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Short communication

Winter blood values of selected parameters in a group of non-hibernating captive brown bears (*Ursus arctos*)

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Abstract

Bears undergo some significant changes reflected in blood values during winter season. The most significant are reduced urea and increased creatinine, by some authors considered to be physiological indicators of hibernation. Studied group of six captive brown bears (*Ursus arctos*) showed decreased activity in winter but were accepting food and walked outdoors. Blood parameters assessed in February 2011 revealed mean values of leucocytes and neutrophils as significantly lower, and creatinine significantly increased compared to captive and free living bears sampled during other seasons when bears are active.

Key words: urea:creatinine ratio, brown bear, hibernation, semi-hibernation, captivity

Introduction

As hibernators, bears undergo some significant changes reflected by blood values during the winter season (Hellgren 1998, Fröbert et al. 2010). Metabolism is slowed down, which is reflected by lower body temperature and decreased heart and respiration rate, as well as by hematological and biochemical serum values. The most significant changes are reduced urea and increased creatinine, by some authors considered to be biological indicators of bear hibernation (Nelson et al. 1984).

Captive bears usually do not hibernate. To describe their behaviour observed during winter the term „semi-hibernation" has been used (Partridge 1992). Our goal was to determine if winter affected blood parameters of the group of captive brown bears that were not obviously hibernating, but were daily fed and released outdoors.

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Table 1. The means and standard deviations of hematological and biochemical parameters of examined brown bears (N=6) in Braniewo Zoo (Poland).

Parameter	Unit	Mean	SD	Min	Max
Red blood cells	T/l	7.13	0.66	6.34	8.00
Hemoglobin	g/l	177.29	16.13	157.00	197.00
Hematocrit	l/l	0.50	0.05	0.43	0.56
White blood cells	G/l	6.74	1.58	4.82	8.93
Neutrophils	G/l	5.33	1.65	3.64	7.65
Lymphocytes	G/l	1.12	0.31	0.77	1.47
Eosinophils	G/l	0.03	0.04	0.00	0.09
Basophils	G/l	0.01	0.01	0.01	0.02
Monocytes	G/l	0.36	0.10	0.24	0.49
MCV	l/cell	70.63	3.17	64.80	73.50
MCH	g/cell	25.04	0.97	23.40	26.10
MCHC	G/l	355.71	4.39	350.00	361.00
Plate	T/l	388.94	282.63	46.60	766.00
Total protein	G/l	82.02	3.87	77.60	88.70
Albumins	G/l	41.13	7.18	27.00	47.60
Creatinine	μmol/l	207.83	54.02	138.70	278.80
Urea	mmol/l	3.54	0.60	2.78	4.44
Bilirubin	mmol/l	1.32	0.41	0.69	1.67
Cholesterol	mmol/l	6.81	1.47	5.61	9.28
Trigliceride	mmol/l	3.19	1.43	1.85	5.43
Potassium	mmol/l	4.31	0.18	4.11	4.50
Sodium	mmol/l	123.17	2.02	120.20	125.10
Chloride	mmol/l	94.52	1.59	92.00	96.50
Calcium	mmol/l	1.97	0.12	1.76	2.12
Magnesium	mmol/l	1.13	0.18	0.94	1.42
Inorganic phosphorus	mmol/l	1.75	0.22	1.41	2.04
AST	IU/l	74.48	20.67	58.10	113.40
ALT	IU/l	19.17	1.72	17.30	22.30
Cholinesterase	IU/l	922.40	333.08	353.70	1361.0
Creatine kinase	IU/l	256.63	288.16	35.10	787.70
Alkaline phosphatase	IU/l	31.17	16.00	10.30	54.10
GGT	IU/l	31.92	36.55	11.60	105.70
Alpha-amylase	IU/l	38.65	19.28	20.70	65.80
Lipase	IU/l	46.34	33.54	11.81	87.50
GLDH	IU/l	7.37	1.32	5.95	8.90
LDH	IU/l	476.63	88.13	412.60	649.20

Materials and Methods

The study material consisted of blood samples obtained from femoral vein, during standard veterinary health check of six brown bears at the Braniewo Zoo (northeastern Poland, 54°23'N 19°50'E) on 17 and 18 February 2011. Automated analyzers were used for hematology (CELL-DYN 3700 VET MODE) and serum biochemistries (Biosystems A25). Bears appeared clinically healthy and were in good or very good body condition. The rectal temperature and life signs were monitored during anesthesia and information on activity of the studied bears was collected.

The mean outside temperature at the location in December 2010-February 2011 was -14°C (range: – 24 to -4°C). Bears were being released into the outdoor enclosures during the day and were held at night in unheated indoor cages at actual temperatures in the range of -4 to +2°C. During this period the routine practice included daily offering of water and food.

Mean and standard deviations (SD) were calculated for each blood parameter (Table 1). The t-test for two unequal sample sizes was used for statistical comparisons of particular parameters measured in this study with published hematological and serum biochemistry values for both captive and wild brown bears in active seasons (Huber et al. 1997, Kusak et al. 2005). Values of $p<0.05$ were considered as statistically significant. All statistical analyses were performed using R for Mac OS X, version 2.13.1 (R Development Core Team 2011).

Results and Discussion

The six bears studied averaged 15.8 y of age and 217 kg of body mass, and four of them were females.

Table 2. Biomarkers (urea, creatinine and urea:creatinine ratios) of hibernation in the blood of brown bears (N=6) in Braniewo Zoo (Poland).

Parameter	Examined bears					
	1	2	3	4	5	6
Urea (mg/dl)	22.43	26.77	22.13	16.76	17.91	21.95
Creatinine (mg/dl)	2.87	3.0	1.90	2.35	2.00	1.53
U:C	7.80	8.73	11.63	7.14	8.95	14.39

All six bears showed low activity. Sleep/rest was the dominant behavior both outdoors and indoors. The obvious indicator of lower activity was body temperature (mean 35.9°C) comparing to brown bears in the stage of full activity (37-37.5°C, Hissa et al. 1994). The temperature of hibernating free-ranging brown bears immobilized for research ranged from 32.2 to 34.8°C within 35 minutes after inducing anesthesia (Evans et al. 2012).

Comparing bears from Braniewo Zoo and captive bears sampled in Croatia during their active period (Kusak et al. 2005), statistically significant differences were found for white blood cells (6.74 G/L vs. 12.9 G/L; $p<0.0369$, respectively) and neutrophils (5.33 G/L vs. 10.53 G/L; $p<0.0466$, respectively) suggesting depressed immune function typical for hibernation (Hellgren 1998). For non-hibernating species, e.g. the Formosan black bear (*Ursus thibetanus formosanus*), white blood cells values are lower in winter as well due to lower immunological defense requirement at that time, but still higher than in bears during hibernation (Chang et al. 2006).

Mean creatinine concentration noted in this study was significantly higher than in the bears in their active period (207.8 μmol/L vs. 97.3 μmol/L, $p<0.0001$, respectively, Huber et al. 1997). Hissa (1997) also noted similar values in captive bears with significantly higher creatinine concentration during winter season comparing to summer. The study by Stenvinkel et al. (2013a) on free-ranging brown bears in Sweden captured in summer and in winter, showed the significant differences between mean values in many biochemical parameters, with creatinine significantly increased in winter.

The urea:creatinine ratios (U:C) were below 10 in four and slightly over 10 (but below 20) in two bears (Table 2). The U:C ratio of above 20 by some authors considered as the border value for bears in full activity (Nelson et al. 1973, Spady et al. 2009) was not found in bears under study. In the study by Stenvinkel et al. (2013a) the mean U:C ratio was 118 in summer and 14 in winter. Nelson et al. (1973) found the urea:creatinine ratio being ≥20 during active periods but during hibernation it decreased to ≤10. However, these changes have been criticized as being inconsistent. Some serum components fluctuate also in response to diet and are related to body condition, but in winter the nutritional effects might be masked by physiology of hibernation state itself (Noyce and Garshelis 1994). Although urea is in essence a product of protein metabolism and its level might be an effect of e.g. low protein diet, during hibernation the bear is metabolizing mainly fat (Stenvinkel et al. 2013b) and thus the effect of nutritional status and diet as itself might be dampened by physiological changes due to hibernation (Noyce and Garshelis 1994).

This report may be useful to develop and evaluate hematology and serum biochemistry health profiles of captive bears in winter. Their energy and nutrient metabolism at this stage requires further study.

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