Animal Sounds
Mobile Veterinary Ultrasound

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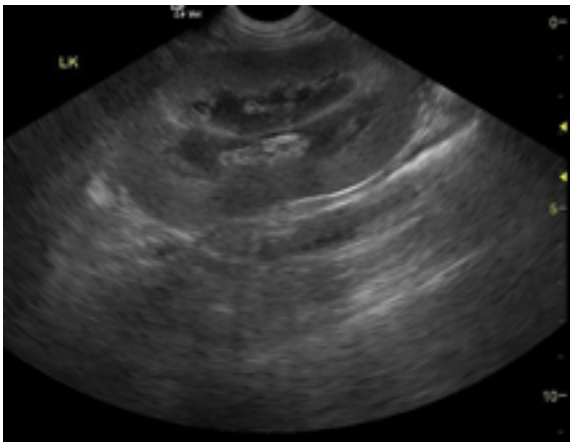
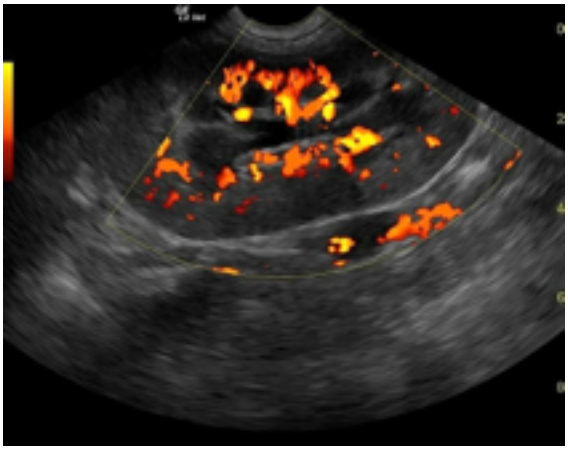
**DECEMBER 2014**

# THE ENZYME CHASE

## PART 1 OF 2: FROM SERUM TOTAL PROTEIN - SERUM BILE ACIDS





Key Small Animal Enzymes and How they Impact Your Patient; The order of potential causes of increased or decreased values for any parameter are formulated based on the frequency of a disease process diagnosed or suspected based on sonographic presentations.

**Serum Total Protein:** Normal limitis (g/dl) (Willard) Canine (5.5-7.5), Feline (5.5-7.8)
Subdivided in Albumin and Globulin

**Serum Albumin:** Normal limitis (g/dl) (Willard) Canine ( 2.4-4.0) Feline (2.5-4.0)

Increased: Dehydration, lab error

Decreased:
Albumin + Globulin = Protein losing enteropathy (PLE), Addison's disease, hemorrhage, dilution, exudative skin lesions.

Albumin alone = Hepatic insufficiency (severe and chronic liver disease)(cullen 414 in mcGavin), Protein Losing Nephropathy (PLN), inadequate intake/assimilation. Assess liver structure, enzymes and bile acid profile and presence of proteinuria respectively.

Albumin + cholesterol = Hepatic insufficiency (severe and chronic disease) or PLE

Albumin + increased cholesterol = PLN

Note: Clear transudate effusions (ascetic fluid) caused by decreased serum albumin (poor oncotic pressure) necessitate levels near or below 1.5 g/dl typically. If effusion is present and albumin is higher than 1.5 g/dl hydrostatic causes (lymphatic strangulation, portal hypertension, passive congestion) should be investigated.

**Serum Globulin:** Normal limitis (g/dl) (Willard)  Canine ( 3.0-3.5) Feline (3.0-3.8)

Increased:  polyclonal (infection, immune mediated disease, neoplasia) or monoclonal disease (ehrlichia, leishmania, idiopathic, neoplasia, amyloidosis)

**Alkaline Phosphatase (SAP):** SAP is an aspecific brush border enzyme in the biliary tree. Present also in other organs such as kidney, intestine, bone and placenta (ettinger 1282). Reflects congestion of the biliary system. Elevations in cats is more specific for clinical disease than in dogs. SAP rise in dogs may occur in low grade benign states as well as aggressive disease states. The practitioner should show particular concern when rapid elevations occur with this enzyme after serial evaluations 1-2 weeks apart.

Increased:

Dogs: Vacuolar hepatopathy (drugs toxins, hormonal influence, toxins and other aspecific causes, breed predisposition), Reactive hepatopathy to other organ disease in the portal system, Post hepatic biliary disease (GB, CBD obstructions, pancreatitis), inflammatory and non inflammatory parenchymal disease, passive congestion (thoracic disease affective vena caval flow). Note: The most dramatic SAP elevations occur in scaling order: Biliary stasis, chronic hepatitis, vacuolar hepatopathy, hepatic necrosis (ettinger 1282).

Cats: Inflammatory and non inflammatory parenhcymal disease, Posthepatic biliary disease (GB, CBD obstructions, pancreatitis), lymphoma, endocrinopathy.

**Gamma Glutamyl Transpeptidase (GGT):** GGT is a liver specific enzyme for biliary disease. Reflects congestion of the biliary system. More specific in cats exceopt for lipidosis. Increased clinical significance if elevated with SAP.

Increased: Same as SAP

**Alanine Transferase (ALT/SGPT):** ALT is a specific liver enzyme derived from cytosol so leakage indicates hepatocyte membrane damage. Degree of elevation is not paralelled with degree of disease state. Cytotoxic injury causes elevationwithin 24-48 hours (ettinger 1279), peak by day 5 and normalize if insult resolved over 2-3 weeks.

Increased:

Dogs: Acute or chronic inflammatory disease, reactive hepatopathy, cirrhosis, pancreatitis, neoplasia, hypoxia, toxin, drugs, trauma, hemolysis.

Cats: Acute or chronic inflammatory disease, reactive hepatopathy, pancreatitis, hypoxia lymphoma, toxin, drugs, trauma, hemolysis.

**Aspartate Transferase (AST/SGOT):** AST is an aspecific liver enzyme also increases with intramuscular injections. If AST is much higher than ALT then a muscle source should be investigated (ettinger 1279). ST lies in mitochondrian of hepatocyte and hence reflects more serious damage to the cell.

Increased: Disruptive hepatic parenchymal disease, muscle disease, hemolysis.

**Total Serum Bilirubin:** Bilirubin is an excretory body waste product produced in the liver and excreted into the common bile duct (CBD) and/or stored in the gall bladder (GB) that contracts in the prandial state passing bile from the GB to the CBD via the cystic duct (CD). From the CBD the bile passes into the duodenum through the duodenal papilla, congiugated to urobilirubin by bacteria assisting with digestion of fat, partially absorbed by the ileum reentering into portal circulation. The remainder and eliminated through the gastrointestinal tract in the form of stercobiliurubin.

Increased: (visible icterus if > 2 mg/dl McGavin):

Prehehaptic: Hemolysis (infectious, autoimmune, toxic, paraneoplastic). Assess CBD for anemia.

Hepatic: Parenchymal liver disease (infectious-Leptospirosis, inflammatory, neoplasia-lymphoma). Assess liver enzyme profile for hepatic disease + ultrasound and sampling of hepatic parenchyma.

Post hepatic: Biliary obstruction (GB mucocele, CBD plug, calculi, or neoplasia, pacreatic and duodenal disease obstruction the duodenal papilla/CBD). Assess liver enzyme profile for hepatic disease + ultrasound of biliary tree and common bile duct.

**Serum Bile acids:** SBA circulate in the enterohepatic system produced in the liver and absorbed in the ileum. Alterations in any step of this enterohepatic cycle may cause elevations in serum bile acids so they are not hepatic specific. This is not an indicated test if hyperbilirubinemia is already present. For more information see Bile Acids chapter.

Increased: Hepatocellular disease, biliary disease, portal vein hypoplasia(microvascular dysplasia), portosystemic shunting, drug therapy (ursodiol), resection or disease of the ileum, spontaneous GB contraction, gastric emptying variabilities, idiopathic, breed variation (Maltese) (ettinger 1289), inadequate fat and amino acid content in test meal.

*Part 2 continued in January 2015…*

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