

PULMONARY HYPERTENSION (HIGH BLOOD PRESSURE IN THE LUNGS)

BASICS

OVERVIEW

- Elevation in systolic blood pressure in the arteries of the lungs (defined as pulmonary artery pressure greater than 30 mmHg or mean pulmonary arterial pressure greater than 20 mmHg)
- Several events can lead to elevations in blood pressure in the arteries of the lungs (pulmonary artery pressure)—primary pulmonary hypertension, a congenital (present at birth) abnormality in the blood vessels of the lungs has not been identified in dogs or cats; secondary pulmonary hypertension can be caused by narrowing or constriction of the arteries or capillaries of the lungs, blockage of the artery of the lung (pulmonary artery), high pressure within the left atrium (left-sided top chamber of the heart) with resultant increase in blood pressure in the capillaries of the lungs, or excessive blood flow in the arteries of the lungs
- Many of the causes for development of high blood pressure in the arteries of the lungs (pulmonary hypertension) involve the heart; the heart of the dog or cat is composed of four chambers; the top two chambers are the right and left atria and the bottom two chambers are the right and left ventricles; heart valves are located between the right atrium and the right ventricle (tricuspid valve); between the left atrium and the left ventricle (mitral valve); from the right ventricle to the main pulmonary (lung) artery (pulmonary valve); and from the left ventricle to the aorta (the main artery of the body; valve is the aortic valve)

GENETICS

- No genetic basis found
- High blood pressure in the arteries of the lungs (pulmonary hypertension) can be secondary to several congenital (present at birth) heart defects that may have a genetic basis

SIGNALMENT/DESCRIPTION of ANIMAL

Species

- Dogs and cats

Breed Predispositions

- May be based on underlying cause of high blood pressure in the arteries of the lungs (pulmonary hypertension), such as congenital (present at birth) heart disease

SIGNS/OBSERVED CHANGES in the ANIMAL

- Signs may be due to high blood pressure in the arteries of the lungs (pulmonary hypertension) or to the underlying primary disease
- Exercise intolerance
- Difficulty breathing (known as “dyspnea”)
- Coughing; spitting up of blood derived from the lungs due to pulmonary or bronchial hemorrhage (known as “hemoptysis”)
- Fainting (known as “syncope”)
- Abdominal distention
- Weight loss
- Heart murmur
- Abnormal heart and/or lung sounds heard when listening to the chest with a stethoscope
- Bluish discoloration of the skin and moist tissues (mucous membranes) of the body caused by inadequate oxygen levels in the red-blood cells (known as “cyanosis”)
- Distension of the jugular veins in the neck

CAUSES

Lung Disease

- Blockage of blood flow in the lungs
- Pneumonia
- Long-term (chronic) inflammation of the bronchi (airways going from the windpipe [trachea] into the lungs; condition known as “bronchitis”)
- Inflammation of the bronchi characterized by the presence of eosinophils, a type of white-blood cell involved in allergic responses by the body and active in fighting larvae of parasites (condition known as “eosinophilic bronchitis”)
- Widespread tumors in the lungs
- Adult respiratory distress syndrome, a group of lung abnormalities that develop secondary to various serious illnesses that cause sudden breathing difficulties

Blood Clots in the Lungs (known as “pulmonary thromboembolism”)

- Excessive levels of steroids produced by the adrenal glands (known as “hyperadrenocorticism” or “Cushing’s disease”)
- Condition in which proteins are lost from the body through the kidneys (known as “protein-losing nephropathy”)

- Presence of pus-forming bacteria and their poisons in the blood or tissues (condition known as “sepsis”)
- Heartworm disease
- Immune-mediated hemolytic anemia—accelerated destruction or removal of red-blood cells related to an immune response, in which the body produces antibodies against red-blood cells
- Cancer
- Inflammation of the pancreas (known as “pancreatitis”)
- Inflammation/infection of the lining of the heart (known as “endocarditis”)
- Blood-clotting disorder (known as “disseminated intravascular coagulation” or “DIC”)
- Primary heart disease

Heartworm Disease

Congenital (Present at Birth) Heart Disease

- Various heart defects (such as patent ductus arteriosus, ventricular septal defect, atrial septal defect)
- Probably a rare cause of high blood pressure in the arteries of the lungs (pulmonary hypertension)

Left-Sided Heart Disease

- Backward flow of blood through the mitral valve (known as “mitral regurgitation”)
- Heart muscle is flabby and weak (known as “dilated cardiomyopathy”)
- Heart muscle disease characterized by inappropriate enlargement or thickening of the heart muscle of the left ventricle (known as “hypertrophic cardiomyopathy”)
- Heart muscle disease in which the muscle is “stiff” and does not expand, such that blood cannot fill the ventricles normally (known as “restrictive cardiomyopathy”)
- Narrowing of the mitral valve (known as “mitral stenosis”)
- Tumors of the left atrium

Causes of Long-Term (Chronic) Low Levels of Oxygen in the Body (known as “hypoxia”)

- Decreased movement of air into and out of the lungs (known as “hypoventilation”)
- High-altitude disease

RISK FACTORS

- Heart and lung disease
- Heartworm disease
- Diseases associated with blood clots to the lungs (pulmonary thromboembolism)
- Obesity
- High altitude

TREATMENT

HEALTH CARE

- Hospitalize patients with severe breathing distress, until stable
- Administer oxygen therapy, medications to enlarge or dilate the bronchi (known as “bronchodilators”), medications to remove excess fluid from the body (known as “diuretics”), and antibiotics on an emergency basis in accordance with underlying disease
- Monitor hydration and body temperature closely
- Administer fluid therapy carefully on basis of hydration status and severity of right-sided heart disease; right-sided heart disease may contraindicate fluid therapy
- Maintain low-stress environment
- Medical management is controversial; treatment of the primary underlying disease process should be the focus, if possible

ACTIVITY

- Restricted

DIET

- Specific guidelines based on underlying disease
- If in heart failure, restricted sodium diet may have benefit

SURGERY

- Surgical heartworm extraction is a consideration in patients with severe infestation

MEDICATIONS

Medications presented in this section are intended to provide general information about possible treatment. The treatment for a particular condition may evolve as medical advances are made; therefore, the medications should not be considered as all inclusive.

- The ideal therapeutic agent should reduce blood pressure in the lungs without affecting the general (systemic) circulation; oxygen can accomplish this, but long-term oxygen administration is not feasible in these patients; short-term or intermittent use of oxygen may be beneficial

Medications to Enlarge or Dilate Blood Vessels (Known as “Vasodilators”)

- Ideally, base selection on lung and systemic blood pressure responses during heart catheterization
- Choices include angiotensin-converting enzyme (ACE) inhibitors (such as enalapril, benazepril), hydralazine, and calcium-channel blockers
- Often not useful due to development of generalized (systemic) low blood pressure (known as “hypotension”)
- Sildenafil (Viagra®) is known to cause enlargement of lung blood vessels with minimal enlargement of generalized (systemic) blood vessels; the usefulness of this medication in dogs is under investigation

Medications to Enlarge or Dilate Bronchi (Bronchodilators)

- May benefit treatment of low oxygen (hypoxia)-mediated high blood pressure in the arteries of the lungs (pulmonary hypertension)
- Choices include sympathomimetics (such as terbutaline) and methylxanthines (such as theophylline, aminophylline)
- Bronchodilators may have additional positive effects on contraction of heart muscle (known as “positive inotropes”)

Medications to Increase Contraction of Heart Muscle (Positive Inotropes)—Digoxin, Dobutamine

- Not a primary treatment of high blood pressure in the arteries of the lungs (pulmonary hypertension)
- May improve right heart function and resolve congestive heart failure
- Monitor closely for digoxin-related irregular heart beats (known as “arrhythmias”)

Medications to Prevent Blood Clots (Known as “Anticoagulant Therapy”)

- Indicated if blood clots in the lungs (pulmonary thromboembolism) are diagnosed
- Choices include heparin, warfarin, and aspirin
- Low molecular-weight heparin (enoxaparin) currently is under investigation in animals

FOLLOW-UP CARE

PATIENT MONITORING

- Physical examination with careful listening of the heart and lungs with a stethoscope (known as “auscultation”)
- Monitor for worsening of clinical signs
- Chest X-rays
- Arterial blood gases (measurements of oxygen and carbon dioxide levels in arterial blood)
- Echocardiogram (use of ultrasound to evaluate the heart and major blood vessels)
- Electrocardiogram (“ECG,” a recording of the electrical activity of the heart)

PREVENTIONS AND AVOIDANCE

- Early evaluation and prevention of conditions that increase likelihood of development of high blood pressure in the arteries of the lungs (pulmonary hypertension)

POSSIBLE COMPLICATIONS

- Right-sided heart failure
- Fainting (syncope)
- Irregular heart beats (arrhythmias)
- Sudden death

EXPECTED COURSE AND PROGNOSIS

- Based on ability to reverse underlying disease
- When changes are irreversible, treatment is designed to improve patient’s condition rather than to cure the disease
- In general, prognosis is very guarded

KEY POINTS

- Diagnosis often is presumptive (that is, based on clinical signs); for definitive diagnosis, need heart catheterization and/or Doppler echocardiography (use of ultrasound to evaluate the heart and major blood vessels)
- Prognosis varies with reversibility of the underlying disease, but is very guarded in most cases
- Avoid environments that may increase likelihood of breathing distress—excessively cold or dry air, excessive heat, second-hand smoke, high altitudes