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Duchenne Muscular Dystrophy: Definitive diagnosis and multispecialty care may improve quality of life, longevity

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The early signs are there. A young boy's parents have noticed that his walking is a little awkward and he's not as quick as other toddlers his age. He is able to stand from a sitting position, but seems to need a little extra help by pushing with his hands against his legs. A trip to the pediatrician and some lab work reveals a markedly elevated CK enzyme, and the possibility of muscular dystrophy comes to mind. The physician recommends further evaluation by a specialist to confirm the diagnosis and determine the type of muscular dystrophy.

Is it Duchenne dystrophinopathy?

The most common form of childhood muscular dystrophy is Duchenne, with onset usually occurring before age 6. Incidence is about one in every 3300 boys. In approximately two of three cases, there is a family history of DMD (X-linked inheritance). In one of three, the disease occurs spontaneously. (Muscular dystrophy rarely occurs in girls. When it does, effects of the disease are minimal and commonly manifest as slight muscle weakness.)

Children with Duchenne dystrophinopathy may walk at a normal age, but some awkwardness in gait is usually noted by age 3 or 4. In some cases, this may be apparent at a much earlier age. In addition, these boys do not run quite as well or as fast as their peers, and fall more than expected.

Other early signs of DMD are weakness in the hip muscles and pseudohypertrophy of the calf muscles (see table 1). As weakness progresses in the hip muscles, boys with DMD will use the Gowers maneuver to stand from sitting. This involves planting their feet widely apart, pushing their bottom up first, and then using their hands to push up on their knees and anterior thighs to reach standing.

Confirming the diagnosis

Depending on the kind of muscular dystrophy, management of the disease and expected outcomes can differ vastly. Differential diagnosis early on is therefore crucial.

Table 1
Initial presentation

1. Awkwardness in walking and running
2. Hip weakness and pseudohypertrophy of the calf muscles
3. Developmental delay
4. Key lab marker — elevated CK enzyme (10,000-30,000 times normal)

When a positive family history for DMD exists, DNA testing (to look for gene deletion on the short arm of the X chromosome) can be done without muscle biopsy to confirm the diagnosis. In other cases, muscle biopsy is the key to differentiating the type of muscular dystrophy. This may be done as a needle biopsy rather than an open procedure.

In pure Duchenne dystrophinopathy, muscle staining for dystrophin shows a complete absence of the protein. In a phenotype known as outlier Duchenne muscular dystrophy, about 10 percent of the muscle fibers will show residual staining for dystrophin. Individuals with outlier DMD have a slower progression of muscle weakness. A child may remain ambulatory until about age 16 (as opposed to age 12 with pure DMD) and may live well into their 20s (as opposed to late teens).

Multisystem involvement requires multispecialty care

In DMD, degeneration of the muscles has ramifications for many of the body's systems. No medical treatment or exercise program can halt or reverse the progression of the disease (see table 2.) Yet, ongoing evaluation and treatment by a multispecialty team of providers can slow the progression of secondary complications.

Table 2
Characteristic features of DMD

- symmetrical weakness and wasting first of the pelvic and leg muscles and then of the pectoral and proximal upper extremity muscles
- pseudohypertrophy of some muscles (especially in the calves)
- cardiac and pulmonary problems
- some cognitive impairment
- early death, usually from cardiac or pulmonary failure during the late teenage years

The overall goal of treatment with Duchenne muscular dystrophy is to ensure maximum quality of life for the patient. This requires a team of multidisciplinary specialists to monitor the child's condition and provide timely interventions. Key members of the team usually include a pediatric neurologist and physiatrist, a nurse coordinator, a genetic counselor, physical and occupational therapists, a nutritionist, orthotists and seating specialists. Cardiologists, pulmonary specialists, pediatric orthopaedic surgeons and psychologists are consulted as needed.

Physical strength and functioning. To prolong the child's ability to walk and perform day-to-day tasks, it is crucial to help them maintain the best possible muscle strength and function. Regular exercise is imperative, and an intense daily stretching program may be necessary as early as age 4 or 5 to prevent debilitating muscle contractures. Bracing is also used.

As muscle strength decreases in the legs, a child may attempt to make up for this loss by altering their gait, such as with toe walking or locking of the knees. This can lead to contractures and subsequent deformities of the bones that may only be correctable by orthopaedic surgery. If a child has surgery, it is paramount that they are up and walking again as soon as possible, with the help of walking casts or a walker, to prevent rapid weakening of the muscles from non-use. Once a child no longer walks, stretching continues to be important to prevent contractures to the extent possible.

For some children, the use of prednisone is helpful in maintaining strength and may delay the loss of ambulation by as much as two years or more. It may also benefit pulmonary function. Side effects of the drug – including weight gain, hypertension and behavior changes – need to be weighed against the benefits of treatment for each individual.

Cardiac and pulmonary problems. Most children with DMD will eventually die from cardiac or pulmonary difficulties. Initial cardiac testing to detect signs of heart failure is usually done at age 6 or 7 and then repeated at about age 12. Studies have shown that the vast majority of boys with DMD have some degree of cardiac compromise. However, under the care of a cardiologist, a child's life might be prolonged by five years or more.

Decreasing vital capacity also means that breathing can be an issue for children with DMD. Children become more and more susceptible to pneumonia and other respiratory complications. While assessment for sleep apnea has not traditionally been a part of routine care for children with Duchenne muscular dystrophy, there is now a growing awareness that it may be an issue for some individuals. Assisted ventilation may be of value for some patients.

Orthopaedic concerns. In addition to bony deformities that can result from muscle contractures, children in wheelchairs are at risk for scoliosis. Muscle weakness in the trunk makes it difficult or impossible for a child to maintain erect posture. A supportive, hard-back seating system can help counter this problem. Some children do develop scoliosis and require orthopaedic surgery. Once a child is no longer walking and weight bearing, bone density lessens and there is also an increased risk of fractures.

Mental function. Just as dystrophin is absent in the muscles of boys with DMD, it is also absent in the brain. This has been shown to have some cognitive effects. The average I.Q. of children with DMD is in the 80s. However, this can vary greatly among individuals, depending where on the gene there are deletions or mutations. Some children do well in school, while others function at a low level. Typically, there are certain problems with non-verbal processing and spatial memory.

Weight problems. Boys with DMD tend to have problems with excessive weight gain. This is especially true once they are no longer ambulatory. Weight gain is also a side effect of prednisone therapy. Whenever weight becomes a problem, it is wise to involve a nutritionist. Not only does excess weight place the child at greater risk of cardiac and pulmonary problems, but it can also lead to the child being less active. In turn, this hastens the weakening and deterioration of the muscles. It also makes it more difficult for caretakers to lift and transfer the child in and out of a wheelchair, once that becomes necessary.

Family-centered care

From the time of a child's initial evaluation for DMD, it is important to involve the family in the education and treatment process. It is the family who will be providing most of the care throughout the child's life.

Often, a family's first questions involve the hereditary nature of the disease. A genetic counselor can interview the family to obtain an expanded family history and address family concerns about future pregnancies. Arrangements for molecular genetic testing can also be made at that time. If the mother chooses to be tested, and proves to be a carrier, her chances of having a subsequent child with DMD are 50 percent if the child is a boy.

With regard to the child's condition, some families want as much information as possible about their child's disease and future, right away. Others do better when they receive the information in stages – too much at one time can be overwhelming and confusing.

As the child grows older, it is important to include him in discussions about his disease and treatments as well. Some boys will suffer from depression as their DMD progresses, especially during adolescence. In such cases, counseling can be helpful.

Care plan for Duchenne muscular dystrophy

An effective care plan for patients with Duchenne muscular dystrophy has interdisciplinary team management at its base. This approach offers the benefit of providing accurate diagnosis and counseling, as well as anticipating, preventing and aggressively managing the associated complications of DMD. A well-coordinated program helps prevent unnecessary, even harmful, consequences. Components of an optimal multidisciplinary approach include:

- Definitive diagnosis through muscle biopsy or molecular genetic testing
- Genetic counseling
- Regular assessment of the child's medical status and needs
- Use of assistive devices such as orthoses, specialized seating, and/or assistive technology (communication devices, powered mobility, computer access equipment, environmental controls, etc.)
- Education for the child and family, as well as school staff and community providers
- Neurocognitive screening and school evaluation to assist with educational planning
- Drug therapy (when available and appropriate)
- Nutritional counseling and appropriate interventions for weight problems
- Occupational and physical therapy
- Social services to assist families in identifying support services and financial resources, (such as funds for making adaptations to the home)
- Psychological evaluation and counseling if needed; support for patients and families through support groups
- End-of-life planning, including discussion with the family about life-sustaining treatment and advanced directives