USE OF VISCOELASTIC COAGULATION TESTING IN MEGACHIROPTERA REVEALS HIGH VARIABILITY IN CLOT KINETICS

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Abstract

Megachiroptera is a mammalian suborder that includes old world fruit bats and flying foxes. Common diseases among captive megachiroptera include liver disease, (e.g., iron storage disease), kidney disease (e.g., protein-losing nephropathy), and heart disease (e.g., dilated cardiomyopathy).[4-6,8] These conditions can be significantly affected by or directly affect coagulation.[7,11,12] A large number of geriatric megachiroptera in captivity have osteoarthritis that is treated with long-term nonsteroidal anti-inflammatory drugs (NSAIDs). Studies in humans and dogs have shown that NSAIDs negatively affect clot formation and strength.[2,3,9] Hemostatic variables were evaluated in captive large flying foxes (*Pteropus vampyrus*) (n=20) and variable flying foxes (*Pteropus hypomelanus*) (n=10) using point-of-care viscoelastography,[a] as well as platelet counts, prothrombin time [PT], and partial thromboplastin time [PTT].[1,10] The results showed marked variability among both clinically normal and NSAID treated populations. Viscoelastic variables, platelet count, and clotting times from the control group were compared to an age and sex-matched population of bats treated with NSAIDs for underlying osteoarthritis or allergic dermatitis. No significant differences were noted in hemostatic variables between treated and untreated groups. The results from this study indicate that clot kinetics vary widely amongst megachiropterans and it is recommended that clinicians establish subject-based reference intervals for individual bats to detect early changes in hemostasis during injury or disease.

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Objectives

1. Establish reference intervals for viscoelastic parameter values in healthy bats
2. Examine the correlation between viscoelastic parameter values and clotting times or platelet counts
3. Compare viscoelastic parameter values amongst species, age class and sex
4. Compare viscoelastic parameter values between healthy untreated bats and bats treated with NSAIDs

Materials and Methods

Animals: 30 individuals, 2 species, aged 6-32, both sexes included

Clotting tests evaluated: Viscoelastography (Entegrion VCM Vet), clotting times (PT, PTT), platelet count

Blood collected from 15 healthy bats and 15 bats treated with anti-inflammatories (meloxicam or aspirin) for clotting tests

Objective 1 + 4: Viscoelastic parameter values were calculated and reported as mean ± standard deviation and median (first, third quartiles). Data for the variables of AA and PTT were not normally distributed.

Objective 2: The correlation between viscoelastic parameter values and clotting times or platelet counts was examined by constructing scatter diagrams and using simple regression analysis.

Objective 3: Among non-treated bats, the distributions for viscoelastic parameter values were compared by species (Hypo, Vamp), sex (male, female), and age-class (6-16 years-old, 20-32 years-old) by using the Student T Test or the non-parametric Wilcoxon Rank Sum Test. Values of $p < 0.05$ were considered statistically significant.

By Andrea Janda [CC BY-NC-ND 2.0], Malayan Flying Fox (closeup), from Flickr

Figure 1: An adult *Pteropus vampyrus* or Malayan Flying fox

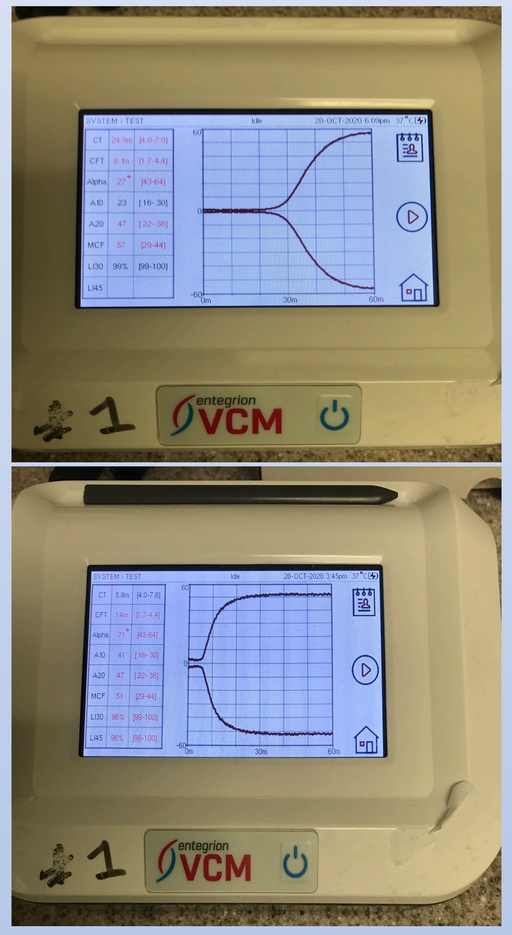

Figure 2: Examples of VCM tracings of bats showing wide variety in clotting kinetics

Results

1. Large variability in all viscoelastic parameter values noted in healthy bats.
2. No correlation between viscoelastic parameter values and clotting times or platelet counts
3. CT and PTT values were higher ($P \leq 0.05$) in *P. vampyrus*, compared to *P. hypomelanus*, and PT values were higher ($p = 0.02$) in *P. hypomelanus*, compared to *P. vampyrus*. Viscoelastic values were not different ($p \geq 0.01$) between males and females or between age age-class groups (≥ 0.06).
4. Comparisons of viscoelastic parameters between healthy bats with NSAID-medicated bats were not statistically significant.

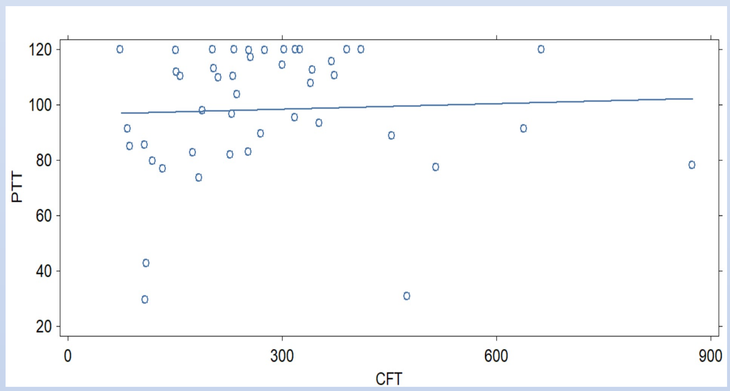

Figure 4 Correlation between CFT and PTT (R = 0.04)

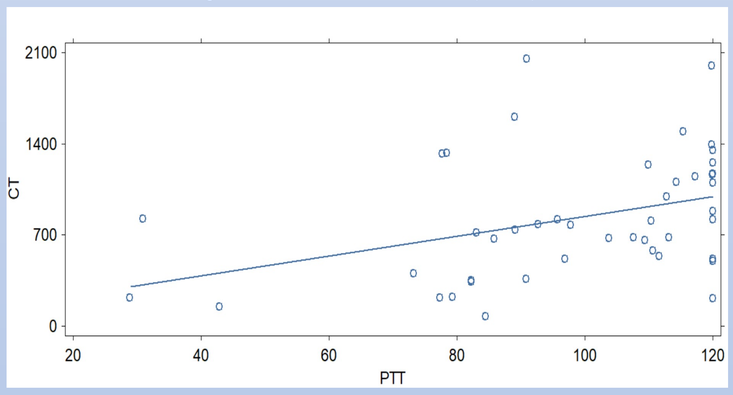

Figure 5: Correlation between PPT and CT (R = 0.37)

Parameters

List of VCM parameters and description

Parameter	Unit of measurement	Parameter description
CT(Clot Time)	Seconds (s)/ Minutes (m)	The clot time is the time from the beginning of the test until the time when an amplitude of 1% above the baseline is achieved.
CFT (Clot Formation Time)	Seconds (s)/ Minutes (m)	The clot formation time is the time between 1% amplitude and 10% amplitude of the clotting signal.
Alpha (Alpha-Angle)	Degrees (°)	The alpha angle is defined as the angle between the time axis and the tangent to the clotting curve through the 1% amplitude point. It describes the kinetic of clotting.
MCF (Maximum Clot Formation)	VCM Units	The Maximum Clot Formation is the measure of the firmness of the clot and therefore the clot quality. It is the maximum amplitude that is reached before the clot is dissolved by fibrinolysis and the clot firmness falls again.
A10 & A20 (Amplitude at 10 and 20 mins)	VCM Units	The A10 and A20 represent the clot firmness. The A10 and A20 are the amplitude at 10 minutes and 20 minutes after clot time.
LI30 & LI45 (Lysis index at 30 and 45 mins)	%	The LI30 and LI45 are the amplitude of the clot at 30 and 45 minutes after clot time as a percentage of the MCF.

The VCM trace

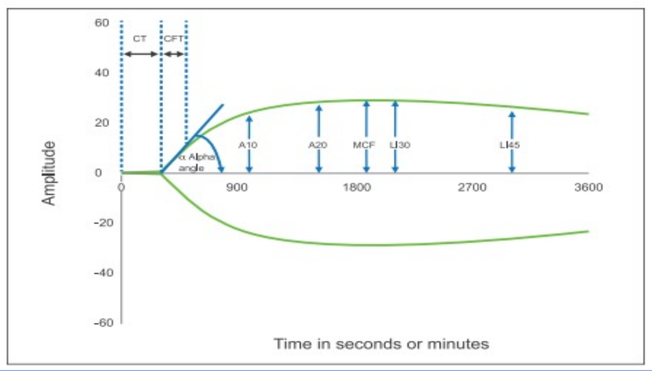

Figure 3: List of VCM parameters and descriptions

Conclusions

Species specific reference ranges should be used when evaluating coagulation in megachiroptera due to significant differences in viscoelastic values (CT) and clotting times (PT, PTT) between megachiropteran species.

Due to the high individual variability seen in viscoelastic values amongst bats the authors recommend that individual reference ranges for viscoelastography should be established to detect early changes in coagulation.

There is poor correlation between clotting tests, therefore, when evaluating hemostasis in bats the authors recommend including viscoelastography, clotting times and platelet count as part of the diagnostic work up.

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