Pulmonary Hypertension

What is pulmonary hypertension?

Pulmonary hypertension (**PH**) refers to high blood pressure within the arteries that lead from the right side of the heart to the lungs. This is a distinct entity from *systemic* hypertension (commonly referred to simply as "hypertension"), in which the elevated blood pressure is within the arteries that travel throughout the body to its various other organs.

A brief explanation of blood flow circulation through the body is helpful in discussing PH. The heart is divided by a septum down the middle into a right side and a left side, with two chambers (an *atrium* followed by a *ventricle*) on each side. The right side of the heart is dedicated to pumping blood to and through the lungs, where oxygen is transferred to blood from air. The left side of the heart is responsible for pumping blood to the rest of the body (called "systemic" blood flow). To summarize, blood takes the following and repeating path:

right atrium ⇒ right ventricle ⇒ **pulmonary arteries** ⇒ lungs ⇒ pulmonary veins
⇑ ⇓
systemic veins ⇐ other organs ⇐ systemic arteries ⇐ left ventricle ⇐ left atrium

The causes of PH are numerous, but can be generally grouped as follows: a) Certain congenital anomalies (heart conditions present at birth) result in excessive delivery of blood to the pulmonary arteries, yielding elevated pressure within them; b) Any severe heart disease affecting the left side of the heart can produce elevated pressure in the left atrium, which can then be transmitted backward through the pulmonary veins, the lungs, and into the pulmonary arteries; c) Some diseases of the lungs prevent oxygen from being transferred through them into the bloodstream. The pulmonary arteries react by squeezing more tightly, increasing the pressure within them; d) Some conditions result in the physical blockage of blood flow through the pulmonary arteries, themselves, leading to PH. Specific examples include heartworm disease and pulmonary thromboembolism; e) In some cases, no underlying cause can be identified. Such cases are typically referred to as either "primary" or "idiopathic" PH.

How is PH diagnosed?

Prior to the diagnosis of PH, symptoms may have been noted but are generally not specific to this condition. Depending on the cause, they may include coughing, intolerance to activity or exercise, episodic or constant weakness, labored breathing, or fainting. In mild cases, however, there may be no symptoms at all. In addition to the above, physical examination using a stethoscope may reveal abnormal breath sounds or a heart murmur (a "whooshing" noise associated with the normally crisp heart sounds). The latter is a result of blood being pushed backward through the valves on the right side of the heart.

Echocardiography (ultrasound examination of the heart) is the most common and noninvasive test used to diagnose PH. It is typically performed either during the course of evaluation of a newly noted heart murmur or due to the presence of one or more symptoms raising suspicion for heart disease or PH. Findings in animals with PH may include more direct evidence of "regurgitant" (backward) blood flow through valves as mentioned above, as well as enlargement of the right side of the heart which must pump against the abnormally high pressure within the pulmonary arteries. Other diagnostic testing may include routine **bloodwork** (complete blood count and chemistry panel), **heartworm testing**, **chest x-rays**, and occasionally other bloodwork or imaging tests.

It should be noted that the "gold standard" test used to confirm the diagnosis of PH involves direct and more invasive (but also more accurate) measurement of the pressure inside the pulmonary arteries. While this test constitutes standard practice for the diagnosis of PH in people, its cost and the need for heavy sedation make it less practical in veterinary medicine.

How is PH treated?

If an underlying cause can be identified, then treatment for that condition should be pursued if possible. For example, medical therapy for congestive heart failure in an animal suffering from severe left-sided heart disease may reduce pulmonary arterial pressure and contribute to symptomatic improvement. Unfortunately, treatment for the underlying cause is not always feasible or effective. As mentioned above, some animals have no identifiable cause at all.

Specific medical therapy for PH is aimed at relaxing the muscle in the walls of the pulmonary arteries. Development of an effective medication for this purpose, however, has proven to be challenging. In human medicine, it is well known that some people with PH simply do not respond to medications for this disease. This is the case in veterinary medicine as well, and attempts at medical therapy are sometimes unrewarding. Examples of drugs that are helpful in some animals with PH include *amlodipine* (a *calcium channel blocker*) *sildenafil* (better known by its brand name, *Viagra*), and *enalapril* (an *ACE inhibitor*).

What is the prognosis? What should I watch for?

The long-term outcome for animals with PH is extremely variable and depends upon several factors. These include whether or not an underlying cause can be found, whether that condition can be successfully treated, as well as the response to specific medical therapy for PH. Animals with mild PH may remain nearly or completely symptom-free. Animals with more severe PH and life-threatening symptoms unfortunately have a guarded prognosis for long-term survival.

It is important to monitor for the development or worsening of the symptoms described earlier. New but milder problems such as occasional **coughing**, mild or transient **weakness**, or **intolerance to activity or exercise** should prompt phone contact with either your regular veterinarian or Veterinary Specialty Services Cardiology Service to discuss an appropriate plan. Severe or sustained weakness, **fainting**, or **difficulty breathing** warrant immediate attention on an emergency basis.