Practice Guidelines

AHA/ATS RELEASE GUIDELINES ON THE DIAGNOSIS AND TREATMENT OF PEDIATRIC PULMONARY HYPERTENSION

Pulmonary hypertension in children is distinct from adult hypertension. It is linked to issues of lung growth and development, and is often related to impaired functional and structural adaptation of pulmonary circulation during transition from fetal to postnatal life. Pulmonary hypertension in children is defined as a resting mean pulmonary artery pressure of more than 25 mm Hg beyond the first few months of life. These guidelines from the American Heart Association (AHA) and the American Thoracic Society (ATS) address evaluation and treatment of pediatric pulmonary hypertension, including diagnosis, pharmacotherapy, and outpatient treatment recommendations.

Diagnosis

A comprehensive history and physical examination, combined with diagnostic testing and formal assessment of cardiac function, should be done at the time of initial pulmonary hypertension diagnosis. Critical diagnostic testing includes chest radiography, electrocardiography, echocardiography, chest computed tomography (CT) with or without contrast media, six-minute walk test, laboratory studies including brain natriuretic peptide levels, and cardiac catheterization. Targeted evaluation with pulmonary function testing, magnetic resonance imaging, lung perfusion scanning, cardiopulmonary exercise testing, and a sleep study may be appropriate in some patients. Follow-up visits should be performed every three to six months, with more frequent visits for patients with advanced disease or after initiation of or change in therapy.

Echocardiography

Echocardiography is noninvasive and useful in identifying potential causes of pulmonary hypertension, right ventricular function, and assessing related comorbidities. It is the preferred tool for screening and should typically be performed every four to six months to monitor disease progression, or if there is a change in therapy.

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Cardiac Catheterization

Cardiac catheterization should be performed before starting therapy for pulmonary hypertension unless a patient is critically ill with an immediate need to start treatment. There are six general goals for catheterization in children with pulmonary hypertension: confirm diagnosis and severity of disease; assess response of the pulmonary bed to pulmonary vasodilators before starting therapy (acute vasoreactivity testing [AVT]); evaluate response to or need for changes in therapy; exclude other diagnoses; assess operability as part of the assessment of patients with systemic to pulmonary artery shunts; and assist in determining heart or heart-lung transplantation suitability. It is recommended that repeat catheterization be performed at clinical worsening, three to 12 months after a significant change in therapy, or every one to two years during follow-up.

Other Diagnostic Tools

CT may produce useful information on disease pathogenesis when evaluating for pulmonary hypertension. CT angiography is the preferred method for detecting pulmonary embolism. Smaller children are able to tolerate chest CT angiography better than ventilation/perfusion scanning, which requires the child to be motionless for several minutes after inhaling a radioisotope and being injected with radioisotope-tagged albumin.

Magnetic resonance imaging is the best option for the evaluation of the right ventricle. It is most commonly used in children with pulmonary hypertension to evaluate right ventricle size, mass, and function in the initial evaluation and during follow-up. Echocardiography is still preferred for frequent assessments.

Physiologic assessments such as the six-minute walk test and cardiopulmonary exercise testing are used for evaluation and follow-up, but have not been standardized in children.

Pharmacotherapy

Vasodilator responsiveness should be assessed by cardiac catheterization, and anatomic obstruction resulting from pulmonary venous disease or left-sided heart disease should be excluded before targeted therapy is started. Vasodilators are commonly used to decrease pulmonary artery hypertension, improve

cardiac output, and possibly reverse pulmonary vascular changes in the lung. New evidence suggests that cellular growth, inflammation, and fibroproliferative changes play an important role in pulmonary artery hypertension that may not be adequately addressed by current therapies.

Conventional Therapy

Conventional therapies used for heart failure are also used to treat right ventricular failure. Digitalis may be beneficial in patients with overt right-sided cardiac dysfunction and clinical heart failure. Diuretic therapy should be used carefully because patients with pulmonary artery hypertension are often preload dependent to maintain an optimal cardiac output. Although long-term studies in children are lacking, anticoagulation with warfarin may be considered in patients with low cardiac output, long-term indwelling catheters, hypercoagulable states, idiopathic pulmonary artery hypertension, or heritable pulmonary artery hypertension. Anticoagulation should not be used in young children with pulmonary artery hypertension who may be prone to hemorrhagic complications.

Other Therapies

Adding specific targeted therapy for pulmonary hypertension to achieve specified therapeutic goals is recommended. Transitioning from parenteral to oral or inhaled therapy can be done in asymptomatic children with stable near-normal pulmonary hemodynamics, as long as close monitoring is done in a specialized treatment center.

Oxygen therapy can be useful for patients with a saturation of less than 92%, especially in the scenario of underlying respiratory disease.

Calcium channel blockers (CCBs) are indicated for patients who are reactive with AVT and older than one year. CCB therapy is contraindicated in children who have not undergone AVT, are nonresponders, or have right ventricular failure, regardless of acute response. Long-term CCB therapies recommended for use in acute responders include nifedipine, diltiazem, and amlodipine. These agents may lower heart rate, and diltiazem is used more commonly in young children with higher heart rates.

Prostacyclin analogues can be used to increase pulmonary vasodilatation. Intravenous or subcutaneous analogues (i.e., epoprostenol, treprostinil, or their analogues) should be started immediately in patients with severe pulmonary artery hypertension.

Phosphodiesterase-5 inhibitors (i.e., sildenafil or tadalafil) and endothelin receptor antagonists (i.e., bosentan and ambrisentan) can be used for oral therapy in children with lower-risk pulmonary hypertension.

Outpatient Care

Establishing experienced, knowledgeable, and multidisciplinary pediatric pulmonary hypertension programs, as well as teams of pediatric subspecialists, can improve the care of children with pulmonary hypertension. A critical aspect of these programs is successful coordination of inpatient and outpatient care.

There is risk of syncope or sudden death with exertion in patients with pulmonary hypertension. It is recommended that a thorough evaluation be performed before the patient engages in athletic activities. Patients with severe pulmonary hypertension should be advised not to participate in competitive sports. In general, these patients should avoid strenuous exertion and should engage in light to moderate aerobic activity, stay well hydrated, and be allowed to selflimit as required.

Because of risks to the mother and fetus during pregnancy, age-appropriate counseling on contraception should be provided to female adolescents with pulmonary hypertension. During travel on airplanes, oxygen may be necessary.

Respiratory viral and bacterial infections are common in childhood and adversely affect outcomes in children with pulmonary hypertension, so it is important that they are treated promptly. For prevention, they should receive the influenza, pneumococcal, and respiratory syncytial virus vaccinations. An experienced pulmonary hypertension team involved during routine surgical and dental procedures can reduce complications related to anesthesia in children. Frequent outpatient visits at three- to six-month intervals and closer follow-up for monitoring changes in disease course can improve communication with families and caregivers. Children and their siblings and caregivers should be assessed for psychosocial stress, with referral as needed.

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