the CMAP includes increased distance between the lesion and muscle, endoneurial tube shrinkage and muscle fiber atrophy.

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Conservative measures for patients with pan plexopathies would benefit from an exercise program with a therapist consisting of range of motion exercises. This would decrease development of joint contractures. Secondly, patients would benefit from an abduction orthosis like the gunslinger shoulder elbow orthosis which stabilizes itself on the pelvic girdle and can have an arm trough attached with it. This helps support the shoulder and can allow dynamic motion. From a surgical standpoint the goal is to restore structure and function in the affected extremity. Early surgery (within 72 hours of onset) is typically done with end-to-end suture repair for clean, open brachial plexopathies. Patients with closed injuries from blunt trauma, ischemia, or stretch injury should be followed for clinical or electrophysiological signs of recovery on serial examinations. When the patient is showing early signs of recovery it is most appropriate to treat conservatively. When there is no recovery noted clinically or electrodiagnostically, surgical exploration should be considered.

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