MISCELLANEOUS (RARE) CARDIOMYOPATHIES

There are other forms of cardiomyopathy which comprise only a very small percentage of the total (~2–3%) number of cardiomyopathies in children. These cardiomyopathies may have overlapping features with any of the previous types described and include arrhythmogenic right ventricular dysplasia (ARVD), mitochondrial and left ventricular non-compaction cardiomyopathies (LVNC).

Patients with ARVD have dilated, poorly functioning right ventricles which have fatty deposits within the walls and are at risk for abnormally fast, life-threatening heart rhythms (ventricular tachycardia). This myopathy can be diagnosed (usually due to the abnormal rhythms) either in early infancy or later in adolescence/adulthood by echocardiogram or MRI, and its prognosis depends, in part, on the age at presentation.

Mitochondrial myopathies are rare and often present early in life. Hearts in the affected patients are often thick-walled (hypertrophic), although dilated hearts with poor function can also occur with this type of myopathy. This cardiomyopathy is caused by abnormalities in the mitochondria of the cells, which are small structures within each cell responsible for generating the energy the cell uses for its normal activities. These cardiomyopathies are often associated with other muscle, liver, neurologic and/or developmental abnormalities and are usually genetically passed from an affected mother to her children.

Finally, left ventricular non-compaction (LVNC) cardiomyopathy is characterized by deep trabeculations (or crevices) within muscle of the left ventricular walls. These hearts may have features of both dilated and/or hypertrophic cardiomyopathy. Conditions associated with LVNC include mitochondrial and metabolic disorders as well as systemic (whole body) processes such as Barth syndrome. Barth syndrome has a constellation of abnormalities including cyclic neutropenia or periodic fluctuations in the white blood cell count (which may not be apparent in early infancy), hypotonia (weak muscles) and LVNC cardiomyopathy. Barth syndrome has recently been linked to an abnormality in the X-chromosome and is passed from mother to son.

Symptoms of ARVD, Mitochondrial and LVNC Cardiomyopathies

Symptoms (the problems noted by the child and/or family) and signs (the problems detected by your physician) of cardiomyopathy in children are dependent on several factors including the type, cause and severity of the specific cardiomyopathy, the age when the problems started, and the effects of treatment. Since patients with ARVD generally have symptoms consistent with DCM, and patients with mitochondrial or LVNC cardiomyopathies can have symptoms seen with either HCM or DCM, families are encouraged to review the relevant sections written for dilated and hypertrophic cardiomyopathies within this brochure to become familiar with the pertinent symptoms for each of these cardiomyopathy types.

Diagnosis of ARVD, Mitochondrial and LVNC Cardiomyopathies

As with presenting symptoms, the clinical diagnosis of these rare forms of cardiomyopathy will depend on the features of the specific cardiomyopathy. That is, the diagnostic criteria in a child with ARVD will generally follow that of DCM while the mitochondrial and LVNC myopathies will follow that of either DCM or HCM depending on the clinical manifestations of the myopathy.

In addition to what is discussed in the diagnostic sections written for the dilated and hypertrophic forms of cardiomyopathy found elsewhere in this brochure, the following comments highlight a few details specific for the diagnosis of each of these rare cardiomyopathies.

The diagnosis of ARVD can be difficult especially in children given its low incidence. However, opposed to the usual form of DCM, which involves the left ventricle to a greater extent, ARVD typically involves the right ventricle preferentially and often times, the clinical suspicion for ARVD can be further explored with MRI (Magnetic Resonance Imaging) which, in many cases, can differentiate fatty deposits from muscle tissue within the wall of the right ventricle that are commonly seen with this disease. The diagnosis can usually be confirmed with visualization of significant fatty deposition within the right ventricular walls (where muscle should be) from biopsy specimens obtained during cardiac catheterization.

Patients with mitochondrial cardiomyopathy often have other associated medical problems such as hearing or vision problems, skeletal muscle weakness in the arm and leg muscles and/or central nervous system issues including learning problems, developmental delay or loss of developmental milestones. Once suspected, in addition to the cardiac assessment (for DCM or HCM) outlined elsewhere in this brochure, a muscle biopsy performed to evaluate

both structure and function of the mitochondria can help verify this diagnosis. A cardiac biopsy is generally not useful because the volume of muscle tissue necessary to perform the mitochondrial analyses can only be safely obtained from arm or leg muscles.

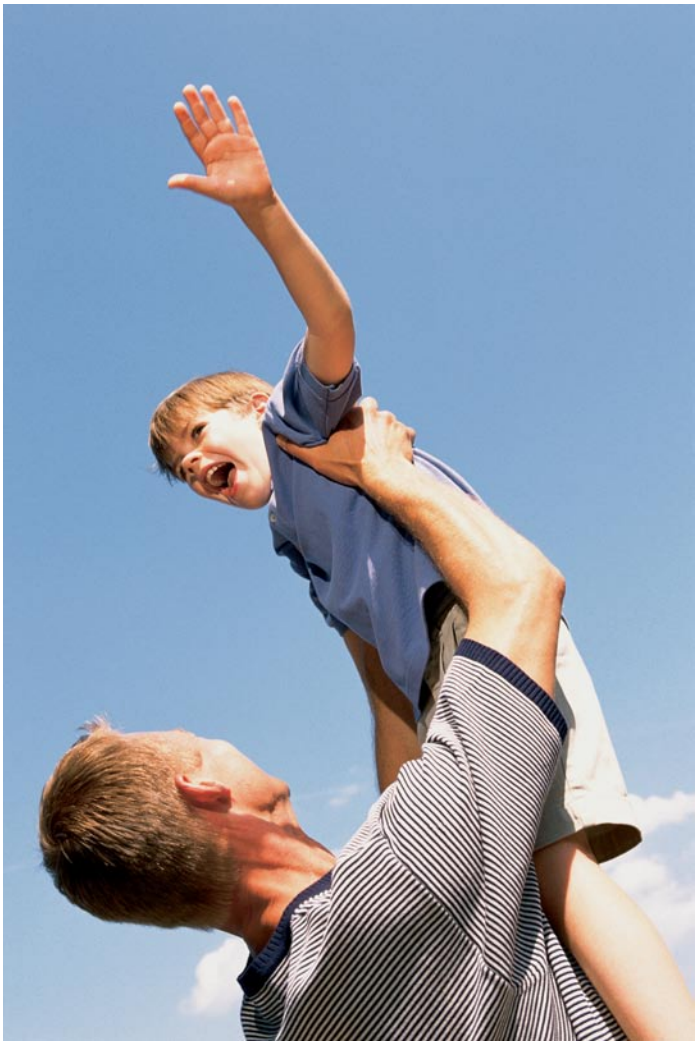
The diagnosis of LVNC can often by strongly suspected when deep crevices or trabeculations are noted with the walls of the left ventricle during an echocardiogram. Very few other cardiac diagnoses have these specific findings. Genetic testing may become more available in the near future to assess identified causes of LVNC especially among male children and those suspected of having Barth syndrome (see following discussion on the G4.5 mutation testing).

Causes of the Miscellaneous Cardiomyopathies

Currently, the cause of these “rare” cardiomyopathies in most children is incompletely understood, but in a subset of children it is clear that the cause is an error or mistake in a gene. For a greater understanding of the basics of human inheritance patterns and a more detailed discussion of the potential genetic causes of the “rare” cardiomyopathies, the reader is encouraged to read separate sections entitled “Overview of Inheritance” and “Genetics of Cardiomyopathies” printed elsewhere in this brochure.

Current Treatment

Currently, there are no therapies that can “cure” cardiomyopathy; however, many treatments are available that can improve symptoms and decrease risk in children with cardiomyopathy. The choice of a specific therapy depends on the type of cardiomyopathy, the clinical condition of the child, the risk of dangerous events and the ability of the child to tolerate the therapy. To review detailed therapies for both the dilated and hypertrophic forms of cardiomyopathy that apply to ARVD, mitochondrial myopathy or LVNC, the reader is directed to the pertient sections on treatment written for DCM and HCM elsewhere in this brochure.



Prognosis

Many children with cardiomyopathy are able to lead relatively normal lives once the diagnosis has been established and appropriate therapies have been started. The long-term prognosis varies depending on the type of cardiomyopathy and the degree of functional impairment. Children with cardiomyopathy should be watched closely for the development of heart failure, abnormal heart rhythms, blood clots inside the heart and other signs that the heart is not able to maintain normal blood flow. Once signs of heart failure or significantly abnormal rhythms appear, aggressive therapy is begun with close monitoring for signs of worsening blood flow to the vital organs. If other organs show signs of damage or the heart failure does not respond to medications, a cardiac assist device and/or transplant is considered early, as the waiting time for a donor heart can be unpredictable. It is important that a child with cardiomyopathy be closely monitored at a center with expertise in pediatric heart failure, cardiomyopathy, arrhythmias, cardiac assist devices and transplantation in order to ensure rapid response to any worsening of his or her condition.

In children with DCM, approximately 35% recover completely, 35% stabilize and the remaining may progressively worsen. Children with DCM are more prone to congestive heart failure and have a higher rate of heart transplantation compared with other forms of cardiomyopathy. However, improved medical therapy may eventually change this scenario. Current average five-year survival rates for children with typical DCM are 40–50%. Survival rates for ARVD, LVNC and mitochondrial myopathies are much less well established.

The outcome of hypertrophic cardiomyopathy is highly variable with some patients remaining asymptomatic, some developing symptoms and possibly progressive heart failure, and all remaining at risk for sudden death. Heart transplant is performed uncommonly and is primarily reserved for patients with severe, uncontrollable heart failure. Average 10-year survival rates for older children with HCM are > 90%, although infants with HCM typically do far more poorly.

Living with Cardiomyopathy

The diagnosis of cardiomyopathy affects many areas of a child's life. The following sections outline the general approaches to living with cardiomyopathy. It is important that specific recommendations are developed by the team caring for the child with cardiomyopathy.

Physical Activity

Children with cardiomyopathy are not allowed to play competitive sports because of the possibility of a sudden collapse or increased heart failure. A competitive sport is an organized team activity for which training is required.

A child with the dilated subtype of rare cardiomyopathy (LVNC and ARVD) and no heart failure symptoms can be allowed to perform recreational athletic activities, also known as low-dynamic or low-static sports, in a non-competitive situation. In milder cases of cardiomyopathy, the child may even participate in gym class after careful discussions between the child, teacher, and parents to ensure that the level of activity does not cause overexertion (breathlessness, chest pain, excessive sweating). Children with the hypertrophic subtype of cardiomyopathy (i.e., mitochondrial) are prohibited from serious recreational sports because of the possibility of a sudden collapse and death. Specific activity recommendations should be individualized by the treating cardiologist.

School

The intellectual, psychological, and social benefits of attending school cannot be overestimated in the child with cardiomyopathy. Adjusting medication schedules so they do not interfere with school activities, discussing safe activity levels with school personnel, and providing tutoring to maintain academic performance are important interventions that can help a child to stay in school and keep up with their peers. Often close communication between the parents, medical care team, and the school nurse can help to keep a child up to date in school.

Friends

Every effort should be made to allow a child with cardiomyopathy to spend time with friends. The child should also be allowed to participate in recreational activities whenever possible. However, an effort should be made to avoid contact with those who are acutely ill with fever, even though many children with cardiomyopathy are able to tolerate upper respiratory tract illnesses (common colds) well.

Psychological Issues

Adjusting to having a chronic illness is stressful for the child and the family. The child's reaction to having cardiomyopathy often depends on the stage of the child's development. Discussions about the disease should be tailored to the specific concerns of the child. Child-life professionals and pediatric psychiatrists are important resources to help children cope, and their services are often available through the treating center.

Family

The impact of a diagnosis of cardiomyopathy is felt throughout the child's immediate and extended family. It is important for parents and other caregivers to realize that they are not alone in feeling the weight of responsibility that comes with taking care of a child with a chronic illness. Anticipating and/or preventing the stress imposed by an illness is an important part of caring for the child and family and personnel at the cardiomyopathy center can help identify issues that can lead to increased stress.

Practical solutions to problems giving medications, keeping track of appointments, and maintaining normal family life can often be found through discussions with nurse clinicians, the social worker, psychiatrist, and other parents of children with cardiomyopathy.

Diet

All children with cardiomyopathy should follow a healthy diet. The recommendations published in 2005 by the United States Department of Agriculture (USDA) can be found at the following website address: http://www.mypyramid.gov/. Certain types of cardiomyopathy are associated with an inability to digest certain types of food, and in these cases, a special diet is developed in consultation with metabolic specialists. In children with the dilated subtype of cardiomyopathy and heart failure, a low salt diet is recommended to avoid fluid retention.

Some children with heart failure may not grow well. In these cases, a diet that increases calories is recommended. Children who are taking some medications may have low levels of magnesium or potassium and a diet that has a higher amount of one or both of these two electrolytes may be recommended. Some children with severe heart failure can retain extra body fluid, and it may be necessary to limit the amount that a child can drink to prevent fluid from accumulating in the lungs.

Health Maintenance

Routine pediatric care is important for children with cardiomyopathy. Regular well child visits and standard childhood immunizations should be performed. The influenza vaccine should be administered on a yearly basis. Children under age 2 should receive Synagis for protection against respiratory syncytial virus.

A medical alert bracelet is an important safety measure for children with cardiomyopathy. In the event of an emergency, these bracelets allow medical personnel to know details about a child's illness, especially if a family member is not available.

What Does the Future Hold for "Rare" Cardiomyopthies?

Much progress has been made in our ability to diagnose rare cardiomyopathies in both the clinical and molecular arenas. However, much additional research is needed in this field. Areas of research to be highlighted over the next decade include: 1) better understanding of these rare cardiomyopathy as a disease process and the characteristics of the disease as they relate to outcome, which will lead to better management strategies; 2) increased clinical trials which will lead to new drug development and more effective therapies; and 3) molecular identification of novel genetic mutations as well as more precise diagnostic genetic testing/screening which will result in more accurate diagnosis.

It is the expectation of the medical community that the data derived from exploring these avenues of scientific research will translate into a clinician's ability to tailor medical therapy based on a given child's precise diagnosis. Achieving this goal over the next couple of decades will represent a large milestone in the field of pediatric cardiomyopathy and will, hopefully, improve the ongoing care and prognosis of children afflicted with these heart muscle diseases.