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CHANGES OF BLOOD VALUES IN PRZEWALSKI HORSES (*EQUUS PRZEWALSKI PRZEWALSKI*) AND ZEBRAS (*EQUUS ZEBRA HARTMANNAE*) DURING CHEMICAL IMMOBILIZATION

C. Kuttner H. Wiesner*

INTRODUCTION

In the medical care of zoo animals one is confronted with the problem that most animals can only be examined if they are under anesthesia. Therefore, blood samples, which are often necessary for examination, must be taken from sedated animals. In the interpretation of results the question arises: to what degree do stress at the time of application, the anesthetic itself, and the bloodletting after sedation sets in have an influence on the blood parameters?

Although so-called baseline data exist for some species, no assertions are made about the influence of anesthesia. In order to be able to determine if a value that deviates from the norm is caused by anesthesia or has a pathological reason, the following experiment was conducted.

Twenty Przewalski horses and seven mountain zebras, all known to be clinically healthy, were anesthetized for hoof care and pregnancy checks. Ten, 20, and 30 min after application of the anesthetic, blood was taken and was examined hematologically as well as serologically. Certain conclusions can be drawn about the influence of stress and anesthetics based on the fluctuations that could be observed when comparing the results for these periods of time.

MATERIALS AND METHODS

Twenty Przewalski horses (*Equus przewalski przewalski*) and seven mountain zebras (*Equus zebra hartmannae*), both male and female and all older than 9 mo, were examined. The animals were clinically healthy, were kept separated from one another, and were fasted for 24 hr before the anesthesia. A mixture of Immobilon®[a] (2.45 mg etorphine hydrochloride + 10 mg acepromazine/ml) and xylazine,[b] which has proven to be an effective anesthetic for sedation of different zoo animals, was used. The following doses were injected into the neck musculature using a blow-pipe: zebras (ca. 300 kg), 1.5 ml Immobilon® + 20 mg xylazine; Przewalski horses (ca. 200 kg), 1.8 mg Immobilon® + 40 mg xylazine; Przewalski horses (ca. 350 kg), 2.5 ml Immobilon® + 40 mg xylazine.

After a period of excitation that lasted about 4–8 min, the animals were sedated. The typical side effects of the drug Immobilon®, tachycardia and muscle tremors, occurred regularly. Ten, 20, and 30 min after injection of the anesthetic blood samples were taken from the jugular vein and placed in EDTA tubes for hematology tests and in clot tubes for serological examination.

After the third sample was drawn, the animals were reawakened by an intravenous injection of Revivon®[c] (10 mg diprenorphine/ml), the antidote to Immobilon®. The animals awakened after a period of 3–5 min and were able to stand up again. Two to 3 hr later the blood samples were examined hematologically and serologically according to standardized methods.

The whole blood was analyzed for complete blood count, urea, and glucose, which were photometrically evaluated after enzymatic reactions.[d] Electrolytes, enzyme activities, bilirubin, creatinine, and total protein were determined in the serum. Sodium, potassium, and calcium were determined in an acetylene flame photometer. Chloride was determined coulometrically and phosphorus photometrically (405 nm). All other serum parameters were analyzed using a Hitachi Autoanalyzer, which works by photometric methods.

The results for the blood samples that were taken 10 min after the injection served as basic data. The other samples were compared to those results and changes were statistically evaluated. Means ($\bar{x}$), standard deviations ($\pm$SD), and significance of differences (P) were calculated.

RESULTS

Only blood glucose showed highly significant changes ($P = 0.001$). The glucose values of the Przewalski horses rose from 112 mg/dl (10 min after injection) to 166 mg/dl (30 min after injection). In the same

* Zoological Garden, Munich, West Germany.

Table 1. Blood values found in Przewalski horses (n = 20).

	10 min postinjection		30 min postinjection	
	$\bar{x}$	±SD	$\bar{x}$	±SD
RBC ($10^6/\mu l$)	8.9	0.9	7.9	1.3
Hemoglobin (mg/dl)	15.5	1.7	13.8	2.1
Hematocrit (%)	43.7	3.7	39.5	4.4
MCV (μm^3)	51	8	49	7
MCHC (%)	35	2	35	2
MCH (pg)	18	2	17	1
WBC ($1/\mu l$)	8,257	1,684	7,871	1,498
Lymphocytes, absolute ($/\mu l$)	2,798	809	3,112	848
Lymphocytes, relative (%)	34	9	40	9
Segments, absolute ($/\mu l$)	5,184	1,444	4,393	1,063
Segments, relative (%)	62	10	56	9
Chloride (mg/dl)	94	4	93	4
Sodium (mmol/dl)	138	4	136	5
Calcium (mmol/dl)	3.0	0.1	2.8	0.1
Potassium (mmol/dl)	4.7	0.5	4.3	0.5
Phosphorus (mg/dl)	4.7	1.3	4.2	1.4
Glucose (mg/dl)	112	21	166	37
Bilirubin (mg/dl)	0.98	0.36	0.87	0.27
Creatinine (mg/dl)	1.12	0.29	1.05	0.37
GOT (IU/liter)	208	49	193	33
GPT (IU/liter)	8	3	6	2
AP (IU/liter)	355	133	323	113
LDH (IU/liter)	579	141	540	130
GLDH (IU/liter)	13	12	11	9
G-GT (IU/liter)	17	6	17	7
Cholinesterase (IU/liter)	7,245	1,118	7,313	850
Total protein (mg/dl)	6.9	1	6.4	1.2
CK (IU/liter)	142	54	141	64
Urea (mg/dl)	27	18	25	20

period the values for the zebras rose from 108 mg/dl to 174 mg/dl.

Significant changes could be observed in hemoglobin ($P = 0.037$), red blood cells ($P = 0.033$), and hematocrit ($P = 0.009$). Each of these parameters decreased. The exact values can be seen in Tables 1 and 2.

Even though the following values cannot be statistically proved, they may however show certain trends. Leucocytes, neutrophils, potassium, calcium, phosphorus, total protein, GOT, GPT, and AP decreased slightly in horses as well as in zebras. In horses the relative lymphocytes showed a strong rise between 10 and 20 min after injection and remained constant between 20 and 30 min after injection, but the zebra values fell slightly from 10 to 20 min after injection and rose from 20 to 30 min after injection. The values of the relative neutrophils showed exactly the opposite results. MCV, MCH and MCHC, total lymphocytes, bilirubin, creatinine, chloride, sodium, CK, G-GT, cholinesterase, and urea proved to be, to a large degree, unchanged by the immobilization.

DISCUSSION

The most distinct changes during anesthesia could be observed in the red blood cells. The significant decline of hemoglobin, erythrocytes, and hematocrit can be explained by the physiological reservoir of the spleen, which is highly developed in equines. Therefore they have 25% more circulating red blood cells during a period of agitation than they have in a period of relaxation. The decline in this experiment is therefore based on the backflow of the erythrocytes to the spleen, which has cleared its capacity

Table 2. Blood values found in zebras (n = 7).

	10 min postinjection		30 min postinjection	
	$\bar{x}$	±SD	$\bar{x}$	±SD
RBC ($10^6/\mu l$)	9.1	0.9	7.9	1.1
Hemoglobin (mg/dl)	15.7	2.6	13.8	2.3
Hematocrit (%)	45.3	5.5	39.4	5.7
MCV (μm^3)	49	4	47	4
MCHC (%)	35	3	35	3
MCH (pg)	17	1	16	1
WBC ($1/\mu l$)	8,850	2,127	7,121	1,015
Lymphocytes, absolute ($/\mu l$)	2,864	578	3,104	678
Lymphocytes, relative (%)	34	11	42	10
Segments, absolute ($/\mu l$)	5,678	2,245	4,398	1,426
Segments, relative (%)	63	12	57	7
Chloride (mg/dl)	91	4	90	7
Sodium (mmol/dl)	137	5	136	2
Calcium (mmol/dl)	2.4	0.2	2.2	0.2
Potassium (mmol/dl)	4.3	0.8	3.6	0.5
Phosphorus (mg/dl)	3.9	0.9	3.6	0.9
Glucose (mg/dl)	108	32	174	42
Bilirubin (mg/dl)	1.1	0.78	1.03	0.72
Creatinine (mg/dl)	1.84	0.17	1.79	0.25
GOT (IU/liter)	222	93	202	79
GPT (IU/liter)	12	14	11	12
AP (IU/liter)	190	57	175	51
LDH (IU/liter)	635	220	579	204
GLDH (IU/liter)	17	36	13	21
G-GT (IU/liter)	25	20	23	17
Cholinesterase (IU/liter)	3,064	1,324	2,741	1,183
Total protein (mg/dl)	6.9	0.4	6.4	0.4
CK (IU/liter)	70	56	61	46
Urea (mg/dl)	32	12	31	11

during the period of excitation. It is possible that this explanation also accounts for the slight drop in leucocytes. Urea showed slight individual changes. All other parameters showed a clear (potassium, calcium, phosphorus, total protein, GOT, GPT, AP, LDH, GLDH) to slight (bilirubin, creatinine, chloride, sodium, CK, G-GT, cholinesterase) tendency to decrease. The uniform decreasing trend of the different parameters is to be interpreted as an extravasal fluid shift, which means a dilution of the blood with the anesthesia working as an unspecific stimulus.

CONCLUSION

The important changes happen in the corpuscular part of the blood as well as in blood glucose. However, even though the changes are significant, the physiological variances are larger than the increase or decline of the values between the three intervals. Only in blood glucose are there no overlaps of standard deviations between 10, 20, and 30 min after injection. The changes in the other parameters are smaller than the physiologic variances known from domesticated horses. Blood values taken under narcosis, which differ from reference values, do not change because of the immobilizing drugs but rather show pathologic changes. Excluded are the values of red blood cells, hemoglobin, hematocrit, and glucose, which changed significantly during the 30-min experiment.

PRODUCTS MENTIONED IN TEXT

a. Immobilon®, Reckitt & Coleman.
b. Xylazine, Bayer.
c. Revivon®, Reckitt & Coleman.
d. Teststrips, Fa. Merck.

REFERENCES

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ANNOUNCEMENTS

ASSOCIATION OF AVIAN VETERINARIANS

The Association of Avian Veterinarians Annual Conference will be held 26 September through 1 October 1988 at the Adams Mark Hotel, Houston, Texas. For further information contact Sylvia Kornelsen, AAV Conference Office, 1625 S. Birch, Suite 106, Denver, Colorado 80222, (303) 756-8380.

Call for papers: The Association of Avian Veterinarians is accepting proposals for clinically oriented case reports, comprehensive reviews, or wet labs on avian medical or surgical topics. Material must be original and previously unpublished. Papers will be presented 26 September through 1 October 1988 in Houston, Texas. Send brief abstract to AAV Conference Office, 1625 S. Birch, Suite 106, Denver, Colorado 80222, (303) 756-8380. Deadline: 1 March 1988.

AMERICAN COLLEGE OF ZOOLOGICAL MEDICINE

The next certification examination of the American College of Zoological Medicine will be offered on 4–5 November 1988 in Toronto, Ontario, Canada, before the annual meeting of the American Association of Zoo Veterinarians. Each applicant must be a graduate of an AVMA-accredited veterinary school and be a licensed veterinarian. Applicants who have completed an ACZM-approved postgraduate training program must have at least 5 years experience, 100% zoological medicine or its equivalent. The applicant must be senior author on at least six publications in the field. The certification examination will be comprehensive, covering all aspects of veterinary medicine relating to a broad range of animal groups including mammals, birds, reptiles, amphibians, and fish. Completed applications, with fees and supporting materials, must be received no later than 1 June 1988. For application forms and specific qualification requirements, contact Dr. Lyndsay G. Phillips, ACZM Secretary, Department of Animal Health, National Zoological Park, Washington, D.C. 20008.