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Effect of Arterial Blood Pressure and Renin and Aldosterone Levels in Dogs

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Abstract The objective of this study was to evaluate the effect of irregular feeding and body mass on the occurrence of hypertension and the function of the mechanisms of the renin-angiotensin-aldosterone system in dogs. The study included 20 dogs that were fed only prepared food. The study was conducted in accordance with the data from VBPS, World Veterinary Association on the classification of hypertension detected by the blood pressure measuring device. During the routine check, the parameters used to detect hypertension included systolic and diastolic blood pressures, the pulse frequency, body mass and age of the dogs. Furthermore, renin and aldosterone levels were determined and comparisons were made. The results were obtained based on the data on the type of hypertension. Our results confirmed the existence of hypertension in this group of dogs. Ten out of twenty dogs were found to have hypertension. Low hypertension was detected in 10% (2) of dogs, medium hypertension in 25% (5) of dogs and high hypertension in 10% (2) of dogs. Hypertension was not detected in 55% (11) of dogs. The study underlined the importance of routine measurements of blood pressure during every check-up that could serve as a screening tool for further diagnostic or therapeutic steps to be taken.

Key words: dogs, hypertension, renin, aldosterone

Introduction

Many authors tend to define blood pressure as a blood force exerted on the surface of a blood vessel unit. Blood flow and pressure are pulsing, producing systolic and diastolic activities (Guyton and Hall 2003). In veterinary medicine, an animal is considered hypertensive if the measured systolic/diastolic pressure is over 150/95 mmHg. In human medicine, these values are somewhat lower, hypertension being defined at blood pressure of over 140/90 mmHG

(Stepanovic *et al.* 2005; Gerc *et al.* 2005). If hypertension is viewed as a syndrome, more effective evaluation of the hypertensive risk of cardiovascular diseases will be made possible (Gerc *et al.* 2005). The objective of a number of studies was to determine if hypertension caused by obesity associated with abnormalities is related to pressure and sodiumuresis (Granger *et al.* 1994). Obesity is generally accompanied with the risk of hypertension. Improved studies on the neurobiology of obesity will provide further insight into the regulation of arterial pressure induced by the obesity claim (Allyn *et al.* 1999).

Obesity accounts for 65-75% of cases of human essential hypertension in most industrially developed countries (Hall *et al.* 2001). The renin-angiotensin-aldosterone system plays an important role in maintaining blood pressure during the genesis of congestive disorder. At an early stage, bringing back of blood pressure back into the normal range depends on circulating angiotensin II, but at later stages blood pressure is dependent on an increase in blood plasma volume (Watkins *et al.* 1976).

Materials and Methods

This study included 20 dogs of different breeds from the region of Tuzla. The dogs were exclusively fed prepared meal. All dogs underwent laboratory medical treatment which included blood pressure measurement by :

- Memoprint Richter Pharma AG A-4600WELS

- Ohmeda biox 3700 E Pulse Oximeter

Upon treatment, all relevant data on blood pressure, pulse, body mass and age of the test dogs were analyzed. At the Veterinary Station in Tuzla, the following was conducted: routine blood pressure measurement, pulse oximetry, body mass measurement and age determination.

Three measurements were made, followed by the calculation of the mean value as an exact blood pressure value.

To examine the renin-angiotensin-aldosterone system, blood samples were secured from each dog following the instructions on every diagnostic procedure conforming to established standards.

A laboratory procedure for serum levels of renin and aldosterone was conducted at the Public Health Institution University Clinical Centre Tuzla, Internal Medicine Clinic, Department of Nuclear Medicine.

Random blood samples were taken by means of vein tap (*v. brachiocephalica antebrachii*, *v. saphaena*) at the Veterinary Station in Tuzla. The blood samples were, first, collected in cooled tubes with EDTA as anticoagulants. The samples were kept in a cold environment and centrifuged at about 2000 X g* (1118×10^{-8}) for plasma to be obtained. Thick-dense hemolyzed or lipemic samples



Fig. 1. Blood pressure measuring device

as well as those that contained particular substances or were microbiologically contaminated were not tested. The samples were kept deeply frozen at -20°C or below before being processed. Prior to processing the samples were defrosted and mixed, with temperature not exceeding 4°C .

The SPSS statistical processing programme was used to statistically analyze the obtained values. The difference between the distribution of the given variable and the normal distribution was estimated by the Shapiro-Wilk variable test. The ANOVA test was used to analyze significant differences between the means of the measured parameters.

Results and Discussion

The results of this research are given in Table 1.

Tab. 1. The measured values of body mass, blood pressure and pulse

Dog number	Dog age (months)	Body mass (kg)	Systolic blood pressure (mmHg)	Diastolic blood pressure (mmHg)	Hypertension type	Pulse frequency (bt/min)
1	12	17	148	101	-	93
2	15	20	148	98	-	70
3	15	25	150	64	-	88
4	36	19	160	105	medium hypertension	102
5	12	25	165	83	medium hypertension	98
6	60	13.2	144	115	-	120
7	12	25	162	110	medium hypertension	96
8	24	12.5	160	97	medium hypertension	137
9	48	26	148	111	-	116
10	14	15	170	128	medium hypertension	122
11	17	19	146	115	-	86
12	96	16	184	139	high hypertension A	50
13	12	40	150	111	-	82
14	108	35	160	118	medium hypertension	111
15	78	25	148	112	-	89
16	24	21	156	80	low hypertension	100
17	36	16	158	86	low hypertension	111
18	18	35	148	120	-	118
19	12	29	145	106	-	88
20	36	23	185	121	high hypertension	85

Ten dogs out of twenty had hypertension. High hypertension was found in dog no. 12 and dog no. 20. The value obtained for dog no. 12 was 184/139 mmHg, being a classic example of high hypertension diagnosed by standard

VBPS blood pressure values at 180/120mmHg and over. Dog no. 20 was also diagnosed with high hypertension and its blood pressure values were 185/121 mmHg. Medium hypertension was recorded in dogs 4, 5, 7, 8, 10 and 14. Low hypertension was found in dogs nos. 16 and 17. Systolic blood pressure was higher than the permitted standard and the values for dogs nos. 16 and 17 were 156 mmHg and 158 mmHg, respectively. The average physiological pulse value was 120 and it was higher than normal in 2 dogs from this group of dogs. Dog no. 12 having high hypertension, showed the lowest value of pulse frequency at only 50 beat/min.

The proportion of each type of hypertension is given in Figure 2. Low hypertension was detected in 10% (2) of dogs, medium hypertension in 25% (5) of dogs and high hypertension in 10% (2) of dogs. Hypertension was not detected in 55% (11) of dogs.

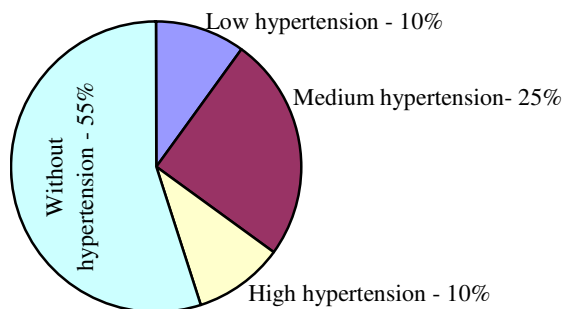


Fig. 2. The proportion of each type of hypertension

The relationship between body mass and blood pressure is given in Figure 3. The graph shows values of systolic pressure ranging from 144-185 mmHg. The lowest blood pressure value of 144 mmHg was found in dog no. 6 having a body mass of 13.2 kg. The systolic pressure in dog no. 20 having a body mass of 23 kg was 185 mmHg. The measured diastolic pressure values ranged from 80-139 mmHg.

According to the American Heart Association, normal renin hormone levels range from 0.3084 $\pm$ 0.0771 nmol/l.

The highest renin level was detected in dog no. 20 and it was 1.30 nmol/l. This dog was also detected to have high hypertension induced by the above pressure values (Table 2). As for aldosterone, its normal values should range from 0.0008 $\pm$ 0.00027 nmol/l, according to the American Heart Association.

The highest aldosterone level was detected in dog no. 4, its value being 1.518 nmol/l, i.e. exceeding the permitted value. This dog was found to have medium hypertension (Table 2).

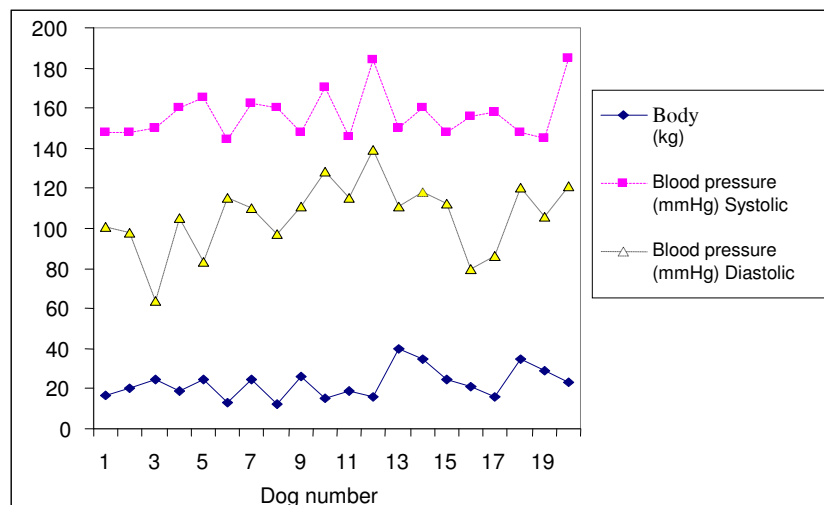


Fig. 3. The relationship between body mass and blood pressure

Tab. 2. Renin and aldosterone levels

Group C dog number	Renin level (nmol / l)	Aldosterone level (nmol / l)
1	0.320	0.081
2	0.550	0.101
3	0.140	0.000
4	0.840	1.518
5	0.050	0.000
6	0.300	0.000
7	0.330	0.110
8	0.210	0.146
9	0.330	0.000
10	0.350	0.005
11	0.970	0.025
12	1.140	0.024
13	0.300	0.194
14	0.320	0.007
15	0.970	0.000
16	0.210	0.322
17	0.350	0.025
18	0.830	0.005
19	0.880	0.131
20	1.300	0.020

Table 3. shows statistical indicators of the test parameters. The obtained results suggested that low hypertension occurred at a systolic blood pressure of 150 mmHg, this finding complying with the results by Štepien (2006), but being in disagreement with Ettinger *et al.* (1995) who reported hypertension at the systolic blood pressure of over 180 mmHg. Our results showed that hypertension generally accompanied some other primary diseases in the test dogs. Hypertension is a common sign of an early stage of a heart disease, and it occurs in 93% of cases of kidney disease in dogs. The routine detection of severe hypertension can suggest a kidney disease or disorder of the renin–angiotensin–aldosterone system. It is for this reason that hypertension detection should be taken very seriously when conducted in different breeds of dogs.

Tab. 3. Statistical data on the tested parameters

Var	Months	Mass	Systolic	Diastolic	Pulse	Renin	Aldosterone
Valid N	20	20	20	20	20	20	20
Mean	34.250	22.835	156.750	106.000	98.100	0.535	0.136
Median	21	22	153	110.5	97	0.340	0.025
Sum	685	456.7	3135	2120	1962	10.690	2.714
Minimum	12	12.5	144	64	50	0.050	0.000
Maximum	108	40	185	139	137	1.300	1.518
Range	96	27.5	41	75	87	1.250	1.518
Variance	864.513	57.197	143.987	312.737	401.568	0.136	0.113
Std.dev.	29.403	7.563	11.999	17.684	20.039	0.369	0.336
Std. error	6.575	1.691	2.683	3.954	4.481	0.083	0.075

Obesity is generally accompanied with the risk of hypertension. Improved studies on the neurobiology of obesity will provide further insight into the regulation of arterial pressure induced by the obesity claim, as reported by Allyn *et al.* (1999) and our study.

This study underlined the importance of routine measurements of blood pressure during every checkup that could serve as a screening tool for further diagnostic or therapeutic steps to be taken.

Conclusion

The tested breeds of dogs were detected to have either low, medium or severe hypertension. The results showed specific variations in the values of the tested parameters within the test groups.

Severe hypertension can suggest disorder of the renin–angiotensin–aldosterone system or a kidney disease, a disease very common in dogs.

This study revealed that different variations in the measured values of the tested parameters were found in both hypertensive and non-hypertensive dogs, especially in the dogs having medium hypertension.

Mild hypertension was detected in 10% (2) of dogs. Medium hypertension was recorded in 25% (5) of dogs and high hypertension in 10% (2) of dogs. Hypertension was not detected in 55% (11) of dogs. The lowest level of renin was found in dog no. 3 and it was 0.14 nmol/l and the pressure was 150/64 mmHg. The highest renin level was found in dog no. 20 and it was 1.300 nmol/l and its blood pressure was 185/121 mmHg. The highest renin level was detected in dog no. 20 and it was 1.300 nmol/l. This dog was also diagnosed with high hypertension, which was induced by the above value of blood pressure.

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UTJECAJ ARTERIJSKOG KRVNOG PRITISKA TE NIVO KONCENTRACIJA RENINA I ALDOSTERONA U POPULACIJI PASA

- originalni naučni rad -

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Rezime

Cilj ovog istraživanja je da se utvrdi kakav utjecaj ima način ishrane i tjelesna masa kod pasa na pojavljivanje hipertenzije pasa i funkcionisanje mehanizama sistema renin-angiotenzin-aldo-steron. Istraživanje je provedeno kod 20 pasa i to na psima koji su isključivo hranjeni sa spravljenim obrokom. Istraživanje je provedeno u skladu sa podacima VBPS – a, Svjetskog Udruženja Veterinara kad je u pitanju klasifikacija hipertenzije koja je detektovana korištenjem aparata za mjerenje krvnog pritiska. Tokom rutinske pretrage kao parametri pomoću kojih je izvršena detekcija hipertenzije, uzeti su sistolni, dijastolni krvni pritisak, frekvencija pulsa te tjelesna masa i starosna dob psa. Također su laboratorijski utvrđene vrijednosti nivoa koncentracije renina i aldosterona te vršena poređenja. Rezultati su rađeni u skladu sa podacima kad je u pitanju tip hipertenzije. Naši rezultati su potvrdili postojanje hipertenzije kod ove grupe pasa. Konstatovani su svi tipovi hipertenzije blaga, srednja i teška hipertenzija. Od 20 pasa njih 9 je imalo hipertenziju. Blaga hipertenzija je konstatovana u 10% (2 slučaja) testiranih pasa. Srednji tip hipertenzije je registrovan kod 25% (5 slučajeva) testiranih pasa, a kod 10% (2 slučaja) testiranih pasa je utvrđena teška hipertenzija. Hipertenzija nije pronađena kod 55% (11 slučajeva) testiranih pasa. Provedena istraživanja upućuju i na činjenicu koliko je bitno prilikom svakoga pregleda psa provesti rutinsko mjerenje krvnog pritiska koje nam služi kao screening za poduzimanje sljedećeg koraka bilo dijagnostičkog ili terapijskog.