



# Cyanosis

## (Bluish Discoloration)

### Basics

#### OVERVIEW

- A bluish discoloration of the skin and moist tissues (mucous membranes) of the body caused by inadequate oxygen levels in the red blood cells

#### SIGNALMENT/DESCRIPTION OF PET

##### Species

A variety of conditions may lead to the development of the bluish discoloration known as “cyanosis.” Cyanosis may be seen in any dog or cat when the oxygen levels in the blood drop below a certain level. The following are some of the conditions that may lead to cyanosis:

- Abnormal blood flow in the heart in which blood from the right side of the heart (where the blood normally has low oxygen levels) is diverted to the left side of the heart (where the blood normally has high oxygen levels); this abnormal blood flow is known as a “right-to-left shunt”—dogs: Keeshonds, English bulldogs, and beagles; some cats; generally young pets
- Tracheal collapse in which a portion of the wall of the windpipe caves in—usually young or middle-aged small-breed dogs (such as Pomeranians, Yorkshire terriers, poodles)
- Congenital laryngeal paralysis in which the pet is born with part of the voice box (larynx) paralyzed—young pets; reported in Dalmatians, Bouvier des Flandres, and Siberian huskies
- Acquired laryngeal paralysis in which part of the voice box (larynx) becomes paralyzed—most common in old, large-breed dogs (such as retrievers)
- Hypoplastic trachea in which the windpipe develops abnormally and is too small—identified in young English bulldogs; occasionally other breeds
- Asthma (cats)—higher incidence reported in Siamese

#### SIGNS/OBSERVED CHANGES IN THE PET

- Cyanosis may be caused by problems associated with low oxygen levels in the blood throughout the body or with problems associated with the actual oxygen-carrying part (hemoglobin) of the red blood cell. These problems cause a type of cyanosis known as “central” cyanosis. A different type is “peripheral” cyanosis in which the bluish discoloration is found in one or more limbs of the body due to decreased blood flow and poor delivery of oxygen-carrying blood to the limb(s). The signs one sees are based on the type of cyanosis—central or peripheral.
- The pet with central cyanosis may have high-pitched, noisy breathing (stridor); respiratory distress; coughing; voice change; periodic weakness; or fainting (syncope)
- The pet with peripheral cyanosis may have weakness or paralysis of the involved limb(s)

## CAUSES

### Respiratory (Breathing) System

- Larynx (voice box)—paralysis (acquired or congenital); collapse or caving in of part of the larynx; spasm; fluid buildup in the tissues of the voice box (edema); trauma; cancer; nodules
- Trachea (windpipe)—collapse or caving in of part of the windpipe; cancer; foreign body; trauma; abnormal development leading to the windpipe being too small
- Lung disease—pneumonia (multiple types such as viral, bacterial, fungal, allergic, aspiration); chronic bronchitis; hypersensitivity bronchial disease or asthma; long-term (chronic) dilation of bronchi or bronchioles, as a consequence of inflammation or blockage of the airway (known as “bronchiectasis”); cancer; foreign body; lung parasites (such as worms [*Filaroides* or *Aelurostrongylus*], flukes [*Paragonimus*], *Pneumocystis jirovecia*, *Toxoplasma*, ); bruising of the lungs (pulmonary contusion) or bleeding (hemorrhage) into the lungs; fluid buildup due to non-heart-related causes, so-called “non-cardiogenic edema” (examples of causes of non-cardiogenic edema: smoke inhalation, snake bite, electric shock); near drowning
- Pleural space is the space between the lungs and the chest wall; problems in the pleural space that may lead to cyanosis include the presence of free air (pneumothorax); infectious diseases (such as bacterial or fungal pleuritis and feline infectious peritonitis [FIP]) leading to the abnormal build up of fluid and/or other inflammatory materials; the presence of milky fluid known as “chyle” that is a combination of lymph fluid and fat droplets (chylothorax); the presence of blood (hemothorax); cancer; trauma
- Thoracic wall or diaphragm—abnormal developmental conditions that are present at birth (congenital conditions) such as problems involving the sac around the heart (pericardial) and/or the diaphragm in which the diaphragm is not complete and allows some of the contents of the abdomen to move into the chest or into the space between the sac surrounding the heart and the heart itself (types of diaphragmatic hernia); trauma (tearing of the diaphragm with some of the contents of the abdomen slipping into the chest [diaphragmatic hernia], fractured ribs); diseases that affect the nerves and muscles of the chest (such as tick paralysis,coonhound paralysis) that prevent normal breathing

### Cardiovascular (Heart and Circulation) System

- Congenital defects are abnormalities in the development of the heart and blood vessels that are present at birth; examples include heart defects such as right-to-left shunting patent ductus arteriosus (PDA), ventricular septal defect (VSD), atrial septal defect (ASD); tetralogy of Fallot; truncus arteriosus; double outlet right ventricle; anomalous pulmonary venous return; lack of normal opening (atresia) of the heart valves (aortic or tricuspid or pulmonary valves)
- Acquired diseases are abnormalities that occur through changes in the heart after the birth of the pet—examples include changes in the heart valve between the left atrium and left ventricle (mitral valve disease); changes in the heart muscle itself (cardiomyopathy)
- Buildup of fluid between the sac surrounding the heart (pericardium) and the heart itself is known as “pericardial effusion”—pericardial effusion may develop for unidentifiable reasons (so-called “idiopathic disease”) or secondary to cancer
- Blood clots in the lungs are known as “pulmonary thromboembolism”; diseases that may lead to these clots include Cushing's syndrome or hyperadrenocorticism in which the adrenal glands produce too much steroid; immune-mediated hemolytic anemia in which the body attacks its own red blood cells; protein-losing nephropathy in which the kidneys are unable to prevent the loss of body proteins into the urine; heartworm disease (dirofilariasis)
- Pulmonary hypertension refers to increased blood pressure involving circulation to the lungs; it may develop for unidentifiable reasons (so-called “idiopathic disease”) or from right-to-left cardiac shunts
- Abnormalities involving the arteries and veins of the body are known as “peripheral vascular disease”—examples include blood clots in the arteries (arterial thromboembolism) such as seen in cats with heart muscle disease (feline cardiomyopathies); blockages in the veins (venous obstruction); decreased amount of blood pumped by the heart (reduced cardiac output); shock, narrowing or squeezing of the arteries (arteriolar constriction)

## **Neuromusculoskeletal (Nervous and Muscle) System**

- Brainstem problems—inflammation of the brain (encephalitis); trauma to the brain; bleeding (hemorrhage) into or surrounding the brain; cancer; drug or medication-induced depression of breathing (respiratory center) of the brain
- Spinal cord problems—accumulation of excessive fluid (edema) in the spinal cord; trauma; vertebral fractures; disk prolapse
- Neuromuscular problems—overdose of drugs used to cause paralysis during surgery; tick paralysis; botulism; coonhound paralysis; abnormalities of the autonomic nervous system (dysautonomia); immune-mediated disease leading to abnormal passage of nerve impulses to the muscle (myasthenia gravis)

## **Methemoglobinemia (Abnormal Oxygen-Carrying Molecule in the Red Blood Cell)**

- Abnormal development of the hemoglobin present at birth (congenital)—NADH-MR deficiency (dogs)
- Toxicity due to eating (ingesting) certain chemicals that affect the oxygen-carrying molecule (hemoglobin) of the red blood cell—these chemicals include acetaminophen; nitrates; nitrites; phenacetin; sulfonamides; benzocaine; aniline dyes; dapsone

# **Treatment**

## **HEALTH CARE**

- Inpatient—immediate diagnostic testing and treatment
- Stabilization therapy (such as administration of oxygen, tapping the chest to remove accumulated fluid [thoracocentesis], making an opening into the windpipe [tracheostomy])—usually started immediately to improve oxygen levels in the blood and before doing diagnostic testing
- Specific therapy for cause of cyanosis—depends on the final diagnosis
- Diseases associated with cyanosis may be life-threatening

## **ACTIVITY**

- Exercise restriction may be required, based on final diagnosis

## **DIET**

- Dietary modification may be required, based on final diagnosis

## **SURGERY**

- Surgical treatment—depends on primary disease process and the extent of heart or lung involvement

# **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

- Oxygen therapy as soon as possible
- Additional treatment and medications based on underlying cause and diagnosis
- Diuretics (furosemide)—to remove fluid buildup (edema) from the lungs
- To treat methemoglobinemia caused by eating acetaminophen, a chemical that affects the oxygen-carrying molecule (hemoglobin) of the red blood cell—acetylcysteine, cimetidine, and ascorbic acid
- Phosphodiesterase type-5 inhibitor—sildenafil citrate; for high blood pressure in the lungs (known as “pulmonary arterial hypertension”)

# **Follow-Up Care**

## **PATIENT MONITORING**

- Pets in an oxygen cage should be disturbed as infrequently as possible for monitoring
- Assess response to in-hospital treatment—changes in depth and rate of breathing; color of moist tissues of mouth (mucous membranes) should return to a normal pink color if the cause is not a right-to-left shunt and if the pet has adequate reserves; measurement of oxygen levels in the blood (pulse oximetry or arterial blood analysis)

- Following discharge, the client should continue to monitor color of moist tissues of the mouth (mucous membrane) and breathing rate and effort and should seek immediate veterinary care if cyanotic condition returns

## **POSSIBLE COMPLICATIONS**

- Obesity or fluid buildup in the abdomen (known as “ascites”)—may complicate or exacerbate underlying respiratory or cardiac diseases
- Advanced pregnancy may exacerbate signs because of pressure on the diaphragm and reduced lung expansion
- Fetuses are likely to be harmed or aborted by the low oxygen levels of the blood (hypoxemia) associated with cyanosis

## **EXPECTED COURSE AND PROGNOSIS**

- Depends on final diagnosis
- Advanced lung or airway disease and severe heart disease—poor long-term outlook (prognosis)

## **Key Points**

- Cyanosis or a bluish discoloration of the skin and moist tissues (mucous membranes) of the body is caused by inadequate oxygen levels in the red blood cells
- Cyanosis is a sign of a potentially life-threatening condition
- Seek immediate veterinary care

## **Notes**

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