Diagnostic algorithm of coagulation disorders

InCoag
Automated Coagulation Analyzer

Basic database:
Medical history, physical examination,complete blood count, serum biochemical tests, urinalysis. Combined with clinical symptoms.

Primary hemostatic defects:
Superficial bleeding, including petechia, ecchymosis, hyphema, mucosal surface bleeding (such as Melena, hematochezia, Epistaxis, hematuria), and prolonged bleeding after venipuncture

Secondary hemostatic defects:
Deep bleeding, including blood flow into the body cavity and joints, deep hematomas, spontaneous bleeding (immediate or delayed) and normal platelet count

Platelet count

PLT ↓

Decrease
＜30×10^9/L

N

Y

Thrombocytopenia could cause forbleeding
-Identify the cause of the thrombocytopenia

Pruduction

Bone marrow examination
Infectious disease tests
Breed preference

-Invasive disease:
Leukemia
Non-leukemic tumors
Osteomyelodysplasia
Myelofibrosis
-Drug ingestion
-Endocrine disease
-Inherited deficiency

Destruction or Consumption

-Infectious disease tests:
Medication history or History 0f blood transfusion
-Imaging
-Coagulation test
-The spleen or lymph node cytology or Histopathological examination
-Antiplatelet antibodies, antinuclear antibodies

-Immune-mediated destruction:
Primary immunity: Autoimmunity, alloimmunity (after blood transfusion)
Secondary immunity: infection, drug induction

-Infection:
Tick-borne disease
Virus
Bacterial or fungal septicemia

-Activation/Sequestration:
DIC
Splenomegaly:
Tumor,inflammation, congestion

Dilution

Massive transfusion
Massive dosage infusion

PLT N

Coagulation test

Abnormal

aPTT ↑

Intrinsic pathway disease

-Intrinsic factor defects: FVII, FIX;
-Contact Factor Deficiencies: FXI, FXII, Prekallikrein, HMW Kininogen

-Acquired:
Liver failure
Vitamin K deficiency/antagonism
-Hereditary:
Hemophilia A(VIII)
Hemophilia B(IX)
Hemophilia C(XI)
-vWD

DIC tests[3]
CBC, chemistry
Imaging etc

Negative
Inherited?
Measurespecific[4]

PT ↑

Extrinsic pathway disease

Factor VII deficiency

-Acquired factor Ⅶ deficiency
Early or mild vitamin K deficiency
Anticoagulant therapy
Cholestasis
Liver failure
Rodenticide intoxication
Attrition clotting disorders

DIC tests[3]
CBC, chemistry
Imaging etc

Negative
Trial vitamin K1 therapy or test for anticoagulant rodenticides

No response?
Inherited?
Measure specific[4]

TT ↑ FIB ↓

Fibrinogen disease

Mild to moderate fibrinogen deficiency;
Dysfibrinogenemia

Inhibitors, such as heparin
Excessive concentrations of circulating fibrin (fibrinogen) degradation products

aPTT ↑ PT ↑

TT N
FIB N

Vitamin K:
deficiency or antagomsm

TT ↑
FIB ↑

Severe liver failure
DIC

Normal

Test for vWD[1]
particularly if relevant breed
vWF: Ag prefered

Normal or mild decrease

Perform BMBT thrombopathia[2]

<30%

likely vWD

PLT ↑

Primary thrombocythemia

Bone marrow examination

Myeloproliferative defects
-Polycythemia
-Myeloid leukemia
-Myelodysplastic syndrome

Reactive thrombocythemia

Bone marrow examination
(including iron staining)
Imaging
Pathogen detection

-ChroniC hemorrhagic anemia:
Gastrointestinal diseases
Urinary tract diseases
Internal/external parasites

-Inflammatory diseases:
Infectious agent
Noninfectious inflammation
Tissue necrosis

Neoplasm

1. Genetic testing for vWD can be done in those breeds for which a genetic test is available, however the genetic test does not necessarily correlate to clinical signs.
2. Thrombopathia (decreased platelet function) is uncommon as a cause of hemorrhage, but can be inherited or secondary to drugs (e.g. aspirin, non-steroidal anti-inflammatory drugs), disease (uremia, liver disease, DIC). A complete medical history, including drug administration or exposure to toxins, is imperative in bleeding animals.
3. Perform additional assays for DIC testing as required, e.g. fibrinogen concentration, FDP/D-dimer concentration, AT activity. Note: If there is a high clinical suspicion of DIC (sick animal with underlying predisposing disease, e.g. bacterial sepsis, cancer, severe inflammation, immune-mediated hemolytic anaemia), consider concurrent DIC panel and platelet count (versus sequential testing as illustrated). Furthermore, in areas where Angiostrongylus vasorum is a problem, testing for this worm that resides in the heart and pulmonary arteries (PCR, ELISA, fecal flotation) is advisable and empirical treatment may be worthwhile.
4. Measurement of FVIIa activity is being used by some clinicians as a marker of vitamin K deficiency, in preference to the PIVKA (proteins induced by vitamin K absence or antagonism) test. Note: Vitamin K deficiency can be due to toxicosis, fat malabsorptive disorders, or liver disease (e.g. cholestatic disorders).

Adapted from Textbook of Veterinary Internal Medicine: Disease of the dog and the cat , 8th & Brooks M B, Catalfamo J L. Current diagnostic trends in coagulation disorders among dogs and cats[J]. Vet Clin North Am Small Anim Pract, 2013,43(6):1349-1372.