INCREASED NUMBER OF RED-BLOOD CELLS (POLYCYTHEMIA)

BASICS

OVERVIEW

- Blood consists of red-blood cells (the most numerous cells normally), white-blood cells, platelets, and plasma (the liquid portion of blood); each of the blood cells and platelets have ranges for the number of cells or platelets that have been established as being "normal;" in the case of red-blood cells, if the red-blood cell count is lower than the normal limit for the low end of the range, the animal has "anemia" and if the red-blood cell count is higher than the normal limit for the high end of the range, the animal has "polycythemia"
- Polycythemia is caused by an increase in packed cell volume ("PCV," a means of measuring the percentage volume of red-blood cells as compared to the fluid volume of blood); hemoglobin concentration (hemoglobin is the compound in the red-blood cells that carries oxygen to the tissues of the body); and red-blood cell (RBC) count above the normal ranges
- Polycythemia is classified as "relative," "transient," or "absolute"
- Relative polycythemia—develops when a decrease in the liquid portion of the blood (plasma volume) produces a high packed-cell volume (PCV), caused by the cellular portion of the blood being a high percentage of the blood volume as compared to the fluid portion and a "relative" increase in circulating red-blood cells; usually caused by dehydration
- Transient polycythemia—caused by contraction of the spleen, which puts extra red-blood cells into the circulation; this response of the spleen is usually momentary and is a response to stress or release of epinephrine, thus the name "transient polycythemia"
- Absolute polycythemia—characterized by a "true" or "absolute" increase in the number of circulating red-blood cells as a result of an increase in bone-marrow production; either primary or secondary to an increase in the production of erythropoietin (the hormone that stimulates the bone marrow to produce red-blood cells)
- Primary absolute polycythemia (known as "polycythemia rubra vera")—a bone-marrow disorder characterized by the uncontrolled, but orderly production of an excessive number of mature red-blood cells
- Secondary absolute polycythemia—caused by the appropriate release of erythropoietin (the hormone that stimulates the bone marrow to produce red-blood cells) resulting from long-term (chronic) low levels of oxygen in the blood (known as "hypoxemia") or by an inappropriate and excessive production of erythropoietin or an erythropoietin-like substance in an animal with normal oxygen levels in the blood

SIGNALMENT/DESCRIPTION of ANIMAL

Species

- Dogs and cats

Breed Predilections

- Short-nosed, flat-faced (known as "brachycephalic") breeds normally have higher packed cell volumes (PCVs) than do breeds with longer noses
- Large, excitable breeds are prone to contraction of the spleen, and thus to transient polycythemia, where the spleen puts extra red-blood cells into the circulation
- Greyhounds typically have high packed cell volumes (PCVs) as compared to other breeds; normal range for the breed is 50% to 65%

SIGNS/OBSERVED CHANGES in the ANIMAL

- Vary with the degree of increased number of red-blood cells (polycythemia)
- Relative polycythemia—dehydration (caused by vomiting, diarrhea, or lack of water intake) and production of only small amounts of urine (known as "oliguria")
- Transient polycythemia—excitement or vigorous exercise
- Absolute polycythemia—sluggishness (lethargy); lack of appetite (known as "anorexia"); bleeding from the nose and nasal passages (known as "epistaxis" or a "nosebleed"); low exercise tolerance; behavioral change; brick-red or bluish moist tissues (known as "mucous membranes") of the body caused by inadequate oxygen levels in the red-blood cells (bluish discoloration known as "cyanosis"); sneezing; seizures; or stunted growth
- Primary absolute polycythemia (polycythemia rubra vera)—variable degrees of enlargement of the spleen (known as "splenomegaly") and of the liver (known as "hepatomegaly"), blood clots (known as "thrombosis"), and bleeding; occasional seizures
- Secondary absolute polycythemia caused by low levels of oxygen in the body tissues (known as "hypoxia")—signs of long-term (chronic) lung disease or heart disease
- Secondary absolute polycythemia caused by inappropriate erythropoietin secretion—signs associated with cancer or either a kidney or hormonal disorder

CAUSES

• Relative polycythemia (common)—vomiting, diarrhea, diminished water intake, excessive urine production (known as "diuresis"), kidney disease, hyperventilation
• Transient polycythemia—excitement, anxiety, seizures, and restraint
• Primary absolute polycythemia (polycythemia rubra vera)—rare, bone-marrow disorder
• Secondary absolute polycythemia caused by low levels of oxygen in the body tissues (hypoxia)—long-term (chronic) lung disease; heart disease; living at high altitude; short-nosed, flat-faced (brachycephalic) breed conformation; and impairment of kidney blood supply
• Secondary absolute polycythemia caused by inappropriate erythropoietin secretion (rare)—kidney disorder (such as a cyst or tumor); excessive production of steroids by the adrenal glands (known as "hyperadrenocorticism" or "Cushing's disease"); excessive production of thyroid hormone (known as "hyperthyroidism"); cancer

TREATMENT

HEALTH CARE

• Depends on type of polycythemia
• Relative polycythemia—rehydration with intravenous (IV) fluids
• Absolute polycythemia—phlebotomy (procedure in which blood is removed from the body via a vein) recommended to reduce the number of circulating red-blood cells to a packed-cell volume (PCV) of 55%; the amount of blood removed should be replaced with intravenous (IV) fluids to prevent the development of low blood pressure (known as "hypotension"), heart and circulatory collapse (known as "cardiovascular collapse"), and blood clots (thrombosis)
• Primary absolute polycythemia (polycythemia rubra vera)—phlebotomy (procedure in which blood is removed from the body via a vein) and hydroxyurea; frequency of bleeding and medication dosage adjusted to maintain a packed cell volume (PCV) of 55% in dogs and 45% in cats
• Secondary absolute polycythemia caused by low levels of oxygen in the body tissues (hypoxia)—phlebotomy (procedure in which blood is removed from the body via a vein) and hydroxyurea; the high packed cell volume (PCV) is an appropriate compensatory response to the low levels of oxygen by the body; thus phlebotomy may be dangerous; if indicated, remove blood at a slower rate; a higher PCV (60% to 65%) may be necessary to sustain life until the cause of low levels of oxygen in the blood (hypoxemia) is identified and can be corrected
• Secondary absolute polycythemia caused by inappropriate erythropoietin secretion—phlebotomy (procedure in which blood is removed from the body via a vein) and removal of the source of erythropoietin

ACTIVITY

• Depends on type and severity of the polycythemia

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.

• Primary absolute polycythemia (polycythemia rubra vera)—hydroxyurea; also may use chlorambucil or busulfan
• Secondary absolute polycythemia caused by low levels of oxygen in the body tissues (hypoxia)—hydroxyurea

FOLLOW-UP CARE

PATIENT MONITORING

• In severely dehydrated animals, packed cell volume (PCV); total plasma protein (a quick laboratory test that provides general information on the level of protein in the fluid portion of the blood); urine output; and body weight are monitored 2 to 3 times daily until normal hydration is maintained
• Patients being treated for primary absolute polycythemia (polycythemia rubra vera) by chemotherapy—monitor weekly for changes in packed cell volume (PCV), white-blood cell counts, and platelet counts during the initial treatment; then monthly for adjustment of chemotherapy and periodic phlebotomy (procedure in which blood is removed from the body via a vein)

POSSIBLE COMPLICATIONS

• Increased red-blood cells in the blood leading to sludging of the blood (known as "hyperviscosity") may occur in patients with absolute polycythemia, especially primary absolute polycythemia (polycythemia rubra vera); hyperviscosity may lead to blood clots (thrombosis), sudden lack of blood supply that leads to death of tissues (known as "infarction"), or bleeding
• Chemotherapy may cause bone-marrow suppression, leading to low red-blood cell and low white-blood cell counts
• Adverse effects of hydroxyurea include loss of cells in the bone marrow (known as "bone-marrow hypoplasia") with resulting low platelet count (known as "thrombocytopenia") and low neutrophil count (a neutrophil is a type of white-blood cell; condition is known as "neutropenia"); hair loss (known as "alopecia"); changes in skin pigmentation; and sloughing of toe nails; hydroxyurea also may decrease or stop the production of sperm

EXPECTED COURSE AND PROGNOSIS

- Prognosis in primary absolute polycythemia (polycythemia rubra vera) is guarded, but is influenced by the animal's response to chemotherapy and phlebotomy (procedure in which blood is removed from the body via a vein)
- Secondary absolute polycythemia caused by low levels of oxygen in the body tissues (hypoxia) depends upon the cause of the low levels of oxygen
- Prognosis in secondary absolute polycythemia caused by inappropriate erythropoietin secretion is determined by identification and elimination of the source of erythropoietin

KEY POINTS

- Identification of the cause or mechanisms responsible for the increase in the number of circulating red-blood cells is the major focus in the clinical diagnosis and treatment of polycythemia
- Polycythemia is caused by an increase in packed cell volume ("PCV," a means of measuring the percentage volume of red-blood cells as compared to the fluid volume of blood); hemoglobin concentration (hemoglobin is the compound in the red-blood cells that carries oxygen to the tissues of the body); and red-blood cell (RBC) count above the normal ranges
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