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Radiographic Assessment of Spleen Size and Its Relationship with Age and Sex in Healthy Dogs Referred to Tehran City Pet Clinics

Reza Behmanesh*, Negin Kazemi

Department of Veterinary Sciences, Ga.C., Islamic Azad University, Garmsar, Iran

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Abstract

Background and aim: A dog's spleen is their largest lymphatic organ, and its size can vary among dogs. Radiographic criteria for assessing spleen size or the expected range of spleen size for healthy dogs have been reported to be very low, and splenomegaly in dogs is subjectively based on changes in shape, presence of smooth margins or the view of the abdominal organ of the spleen is determined in the side view. The aim of this study was to investigate the reliability of radiographic variables for estimating spleen size by evaluating the relationship between spleen volume and radiographic dimension variables, and also by examining the correlation between radiographic dimension variables in different ages and sexes in healthy dogs.

Materials and Methods: This study was a cross-sectional analytical observational study. This study includes the measurement of the spleen using radiography of 50 adult dogs, including 26 male dogs (52%) and 24 female dogs (48%), in ventrodorsal and lateral view. Radiographs were prepared in DICOM format. Then the ratio of the length and width of the spleen (tail of the spleen and body of the spleen) were obtained. Two independent two-sample t-tests and Pearson's test were used to check the relationship between the variables.

Results: The results showed that the male and female groups did not have a statistically significant difference in the average spleen size, and the spleen size in male dogs was not significantly greater than that in female dogs ($P>0.05$). The results showed that the average spleen size in dogs of different breeds (large, medium and small) was not significant ($P>0.05$), and statistical analysis of the findings related to age showed that there was no significant relationship between spleen size and age ($P>0.05$).

Conclusion: The exact standards obtained in the present study can be used in the interpretation of results and clinical decisions to determine the normal and abnormal size of the spleen and its ratio with age, and sex in dogs.

Keywords: *Spleen, Radiography, Dog*

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**** Corresponding Author***
Department of Veterinary Sciences,Ga.C., Islamic Azad University, Garmsar, Iran.
E-mail: behmaneshdvr@iau.ac.ir , Orcid: https://orcid.org/ 0000-0003-0521-1424

Introduction

The spleen in dogs is a sinusoidal structure that has less capacity to store large amounts of blood compared to the spleen of cats. Ultrasound is used as the first standard diagnostic test for dogs suspected of having spleen disease. If ultrasound imaging is not available, radiography may be used in veterinary clinics. However, research on the use of radiography to assess spleen size in dogs has been limited (McGavin & Zachary, 2012; Hanson *et al.,* 2001).

Radiographic criteria for assessing spleen size or the expected range of spleen size for healthy dogs have been reported very little, and splenomegaly in dogs is subjectively determined based on changes in shape, presence of smooth margins, or visibility of the abdominal organ of the spleen in lateral view. Therefore, according to the limitations of the basic information in this field, more studies should be done in this field and the longitudinal and transverse sizes and dimensions of the normal spleen so that this information can be used in the diagnosis of spleen diseases in dogs (Spangler & Culbertson, 1992).

In the lateral radiograph of the abdomen, the tail of the spleen can be seen in the floor of the ventricular area behind the liver. And in the dorsal abdominal radiograph, the apex of the spleen can be seen in the form of a triangle behind the fundus of the stomach. Splenomegaly has two signs in the radiograph. The most important symptom is the observation of a mass in the middle part of the ventricular area. The second sign is the displacement of the organs near the spleen. Enlargement of the spleen is normal in some cases, such as the administration of sedatives. An enlarged spleen is seen as a mass inside the abdominal cavity that displaces other organs such as the small intestines (Hecht & Mai, 2015).

The spleen in dogs and cats is easily seen on radiographs. However, its location is variable due to the mobility of its caudal aspect. A standard dorsal ventral projection usually shows the cranial end of the spleen as a triangular cross-section in the left cranial quadrant caudal to the fundus of the stomach and cranial lateral to the left kidney (Reese *et al.,* 2013)

The caudal part of the spleen often extends along the left side of the body wall. However, it may be obscured due to crowding with other viscera if it is more axially located. The spleen in dogs is more visible on the right lateral view than on the left (Sayre & Spaulding, 2014; Spangler & Culbertson, 1992).
In a lateral projection, the shadow of the caudal organ of the spleen appears as a triangular, oval or round structure slightly caudal and ventral to the pylorus or liver. Thinner and smaller, the cat's spleen is seen in the ventral and lateral projections in the same direction as the dog's spleen. Although the caudal organ of the spleen may not be visible in the lateral view. Large splenic masses often appear in the middle of the abdomen in the ventral and lateral views (Johnson *et al.,* 2017).

Masses in the caudal organ or splenic body tend to displace the small intestines toward the back and tail. Displacement of the cranial stomach and caudal, internal and ventral displacement of the intestines indicate the presence of a splenic mass in the skull. Generalized splenomegaly leads to rounding or tearing of the splenic margin. The shadow makes the spleen and liver difficult (Auger *et al.,* 2018; Reese *et al.,* 2013).

Lesions and diseases of the spleen are a common problem in dogs and many of the diseases described, such as excessive enlargement of the spleen in some diseases such as liver cirrhosis and hyperactivity and over activity of the spleen and an asplenia and the absence of the spleen or its lack of function, for example As a result of trauma to the spleen, which makes the animal more vulnerable to some infectious diseases such as pneumococcus, and since the spleen has a lymphatic-blood structure, they can cause a change in the size or appearance of the spleen (Cools, 1983).

The purpose of this study was to investigate the reliability of radiographic variables to estimate spleen size by evaluating the relationship between spleen volume and radiographic dimensional variables and by examining the correlation between radiographic dimensional variables in different ages and sexes in healthy dogs. A secondary objective will be to develop preliminary guidelines for evaluating the radiographic variable selected as the most reliable estimator of spleen size in healthy dogs. We hypothesize that spleen length measurements on radiographic images are significantly related to spleen volume and can be used as a reliable estimate of spleen size in dogs (Larson, 2018).

Therefore, evaluation of spleen size can provide useful clinical information in combination with other

parameters. Spleen size is influenced by various factors such as race, age, body weight, gender or the status of some glands. Several methods have been studied to evaluate the size of the spleen in cats and dogs using different anatomical signs. In this research, we tried to study the size of the spleen of dogs referred to clinics in Tehran city.

Materials and methods

In this study, dogs (n=50) were used that had normal spleen radiology standards based on history, clinical pathology tests and physical examination. Radiographs were prepared using a radiograph with a device (DR, VIVIX). Radiographic images were saved in DICOM format and a DICOM viewer (Sante DICOM Viewer 3D pro) was used. Caliper size was 1mm.

In the first method (Figure 1A), the spleen is measured to measure the images in panels A and B, and the remaining sizes are obtained in the abdominal views. A and B WSH (Width of the splenic head, Figure 1A; white arrow) was measured in a straight line from the cranial to the caudal margin of the splenic head in the widest anterior-posterior dimension. HSH (Height of the splenic head, Figure 1A; yellow arrow) in a straight line in the widest dorsal dimension, perpendicular it was measured on WSH. The distance from the caudal border of the head of the spleen to the anterior pole of the left kidney (Figure 1A; black line) was measured in a straight line in the same view. Then, C and D TLS (Total length of the spleen) will be measured by connecting the starting point of the spleen head to the end of the tail of the spleen through a curved middle line. Also, E and F SLS (Segmental length of the spleen) will be measured in a straight line from the folding point of the spleen body to the end of the tail of the spleen. At the end, G and H WS (Width of the spleen) are measured in a straight line in the widest lateral dimension, perpendicular to the long axis of the splenic curve (Jang *et al.,* 2021).

In the second method, radiographs of the dog's abdomen were used in the right lateral view and in the ventrodorsal view. Figure 1B and C shows a sample of spleen measurements, the straight white lines show the measurement points used to determine the length of the spleen. LMTL means lateral maximum transvers length and LMVL means lateral maximum vertical length in side view. VDMTL means the ventrodorsal maximum transverse length and VDMVL means the ventrodorsal maximum vertical length in ventraldorsal view (Choi *et al.,* 2007).

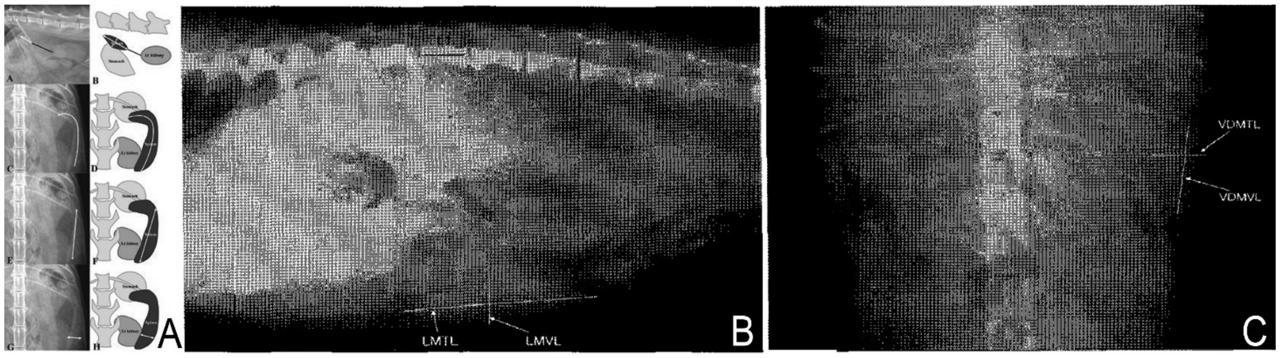

Figure 1. (A) The first method of measuring the spleen was measured in panels A and B in ventrodorsal views (Jang *et al.,* 2021). (B and C) The second method of radiography of the dog's abdomen in the right lateral view and in the ventrodorsal view. LMTL: lateral maximum transvers length, LMVL: lateral maximum vertical length, VDMTL: ventrodorsal maximum transverse length and VDMVL: ventrodorsal maximum vertical length in ventraldorsal view (Choi *et al.,* 2007).

Data Analysis

All data were analyzed using SPSS version 22 software. The significance level in the tests was considered 0.05. The results were reported as "Mean and standard deviation" for quantitative data and as "number (percentage)" for qualitative data. Two independent two-sample t-tests and Pearson's test were used to investigate the relationship between the variables. Descriptive and inferential statistics methods were used to analyze and describe statistical data.

Results

Figure 2 shows how to measure the spleen from the lateral and ventrodorsal views (Figure 2A and 2B, respectively). Table 1 shows the number of male and

female dogs. No significant difference was found in the number of male and female dogs. The results of this study showed that there was no statistically significant difference in mean spleen size between male and female groups. Although it was observed that spleen size was larger in male dogs than in female dogs, this was not significant (P<0.05; Table 2 and 3). The results of two-sample independent t-tests showed that the average spleen size in dogs of different breeds (large, small, medium) was not statistically significant (P>0.05; Table 4 and 5). Statistical analysis of the results regarding the relationship between age and spleen size in dogs showed that there was no significant relationship between age and spleen size. (P<0.05; Table 6 and 7).

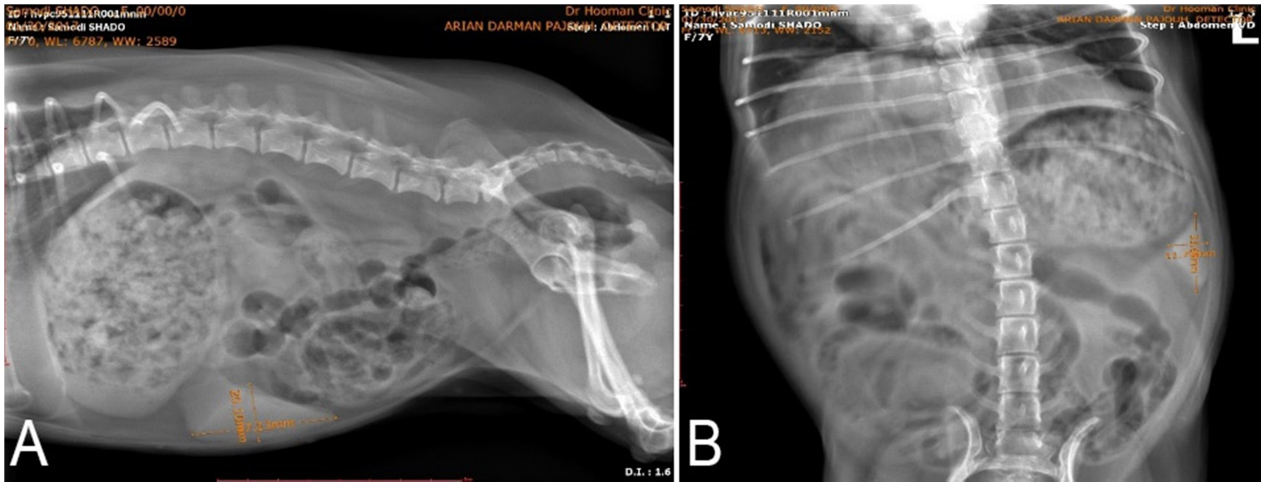

Figure 2. (A) Lateral radiographic view of the abdomen to measure the size of the spleen. (B) Ventrodorsal radiographic view of abdomen to measure the spleen.

Sex	Number	Percentage
Female	24	%48
Male	26	%52
Total	50	%100

Table 1. Frequen1y distribution of gender of studied dogs.

Sex		VDMTL	VDMVL	LMVL	LMTL
Male	Mean	25.2746	126.4342	31.7219	78.7515
	Standard deviation	13.84247	61.92327	13.64154	30.89498
	Variance	191.614	3834.492	186.092	954.5
	Maximum	77.9	274.61	68.31	156.96
	Minimum	11.56	57.71	13.92	30.43
Female	Mean	21.1	118.5754	26.0429	69.9696
	Standard deviation	13.28016	72.23413	10.54597	29.98379
	Variance	176.363	5217.769	111.217	899.028
	Maximum	59.94	268.9	46.68	127.33
	Minimum	8.12	30.94	12.45	28.72
Total	Mean	23.2708	122.662	28.996	74.5362
	Standard deviation	13.60085	66.49256	12.46447	30.47335
	Variance	184.983	4421.26	155.363	928.625
	Maximum	77.9	274.61	68.31	156.96
	Minimum	8.12	30.94	12.45	28.72

Table 2. Measured findings of spleen size by the method of LMTL (lateral maximum transvers length), LMVL (lateral maximum vertical length),VDMTL (ventrodorsal maximum transverse length) and VDMVL (ventrodorsal maximum vertical length) in ventral-back view in both sexes.

Sex		WS	SLS	TLS	DSLH	HSH	WSH
Male	Mean	24.1208	126.4342	186.0354	8.9223	21.3488	37.9242
	Standard deviation	9.99641	61.92327	79.84038	1.88779	12.32533	17.18962
	Variance	99.928	3834.492	6374.486	3.564	151.914	295.483
	Maximum	47.90	274.61	371.14	13.28	55.76	71.05
	Minimum	11.56	57.71	85.28	6.09	7.73	15.78
Female	Mean	20.2667	118.5754	173.4904	9.8908	21.3896	36.7292
	Standard deviation	11.20185	72.23413	87.44264	2.32898	12.18953	19.13552
	Variance	125.481	5217.769	7646.216	5.424	148.585	366.168
	Maximum	41.76	268.90	354.65	13.78	49.07	78.21
	Minimum	8.12	30.94	56.61	6.12	7.83	16.38
Total	Mean	22.2708	122.6620	180.0138	9.3872	21.3684	37.3506
	Standard deviation	10.66145	66.49256	82.95428	2.14550	12.13471	17.97207
	Variance	113.667	4421.260	6881.412	4.603	147.251	322.995
	Maximum	47.90	274.61	371.14	13.78	55.76	78.21
	Minimum	8.12	30.94	56.61	6.09	7.73	15.78

Table 3. Measured findings of spleen size by WSH, HSH, DSLH size method in lateral view and TLS, SLS and WS in ventrodorsal view in both sexes.

Breed		VDMTL	VDMVL	LMVL	LMTL
Small	Mean	17.5044	86.3568	25.7028	56.8800
	Standard deviation	5.86988	14.21082	7.91431	12.27234
	Variance	34.456	201.947	62.636	150.610
	Maximum	29.60	108.58	39.40	72.33
	Minimum	8.12	55.27	12.68	29.14
Medium	Mean	14.4000	79.2880	24.3320	58.6360
	Standard deviation	3.76819	31.20940	12.94602	13.36793
	Variance	14.199	974.026	167.599	178.702
	Maximum	21.61	132.76	44.23	76.54
	Minimum	10.16	30.94	12.45	28.72
Large	Mean	38.7953	212.0867	37.5940	114.5633
	Standard deviation	14.33301	47.29278	14.64723	20.57286
	Variance	205.435	2236.607	214.541	423.242
	Maximum	77.90	274.61	68.31	156.96
	Minimum	21.34	104.98	18.65	78.01
Total	Mean	23.2708	122.6620	28.9960	74.5362
	Standard deviation	13.60085	66.49256	12.46447	30.47335
	Variance	184.983	4421.260	155.363	928.625
	Maximum	77.90	274.61	68.31	156.96
	Minimum	8.12	30.94	12.45	28.72

Table 4. Measured findings of spleen size by the method of LMTL (lateral maximum transvers length), LMVL (lateral maximum vertical length),VDMTL (ventrodorsal maximum transverse length) and VDMVL (ventrodorsal maximum vertical length) in ventral-back view in different breeds (large, medium and small).

Breed		WS	SLS	TLS	DSLH	HSH	WSH
Small	Mean	17.5044	86.3568	159.0452	10.1800	16.4304	31.5148
	Standard deviation	5.86988	14.21082	33.58541	2.06333	5.04766	9.89786
	Variance	34.456	201.947	1127.980	4.257	25.479	97.968
	Maximum	29.60	108.58	227.70	13.78	24.02	46.95
	Minimum	8.12	55.27	98.20	6.98	7.73	16.38
Medium	Mean	14.4000	79.2880	103.4930	7.5280	13.1540	21.9130
	Standard deviation	3.76819	31.20940	38.49625	1.14166	3.29964	7.70530
	Variance	14.199	974.026	1481.961	1.303	10.888	59.372
	Maximum	21.61	132.76	165.87	9.80	18.90	41.89
	Minimum	10.16	30.94	56.61	6.09	7.83	15.78
Large	Mean	35.4620	212.0867	265.9753	9.3053	35.0747	57.3687
	Standard deviation	7.64086	47.29278	91.17991	2.09198	13.10272	16.24752
	Variance	58.383	2236.607	8313.775	4.376	171.681	263.982
	Maximum	47.90	274.61	371.14	12.98	55.76	78.21
	Minimum	21.34	104.98	85.28	6.12	9.41	32.23
Total	Mean	22.2708	122.6620	180.0138	9.3872	21.3684	37.3506
	Standard deviation	10.66145	66.49256	82.95428	2.14550	12.13471	17.97207
	Variance	113.667	4421.260	6881.412	4.603	147.251	322.995
	Maximum	47.90	274.61	371.14	13.78	55.76	78.21
	Minimum	8.12	30.94	56.61	6.09	7.73	15.78

Table 5. Measured findings of spleen size by WSH, HSH, and DSLH size method in lateral view and TLS, SLS, and WS in ventral-back view in different breeds (Large, medium and small).

Age		VDMTL	VDMVL	LMVL	LMTL
	Mean	9.5150	67.8600	19.7800	44.2350
	Standard deviation	1.97283	17.80495	10.04092	21.34755
1.00	**Variance**	3.892	317.016	100.820	455.718
	Maximum	10.91	80.45	26.88	59.33
	Minimum	8.12	55.27	12.68	29.14
	Mean	18.1783	113.1217	28.2583	65.9750
	Standard deviation	8.14383	73.23178	10.10002	29.87663
2.00	**Variance**	66.322	5362.893	102.010	892.613
	Maximum	31.28	259.12	39.01	119.93
	Minimum	9.54	57.71	14.76	30.43
	Mean	21.3614	98.2557	28.8857	66.2314
	Standard deviation	10.53739	52.73440	11.52999	30.63328
3.00	**Variance**	111.037	2780.917	132.941	938.398
	Maximum	41.18	204.34	46.68	127.33
	Minimum	10.93	30.94	13.20	28.72
	Mean	22.6563	123.5263	27.9438	72.1038
	Standard deviation	8.25793	65.81109	8.55955	17.68880
4.00	**Variance**	68.193	4331.100	73.266	312.894
	Maximum	40.65	268.90	39.98	100.53
	Minimum	13.34	61.29	13.92	57.32
	Mean	26.4614	126.4157	30.9857	75.3814
	Standard deviation	17.67382	74.10909	10.46783	27.82658
5.00	**Variance**	312.364	5492.157	109.575	774.318
	Maximum	59.94	246.69	45.76	119.97
	Minimum	12.50	69.99	14.47	50.18
	Mean	28.6500	137.1700	39.6233	88.3500
	Standard deviation	13.42945	67.36325	18.33168	36.99033
6.00	**Variance**	180.350	4537.808	336.051	1368.284
	Maximum	43.80	214.55	58.73	130.65
	Minimum	18.21	91.62	22.18	62.07
	Mean	21.7480	118.8720	20.7000	71.2700
	Standard deviation	11.07567	60.81426	8.46717	29.15299
7.00	**Variance**	122.670	3698.374	71.693	849.897
	Maximum	32.50	189.65	33.76	105.71
	Minimum	9.45	56.98	12.45	42.48
	Mean	19.5971	104.2786	27.4600	69.9743
	Standard deviation	9.91290	54.52920	16.07265	29.63239
8.00	**Variance**	98.266	2973.433	258.330	878.079
	Maximum	39.90	213.17	55.91	128.04
	Minimum	11.45	58.53	12.72	34.89
	Mean	25.0033	177.9700	28.4967	103.8100
	Standard deviation	12.65676	87.44184	5.87759	48.47247
9.00	**Variance**	160.194	7646.076	34.546	2349.580
	Maximum	36.69	274.61	32.80	156.96
	Minimum	11.56	104.32	21.80	62.04
	Mean	56.2750	244.0050	48.9800	125.8600
	Standard deviation	30.58237	5.59321	27.33675	24.32447
10.00	**Variance**	935.281	31.284	747.298	591.680
	Maximum	77.90	247.96	68.31	143.06
	Minimum	34.65	240.05	29.65	108.66
	Mean	23.2708	122.6620	28.9960	74.5362
	Standard deviation	13.60085	66.49256	12.46447	30.47335
Total	**Variance**	184.983	4421.260	155.363	928.625
	Maximum	77.90	274.61	68.31	156.96
	Minimum	8.12	30.94	12.45	28.72

Table 6. Measured findings of spleen size by the method of LMTL (lateral maximum transvers length), LMVL (lateral maximum vertical length),VDMTL (ventrodorsal maximum transverse length) and VDMVL (ventrodorsal maximum vertical length) in ventral-back view in different age groups.

Age		WS	SLS	TLS	DSLH	HSH	WSH
1.00	**Mean**	9.5150	67.8600	135.8500	11.8200	10.3400	17.3600
	Standard deviation	1.97283	17.80495	28.92067	.83439	.50912	1.38593
	Variance	3.892	317.016	836.405	.696	.259	1.921
	Maximum	10.91	80.45	156.30	12.41	10.70	18.34
	Minimum	8.12	55.27	115.40	11.23	9.98	16.38
2.00	**Mean**	18.1783	113.1217	176.9333	9.0167	20.4333	35.2483
	Standard deviation	8.14383	73.23178	68.38016	2.15039	13.51805	19.15405
	Variance	66.322	5362.893	4675.846	4.624	182.738	366.877
	Maximum	31.28	259.12	303.60	12.87	45.06	71.09
	Minimum	9.54	57.71	115.00	6.98	7.73	18.82
3.00	**Mean**	21.3614	98.2557	163.0771	11.0371	21.5700	35.6829
	Standard deviation	10.53739	52.73440	92.34933	2.06473	12.91536	16.64530
	Variance	111.037	2780.917	8528.398	4.263	166.806	277.066
	Maximum	41.18	204.34	354.65	12.98	49.07	66.09
	Minimum	10.93	30.94	56.61	7.17	7.83	17.69
4.00	**Mean**	22.6563	123.5263	180.5313	8.8975	20.0400	36.5138
	Standard deviation	8.25793	65.81109	67.10173	1.73875	10.37833	17.34155
	Variance	68.193	4331.100	4502.642	3.023	107.710	300.730
	Maximum	40.65	268.90	312.29	11.96	41.03	73.67
	Minimum	13.34	61.29	85.38	6.12	11.10	15.78
5.00	**Mean**	23.6043	126.4157	197.6457	10.1486	22.3886	40.3329
	Standard deviation	12.09613	74.10909	84.82529	2.81778	10.09646	21.75402
	Variance	146.316	5492.157	7195.330	7.940	101.939	473.237
	Maximum	41.76	246.69	323.04	13.78	39.98	78.21
	Minimum	12.50	69.99	94.06	6.42	8.78	17.59
6.00	**Mean**	28.6500	137.1700	266.9800	10.4267	26.6067	45.5900
	Standard deviation	13.42945	67.36325	88.11145	1.11002	17.69404	19.27808
	Variance	180.350	4537.808	7763.627	1.232	313.079	371.644
	Maximum	43.80	214.55	367.90	11.54	45.98	65.98
	Minimum	18.21	91.62	205.34	9.32	11.30	27.66
7.00	**Mean**	21.7480	118.8720	155.8960	8.6460	24.1220	37.8700
	Standard deviation	11.07567	60.81426	65.45689	2.53654	12.37790	14.75350
	Variance	122.670	3698.374	4284.605	6.434	153.212	217.666
	Maximum	32.50	189.65	228.98	13.04	39.67	54.98
	Minimum	9.45	56.98	79.33	6.56	11.15	18.62
8.00	**Mean**	19.5971	104.2786	139.9414	8.2471	17.5371	34.7400
	Standard deviation	9.91290	54.52920	77.41721	1.35060	9.35748	18.23383
	Variance	98.266	2973.433	5993.424	1.824	87.562	332.473
	Maximum	39.90	213.17	298.09	10.78	37.84	69.43
	Minimum	11.45	58.53	64.74	6.90	11.23	16.80
9.00	**Mean**	25.0033	177.9700	140.3167	7.3233	13.8233	28.9533
	Standard deviation	12.65676	87.44184	48.48972	1.06927	6.67301	10.07297
	Variance	160.194	7646.076	2351.253	1.143	44.529	101.465
	Maximum	36.69	274.61	176.75	7.99	21.50	36.98
	Minimum	11.56	104.32	85.28	6.09	9.41	17.65
10.00	**Mean**	41.2750	244.0050	358.5600	8.9650	46.2250	70.4700
	Standard deviation	9.36916	5.59321	17.79081	.10607	13.48453	.82024
	Variance	87.781	31.284	316.513	.011	181.832	.673
	Maximum	47.90	247.96	371.14	9.04	55.76	71.05
	Minimum	34.65	240.05	345.98	8.89	36.69	69.89
Total	**Mean**	22.2708	122.6620	180.0138	9.3872	21.3684	37.3506
	Standard deviation	10.66145	66.49256	82.95428	2.14550	12.13471	17.97207
	Variance	113.667	4421.260	6881.412	4.603	147.251	322.995
	Maximum	47.90	274.61	371.14	13.78	55.76	78.21
	Minimum	8.12	30.94	56.61	6.09	7.73	15.78

Table 7. Measured results of spleen size by WSH, HSH, and DSLH size method in lateral view and TLS, SLS, and WS in ventral-back view in different age groups.

Discussion

A study was conducted in 2007 by Choi *et al.,* in which the study of 134 dogs referred to Jeosang Veterinary Hospital in South Korea was conducted. Different weights were checked in VD radiographs. The aim of this study was to estimate the standard normal size of the spleen and its changes in relation to age and the length of the first lumbar vertebra (L1) using radiography. Maximum transverse length (MTL) and maximum vertical length (MVL) of the spleen were obtained from abdominal radiographs of 134 dogs radiographed for signs unrelated to splenic disease. Spleen size had no significant relationship with age. MTL and MVL increased with body weight according to non-linear correlation. Also, MTL and MVL increased with L1 length according to linear correlation (Choi *et al.,* 2007).

In our study, it was shown that male and female groups did not have a statistically significant difference in mean spleen size, and it was observed that the spleen size in male dogs was not significantly greater than that of female dogs.

Another research in a research in 2020 by Jang *et al.,* in Korea, was conducted and after the radiographic examinations, the results of this research show showed that the radiographic measurements of the total and segmental length of the spleen had a significant relationship with the corresponding CT measurements and with the volume of the spleen. The agreement between the radiographic and CT measurements of the segmental length was reported to be good in this research. In the retrospective evaluations of Jang et al.'s study, the median segmental length of the spleen was 57.87 mm (range, 34.72 to 105.44 mm) on radiographs. The caudal border of the head of the spleen in the lateral views was from the cranial part of L1 to the caudal part of L2, and the caudal border of the tail of the spleen in the ventral views was from the caudal part of L2 to the caudal part of L5 (Jang *et al.,* 2021).

In that research, they concluded that the segmental length of the spleen in radiography is a reliable estimate of the size of the spleen in healthy cats (Jang *et al.,* 2021). In another study, on 100 healthy cats, it was determined that there was no strong correlation between any of the radiographic and ultrasound measurements of the spleen and each should be used independently to measure and prepare normal sizes (Johnson *et al.,* 2017)

In the present study, the results of the two-sample independent t-test showed that the mean size of the spleen in dogs of different breeds (large, small, medium) was significantly different from the statistical point of view. Also, in the statistical analysis of the results, and the results of the independent t-test of the age of the studied dogs revealed that there is no significant relationship.

Based on the results of the present study, there were differences in the size of the spleen. Therefore, the exact standards obtained in the present study can be used to interpret the results and make clinical decisions to determine the normal and abnormal size of the spleen in dogs.

Conclusion

In the study, considering that two measurement methods were used to determine the size and dimensions of the spleen, and also since there was no more complete research for the radiographic evaluation of the size of the spleen, the findings of this research can be used as a reference in clinical research and examinations be used.

Conflict of interest

The authors have none to declare.

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ارزیابی رادیوگرافی اندازه طحال و ارتباط آن با سن و جنس در سگ‌های سالم مراجعه کننده به کلینیک‌های حیوانات خانگی شهر تهران

رضا بهمنش*، نگین کاظمی

گروه علوم دامپزشکی، واحد گرمسار، دانشگاه آزاد اسلامی، گرمسار، ایران

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چکیده

زمینه و هدف: طحال سگ بزرگترین اندام لنفاوی آنهاست و اندازه آن در سگها می تواند متفاوت باشد. معیارهای رادیوگرافی برای ارزیابی اندازه طحال یا محدوده مورد انتظار اندازه طحال برای سگ های سالم بسیار کم گزارش شده است و اسپلنومگالی در سگ ها به طور ذهنی بر اساس تغییرات در شکل، وجود حاشیه های صاف یا نمای اندام شکمی طحال است. هدف از انجام این مطالعه بررسی پایایی متغیرهای رادیوگرافی برای تخمین اندازه طحال با ارزیابی رابطه بین حجم طحال و متغیرهای ابعاد رادیوگرافی و همچنین با بررسی همبستگی بین متغیرهای ابعاد رادیوگرافی در سن و جنس‌های مختلف در سگ‌های سالم بود.

مواد و روش‌ها: این مطالعه یک مطالعه مشاهده ای تحلیلی مقطعی بود. این مطالعه شامل اندازه گیری طحال با استفاده از رادیوگرافی ۵۰ سگ بالغ شامل ۲۶ سگ نر (۵۲٪) و ۲۴ سگ ماده (۴۸٪) در نمای شکمی-پشتی و جانبی بود. رادیوگرافی با فرمت DICOM تهیه شد. سپس نسبت طول و عرض طحال (دم طحال و بدن طحال) به دست آمد. برای بررسی ارتباط بین متغیرها از آزمون t دو نمونه ای مستقل و آزمون پیرسون استفاده شد.

یافته‌ها: نتایج نشان داد که گروه نر و ماده تفاوت آماری معنی داری در میانگین اندازه طحال نداشتند و اندازه طحال در سگ های نر به طور معنی داری بیشتر از سگ های ماده نبود ($P>0/05$). نتایج نشان داد که میانگین اندازه طحال در سگ‌های نژادهای مختلف (بزرگ، متوسط و کوچک) معنی‌دار نبود ($P<0/05$) و تجزیه و تحلیل آماری یافته‌های مربوط به سن نشان دادند که بین اندازه طحال و سن رابطه معنی داری وجود نداشت ($P>0/05$).

نتیجه‌گیری: از استانداردهای دقیق به‌دست آمده در مطالعه حاضر می‌توان در تفسیر نتایج و تصمیم‌گیری‌های بالینی برای تعیین اندازه طبیعی و غیرطبیعی طحال و نسبت آن با سن و جنس در سگ‌ها استفاده کرد.

واژه‌های کلیدی: *طحال، رادیوگرافی، سگ*

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* نویسنده مسئول: *گروه علوم دامپزشکی، واحد گرمسار، دانشگاه آزاد اسلامی، گرمسار، ایران.*

E-mail: behmaneshdvr@iau.ac.ir, Orcid: https://orcid.org/ 0000-0003-0521-1424