



EMG Case No. 54, February 2002

Presenting Symptom: Progressive Weakness

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Appropriate Audience: Residents and practicing physicians

Learning Objectives: After completing this educational activity, participants will be able to (1) formulate differential diagnosis for progressive generalized weakness, (2) review the physical examination findings of muscular dystrophy, and (3) interpret the electrodiagnostic data from needle EMG.

This case is no longer available for CME credit.

History

A 50-year-old right-handed gentleman presents for evaluation of progressive generalized weakness over the past several decades. The patient reports that the weakness involves both arms and legs and has worsened more steadily over the last 4 years. He is unable to lift boxes in the grocery store that he owns, and has difficulty climbing up stairs. He denies any falls, and does not have dysphagia, breathing difficulty, or twitching of the muscles.

- *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

In patients with weakness in the absence of numbness, the differential diagnosis includes anterior horn cell disease, neuromuscular junction disorders, Guillain-Barre syndrome, and acquired or hereditary myopathy. One would argue against Guillain-Barre syndrome, given the history of progressive and generalized weakness over many years. Anterior horn cell disease is less likely in a patient without fasciculation or bulbar symptoms. Other causes of the weakness include neuromuscular junction disorders and myopathies. Frequently, neuromuscular junction disorders present with fatigue with repetitive activities, diplopia, ptosis, and slurred speech. In adults the most common symptoms of intrinsic muscle disease are weakness and fatigue. Specific myopathic disorders include inflammatory myopathies, HIV-associated myopathy, polymyalgia rheumatica, thyrotoxic myopathy, hypothyroid myopathy, and myopathies associated with Cushing syndrome and adrenal insufficiency. Myotonic disorders include myotonic dystrophy, myotonia congenita, and paramyotonia.

History, continued

Twenty-five years ago he had occasional symptoms of episodic hand contractions and spasms, which usually manifested during winter. The spasms worsened over time to the extent that he sustained burn injuries to his hand a year ago after having difficulty releasing



a metal basket while frying potatoes. The patient denies heat intolerance, double vision, and prior gastrointestinal illness. The patient also denies history of jaw dislocation and/or claudication.

Two months ago he was brought to an emergency room with chest pain and did not have myocardial infarction. The patient has a past medical history of diabetes mellitus, hypertension, coronary artery disease, and atrial fibrillation. He denies any history of alcohol use, thyroid disease, or drug and toxin exposure. The patient was diagnosed with atrial fibrillation in 1982 and has been taking coumadin. Further review of medical records showed normal thyroid function tests and cortisol levels. He is currently taking oral hypoglycemic agents and the most recent HgbA1C is 8.5.

The patient denies any difficulty in learning or in school. He denies difficulty in fertility and has one healthy daughter. He has noticed testicular atrophy for the last 6 years. The patient has four brothers and two sisters. One brother passed away at the age of 42 due to a heart attack. Another brother was a weight lifting champion in his thirties, and had coronary artery by-pass in his forties. A third brother has had difficulty in walking for the last 20 years and is able to ambulate only inside the house. The fourth brother is currently having heart problems. His two sisters are healthy.

- *If necessary, revise your differential diagnosis based on the additional clinical history.*
- *On which details of the physical examination should you focus at this point?*

Commentary II

Given the above history and patient's presentation, it is less likely that he has a neuromuscular junction disorder, an inflammatory myopathy, or other myopathies such as toxic, drug, or familial. The additional history of worsening spasms also speaks against myopathy or myositis. A negative history for double vision, heat intolerance, and attacks of weakness rules out multiple sclerosis. Additional physical examination should focus on muscular atrophy, hand and foot deformities, and motor strength testing. On physical examination, special attention should be paid to motor strength of both proximal and distal muscles.

Physical Examination

The patient is in no apparent distress. Temporal wasting and balding is noted, as are ptosis and mild dysarthria. There is no evidence of intrinsic hand or foot muscle atrophy. There are no foot deformities.

Muscle strength is 5/5 at the deltoid, 4/5 at the biceps and triceps, 3/5 at the wrist flexors, extensors, finger flexors and extensors in both upper extremities. In the lower limbs, the muscle strength is 4/5 throughout except 3/5 at the toe flexors and extensors. Muscle stretch reflexes are 1+ symmetrically in the upper and lower limbs. Sensation is intact to light touch, pinprick, and proprioception.

- *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

The physical examination should be performed carefully enough to reflect the muscle strength in large as well as small muscle groups. The findings here are those of distal muscle weakness without prominent atrophy in the intrinsic muscles of the hands and feet. This points to a distal myopathy such as myotonic dystrophy. Evaluation of muscle stretch reflexes is one of the most objective parts of the neurologic examination. Functional examination and cognitive evaluation are also essential, and will help to clarify the picture.

Physical Examination, continued

There is percussion myotonia of the abductor pollicis brevis muscles bilaterally. The patient has difficulty relaxing the hand after a strong grip, and difficulty in opening his eyes following closure. Additionally, the patient has difficulty with fine motor activities such as unbuttoning his shirt. The Mini Mental Status Exam was 29/30 and -1 for date.

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

Commentary IV

The presence of myotonia upon direct percussion of a muscle is striking. However, one should be careful to distinguish this from the normal contraction response. The normal response is usually a brief flickering movement of the muscle but may be pronounced enough to cause the joint to move. Most importantly, the delay in relaxation, which is so characteristic for myotonia, is not seen in a normal response.

The age of onset for myotonia congenita (Thomsen's Disease) is between ages 1 and 6 years, and for myotonia congenita (Recessive Generalized: Becker Type) is between 4 to 12 years. This patient denies any weakness in childhood. Paramyotonia congenita can easily be ruled out since the patient does not have worsening of the spasms or delay in relaxation of the muscles with repetitive use. There is no atrophy in posterior neck and shoulder muscles and no identified muscle weakness, negative findings that are helpful for ruling out fascioscapular muscular dystrophy, fascioscapulohumeral spinal muscular atrophy, scapuloperoneal syndromes, and scapulohumeral muscular dystrophy. The patient denies any muscle stiffness that fluctuates in severity and is exacerbated in a delayed manner, which speaks against myotonia fluctuans.

Electrophysiologic Data

MOTOR NERVE CONDUCTION STUDIES									
nr = no response									
NERVE	LATENCY (ms)			AMPLITUDE (mV)			CONDUCT VEL (m/s)		
	R	L	Norm	R	L	Norm	R	L	Norm
ulnar (wrist)	3.2	-	-	6.7	-	-	-	-	-



ulnar (elbow)	7.0	-	-	6.0	-	-	51	-	-
median (wrist)	3.9	-	-	3.8	-	-	-	-	-
median (elbow)	8.4	-	-	3.6	-	-	47	-	-
peroneal (ankle)	4.2	-	-	1.6	-	-	-	-	-
peroneal (fib. head)	11.9	-	-	1.5	-	-	40	-	-

SENSORY NERVE CONDUCTION STUDIES									
nr = no response									
NERVE	LATENCY			AMPLITUDE (µV)			CONDUCTION VEL (m/s)		
	R	L	Norm	R	L	Norm	R	L	Norm
ulnar	3.9	-	-	20	-	-	-	-	-
median	3.2	-	-	23	-	-	-	-	-
sural	nr	-	-	-	-	-	-	-	-

NEEDLE ELECTROMYOGRAPHY										
N = normal incr = increased decr = decreased 0 = absent 1+ = minimal 4+ = maximal crd = complex repetitive discharge fasc = fasciculation potential myk = myokymic discharge myt = myotonic discharge nmt = neuromyotonic discharge p wave = positive sharp waves fib = fibrillation potentials recr = recruitment amp = amplitude dur = duration poly = polyphasic potential										
R/L	MUSCLE	INSERTION		SPONTAN		VOLUNTARY				
		activ	p wave	fib	other	recr	amp	dur	poly	effort
R	VMO	incr	0	0	myt	N	N	N	+	full
R	deltoid	incr	0	0	myt	N	N	N	+	full
R	APB	incr	0	0	myt	N	N	N	+	full
R	EHL	incr	0	0	myt	N	N	N	+	full
R	gastrocnemius	incr	0	0	myt	N	N	N	+	full
R	nasalis	incr	0	0	myt	N	N	N	+	full



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

Diagnostic Impression

Based on clinical findings and electrodiagnostic testing, the diagnoses are myotonic dystrophy with concomitant sensorimotor, axonal and demyelinating peripheral polyneuropathy.

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

Commentary V

Based on history alone, it would have been difficult to diagnose myotonic dystrophy, since the clinical history is extremely variable. The mild form of the disease begins in middle to old age. Initial symptoms are reported to be only muscle stiffness with or without muscle cramping. Insidious and progressive weakness of the hands and feet slowly progresses to affect proximal muscles. This is not seen in other muscular dystrophies. Recall that this patient has progressive weakness, difficulty climbing stairs, fatigue, and inability to relax the hands. The patient has been diagnosed with chronic atrial fibrillation. First-degree heart block and other cardiac arrhythmias are seen in more than 50%, and mitral valve prolapse is seen in 17% of patients with myotonic dystrophy. The patient has a history of diabetes mellitus and testicular atrophy. Endocrine abnormalities associated with myotonia include disturbances of hypothalamus, thyroid, pancreas and testes. Testicular atrophy is common. The diagnosis of myotonic dystrophy is supported by a strong family history of cardiac problems and difficulty in walking. Myotonic dystrophy is a dominantly inherited, multisystem disease with clinical features of myotonia, muscular dystrophy, cardiac conduction defects, cataracts, and endocrine disorders.

There are two forms of adult myotonic dystrophy. The first presents with less prominent muscle weakness and cataracts and the second with more significant muscle weakness and clinical myotonia.

The adult patient with advanced myotonia has a characteristic appearance. Atrophy of the muscles around the temple and jaw is apparent. A thin neck is a prominent finding secondary to wasting of the neck flexor muscle group. The most striking findings are the percussion myotonia of the thenar eminence as well as difficulty in releasing the grip and opening the eyes after forceful closure. The range of motion limitation or painful range of the temporomandibular joint is absent in this patient. In contrast to other muscular dystrophies, muscle wasting begins distally and slowly progresses proximally.



With regard to lab tests, serum creatine kinase levels are usually normal, however might be elevated as the disease progresses. In this patient creatine kinase level was within normal limits.

In myotonic dystrophy motor and sensory nerve conduction studies are usually, but not always, normal. The electrodiagnostic studies in this patient showed delayed distal latency of the right ulnar SNAP and absent right sural SNAP, as well as low amplitude of right median and right peroneal CMAP. Given this patient's known history of diabetes mellitus, it is likely that he has a superimposed peripheral polyneuropathy. The incidence of diabetes in patients with myotonic dystrophy is slightly higher than in the general population. This is probably due to increased peripheral insulin resistance. The needle EMG showed increased insertional activity along with reduced duration and amplitude and increased polyphasicity of motor unit potentials. Myotonic discharges with waxing and waning of the amplitude and frequency of the motor units were striking findings in all muscles tested. In most patients, myotonic discharges are more pronounced in the distal hand and in the facial muscles, but might also be seen proximally.

Genetics analysis in this patient showed a defect on Chromosome 19q, and CTG repeat >30, which encodes serine and treonine. This is the protein kinase gene (DMPK), which is found to be defective for most common forms of muscular dystrophy in adults, and can be caused by a mutation on either chromosome 19q13 (DM1) or 3q21 (DM2/PROMM). The main genetic abnormality in myotonic dystrophy is mutational expansion of CTG sequence. This sequence may be repeated 5-27 times without producing symptoms. If the CTG sequence is repeated more than 30 times, the symptoms are expected to be severe. A mildly affected mother may give birth to a severely affected child, whereby the above sequence repetition is multiplied many fold. This is called anticipation.

The treatment of myotonic dystrophy depends on the severity of the symptoms. Medications such as quinine, quinidine, phenytoin, carbamazepine, proconamide, disopyramide, mexiletine, and tocainide have all been recommended to alleviate myotonia. Pursed lip breathing and deep breathing exercises were found to be effective in improving the tidal volume and oxygen saturation in patients with myotonic dystrophy. Additional caution should be practiced in selecting the anesthetic agents and best assisted ventilation techniques for patients with myotonic dystrophy who will undergo general anesthesia, due to the vulnerability of these patients to respiratory failure.

Genetic mapping may help to enlighten the future therapeutic understanding of myotonic dystrophy.

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