ISIS NORMAL VALUES FOR TIGERS (*Panthera tigris*): ARE THEY BETTER THAN DOMESTIC CAT REFERENCE INTERVALS?

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Abstract

ISIS clinical pathology data are commonly used by zoo clinicians in interpreting their patients' clinical pathology values. However, ISIS values have several potential sources of error, including: multiple reports from some individual animals; possible inclusion of values from individuals with subclinical disease(s); no exclusion of outlying values; and inclusion of analyses performed at multiple laboratories, using multiple analytical techniques. Additionally, ISIS values are described by parametric methods (means and standard deviations); however, data were not determined to be normally distributed. A robust, accepted technique for determining clinical pathology reference intervals was applied to tiger (*Panthera tigris*) blood samples (n = 42) evaluated at The University of Tennessee's College of Veterinary Medicine's Clinical Pathology Laboratory, and in-house tiger reference intervals calculated (Tables 1 & 2).[1] These were compared to two sets of intervals calculated from ISIS data (ISIS #1 intervals = mean ± 1 standard deviation; ISIS #2 intervals = mean ± 2 standard deviations) and to in-house domestic cat reference intervals in an effort to determine which set most accurately reflected tiger reference intervals.[2] Very few clinically important differences were identified amongst the four sets of intervals. Of the 18 clinical chemistry analytes evaluated, 10 domestic cat reference intervals were the closest fit to tiger intervals, more than either ISIS #1 or ISIS #2 intervals. Hematology values were also not more closely associated with ISIS intervals than with the domestic cat intervals. These data suggest domestic cat reference intervals are as useful for interpreting tiger clinical pathology as ISIS data.

LITERATURE CITED

1. Geffre´, A., D. Concordet, J. P. Braun, and C.Trumel. 2011. Reference Value Advisor: a new freeware set of macroinstructions to calculate reference intervals with Microsoft Excel. Vet. Clin. Pathol. 40: 107–112.
2. ISIS, MedARKS, In-house reference values, Apple Valley, MN.

Table 1. Tiger and domestic cat hematological reference intervals (RI) derived from ISIS data[1] and determined by the University of Tennessee's College of Veterinary Medicine's (UTCVM) Clinical Pathology Laboratory. Reference intervals with asterisk were deemed most similar to UTCVM tiger reference intervals.

Analyte (units)	ISIS #1 RI (mean ± 1 SD)	ISIS #2 RI (mean ± 2 SD)	UTCVM Tiger RI	UTCVM Domestic cat RI
White blood cells ($x10^3$/uL)	8.2 - 15.3	4.7 - 18.9*	5.1 - 21.1	4.7 - 15.3
Red blood cells ($x10^6$/uL)	5.7 - 7.6	4.7 - 8.6*	5.6 - 8.8	7.5 - 11.7
Hemoglobin (g/dL)	11.0 - 14.8	9.1 - 16.7	11.2 - 16.4	11.5 - 15.9*
Hematocrit (%)	33.3 - 44.1	27.9 - 49.5	31.8 - 49.2	34 - 48*
Mean cell volume (fL)	53.3 - 64.3*	47.8 - 69.8	50.7 - 62.7	36 - 46
Mean cell hemoglobin (Hb) (pg)	18.0 - 21.4	16.3 - 23.1*	8.5 - 32.0	12.5 - 16.4
Mean cell Hb conc. (g/dL)	30.8 - 36.2	28.1 - 38.9	31.3 - 37.1	32.2 - 36.8*
Total plasma protein (g/dL)	6.5 - 7.7	5.9 - 8.3	6.7 - 9.0	6.5 - 8.6*
Neutrophils ($x10^3$/uL)	4.5 - 11.7	0.9 - 15.2	2.0 - 21.0	2 - 9.2*
Bands ($x10^3$/uL)	0.0 - 2.6*	0.0 - 4.0	0.0 - 1.7	na[a]
Lymphocytes ($x10^3$/uL)	0.5 - 2.8 *	0.0 - 4.0	0.0 - 2.8	1.05 - 8
Monocytes ($x10^3$/uL)	0.1 - 0.6	0.0 - 0.9*	0.0 - 0.9	0.1 - 0.3
Eosinophils ($x10^3$/uL)	0.0 - 0.5	0.0 - 0.7	0.0 - 1.1	0.2 - 1.1*
Basophils ($x10^3$/uL)	0.0 - 0.1	0.0 - 0.2*	0.0 - 0.2	Rare
Platelet count ($x10^3$/uL)	134 - 400*	1 - 533	105 - 433	169 - 480

[a]Not available.

Table 2. Tiger and domestic feline clinical chemistry reference intervals (RI) derived from ISIS data[1] and determined by the University of Tennessee's College of Veterinary Medicine's (UTCVM) Clinical Pathology Laboratory. Reference intervals with asterisk were deemed most similar to UTCVM tiger reference intervals.

Analyte (units)	ISIS #1 RI (mean ± 1 SD)	ISIS #2 RI (mean ± 2 SD)	UTCVM Tiger RI	UTCVM Domestic cat RI
Blood urea nitrogen (mg/dL)	20 - 34*	13 - 41	19 - 34	19 - 39
Creatinine (mg/dL)	1.9 - 3.7	1.0 - 4.6	0.8 - 2.2	0.9 - 2.0*
Total protein (g/dL)	6.5 - 7.7	5.9 - 8.3	6.6 - 8.8	6.7 - 8.3*
Albumin (g/dL)	3.3 - 4.1	2.9 - 4.5*	2.9 - 4.3	2.9 - 4.0
Globulin	2.8 - 4.0	2.2 - 4.6	2.8 - 5.3	2.8 - 4.8*
Glucose (mg/dL)	90 - 178	46 - 222*	31 - 213	88 - 183
Calcium (mg/dL)	9.4 - 10.8*	8.7 - 11.5	9.4 - 11.8	9.5 - 11.2
Phosphorus (mg/dL)	4.5 - 6.9	3.3 - 8.1	2.1 - 5.7	2.2 - 5.5 *
Alkaline phosphatase (U/L)	0 - 74	0 - 111	3 - 57	13 - 71*
Alanine aminotransferase (U/L)	26 - 94*	0 - 128	18.8 - 98.7	32 - 110
Aspartate aminotransferase (U/L)	12 - 44*	0 - 60	14.5 - 43.0	12 - 50
Sodium (mEq/L)	146 - 154	142 - 158	151 - 159	148 - 155*
Potassium (mEq/L)	3.8 - 4.6	3.4 - 5.0	3.0 - 4.5	2.8 - 4.8*
Chloride (mEq/L)	116 - 124	112 - 128	113 - 123	113 - 123*
Bicarbonate (mEq/L)	13.1 - 18.1*	10.6 - 20.6	13.1 - 20.8	11 - 19
Anion gap (mEq/L)	13.3 - 18.9	10.5 - 21.7	16.4 - 27.3	17 - 25*
Total bilirubin (mg/dL)	0 - 0.4*	0 - 0.6	0.0 - 0.4	0.1 - 0.6
Creatine kinase (U/L)	0 - 646	0 - 989*	0 - 1043	69 - 893
Cholesterol (mg/dL)	177 - 289	121 - 345	54 - 263	77 - 253*