Radiographic assessment of splenic size and correlation with splenic measurements estimated by use of computed tomography in healthy cats

Youjung Jang DVM, MS
Eunji Lee DVM
Sang-Kwon Lee DVM, MS
Hyejin Je DVM, MS
Jin-Woo Jung DVM, MS
Seolyn Jang DVM
Bo-Kwon Choi DVM
Suhyun Lee DVM
Saran Chhoey DVM
Jihye Choi DVM, PhD

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From the Department of Veterinary Medical Imaging, College of Veterinary Medicine, and BK21 Plus Project Team, Chonnam National University, Gwangju 61186, Republic of Korea.

Address correspondence to Dr. Choi (imsono@chonnam.ac.kr).

OBJECTIVE
To investigate radiographic variables for correlation with splenic size as estimated with CT in cats.

ANIMALS
38 healthy adult cats.

PROCEDURES
The width and height of the splenic head and total length, segmental length, and width of the spleen were measured on radiographic and CT images obtained from 10 cats in prospective, exploratory experiments. Distance between the splenic head and left kidney, anatomic locations of the head and tail of the spleen, and CT-derived splenic volume were also assessed. Correlation and agreement between radiographic and CT measurements and interobserver agreement for measurements with each method were determined. A retrospective evaluation of radiographs obtained without sedation or anesthesia for 28 cats was performed to establish preliminary guidelines for the measurement deemed the most reliable estimator of splenic size.

RESULTS
Radiographic measurements of total and segmental splenic length were significantly correlated with the respective CT measurements and with splenic volume. Agreement between radiographic and CT measurements of segmental length was good; interobserver agreement was excellent for all variables. In retrospective evaluations, median segmental length of the spleen was 57.87 mm (range, 34.72 to 105.44 mm) on radiographs; the caudal border of the splenic head on lateral views was located from the cranial part of L1 to the caudal part of L2, and the caudal border of the splenic tail on ventrodorsal views was located from the caudal part of L2 to the caudal part of L5.

CONCLUSIONS AND CLINICAL RELEVANCE
Results indicated that segmental length of the spleen on radiographs is a reliable estimator of splenic size in healthy cats. (*Am J Vet Res* 2021;82:546–553)

The spleen in cats is a nonsinusoidal structure that has less storage capacity for large amounts of blood, compared with the spleen in dogs.[1] Physiologic splenomegaly is rare in cats, and severe splenomegaly is usually a response to pathological changes, including infiltrative tumors, infectious or immune-mediated disorders, conditions that cause extramedullary hematopoiesis, and lymphoid hyperplasia.[2–4] Many studies[5–8] have investigated the size of the spleen in cats, mainly with ultrasonography. An ultrasonographically measured height of the proximal third of the spleen > 9.1 mm indicates splenomegaly.[6]

Ultrasonography is used as the first-line standard diagnostic test for cats with suspected splenic disease. In the absence of access to ultrasonographic imaging, radiography may be used in veterinary clinics. However, investigations of the use of radiography to evaluate splenic size in cats has been limited. In 2 studies,[7,8] the radiographic WSH and HSH and the WS were measured and compared with the ultrasonographic WS. However, correlations between radiographic and ultrasonographic measurements were not consistent in either study. Thus, the radiographic criteria for assessing splenic size or expected ranges of the splenic size have not been reported for healthy cats. Splenomegaly in cats is determined subjectively on the basis of changes in shape, presence of blunt margins, or visibility of the ventral extremity of the spleen in a lateral view.[9]

ABBREVIATIONS

HSH	Height of the splenic head
ICC	Intraclass correlation coefficient
SLS	Segmental length of the spleen
TLS	Total length of the spleen
WS	Width of the spleen
WSH	Width of the splenic head

In people, splenic volume estimated with CT is considered the most accurate representation of splenic size, and studies[10–16] have been performed to find a simple measurement that is strongly correlated with the CT-assessed volume for a rapid diagnosis of splenomegaly. In veterinary medicine, investigators of 2 studies[17,18] used CT to measure the splenic volume in dogs to assess the effects of anesthetic drugs on splenic size. However, to the best of our knowledge, there has been no study to find a simple measurement to represent splenic size as determined by the CT-measured splenic volume in cats.

The purpose of the study reported here was to investigate the reliability of radiographic variables for estimation of splenic size by assessing the association between splenic volume and dimensional radiographic and CT variables and by investigating the correlation between radiographic and CT dimensional variables in healthy cats with Spearman correlation analysis. A secondary aim was to establish preliminary guidelines for assessment of the radiographic variable chosen as the most reliable estimator of splenic size in healthy cats. We hypothesized that measurements of splenic length on radiographic images would be significantly correlated with splenic volume and could be used as reliable estimates of splenic size in cats.

Materials and Methods

The study was designed in 2 parts. The first part of the study was prospective and comprised exploratory experiments to investigate correlations among radiographic and CT measurements of the spleen, assess interobserver agreement (ie, interobserver reliability) for these measurements, and determine anatomic locations of the splenic head and tail in healthy cats. In the second part of the study, radiographs of healthy cats were retrospectively evaluated to estimate splenic size by use of the radiographic measurement that was selected for this purpose in part 1, and anatomic locations of the splenic head and tail were recorded.

Part 1

Animals—A convenience sample of 10 cats owned by veterinary students of Chonnam National University College of Veterinary Medicine was enrolled for participation in part 1. Written informed consent was obtained from all cat owners prior to their pet's inclusion in the study. The study protocol was approved by the Institutional Animal Care and Use Committee at Chonnam National University, and the protocol for the care of cats adhered to the Guidelines for Animal Experiments of Chonnam National University (CNU IACUC-YB-2019-40). The cats were deemed healthy on the basis of history and the results of a general physical examination, CBC, serum biochemical analysis, radiography, abdominal ultrasonography, and echocardiography.

Imaging—Radiographic and CT examinations were performed with the cats under general anesthesia because the CT had to be performed with cats in the same position used to obtain ventrodorsal radiographic views. After food was withheld for ≥ 12 hours, anesthesia was induced by IV injection of alfaxalone[a] (0.3 mg/kg); an endotracheal tube was placed, and anesthesia was maintained with isoflurane[b] in oxygen (1 L/min). Immediately after the induction of anesthesia, right lateral radiographs were obtained; cats were then placed in dorsal recumbency with the forelimbs extended cranially and hind limbs extended caudally, and ventrodorsal radiographs and CT images were obtained. Radiographic images were obtained with a digital radiographic system[c] (maximum tube voltage, 125 kV; maximum tube current, 500 mA) and a cesium iodine–based flat-panel detector[d] integrated into the table. The radiographs were obtained by placing the cats directly on the table without use of a grid. A focal film distance of 100 cm was used with exposure factors of 50 to 70 kV (depending on the size of the cat) and 3 mA. Non–contrast-enhanced CT images were acquired with a 16-row multidetector scanner[e] with the following settings: 16 rows × 0.5-mm collimation, helical pitch of 0.8, rotation duration of 600 milliseconds, tube voltage of 130 kV, and effective tube current of 120 mA. The CT images were reconstructed in transverse, dorsal, and sagittal planes with a thickness of 1 mm, slice interval of 0.7 mm, and soft tissue algorithm.

Splenic measurements—Radiographic and CT measurements of the spleen were performed independently at the same workstation by 2 observers (YJ and EL) using electronic calipers on a DICOM-formatted file[f] in a blinded manner. The CT images were evaluated with a window width of 400 HU and a window level of 40 HU. If the splenic margins could not be clearly observed, the cat was excluded from further analyses. The splenic volume was measured with CT volume–measuring software[g] by summing regions of interests drawn over the spleen on transverse images by tracing on each slice.

Measurements used to determine the WSH, HSH, TLS, SLS, WS, and distance between the splenic head and left kidney on radiographic and CT images are shown **(Figures 1 and 2)**. On CT images, the TLS was determined by measuring the SLS and length of the splenic head as shown and adding the 2 values together. The location of the spleen was assessed by comparing the caudal border of the splenic head to the level of the adjacent vertebrae, with the relevant vertebral bodies divided into 3 parts (cranial, middle, and caudal) on lateral radiographic views and sagittal or parasagittal plane CT images, and by comparing the caudal border of the splenic tail to the level of the adjacent vertebrae in the same manner on ventrodorsal radiographic views and dorsal plane CT images.

Correlations between radiographic and CT splenic measurements and the CT-derived splenic volume were assessed, and correlations between each

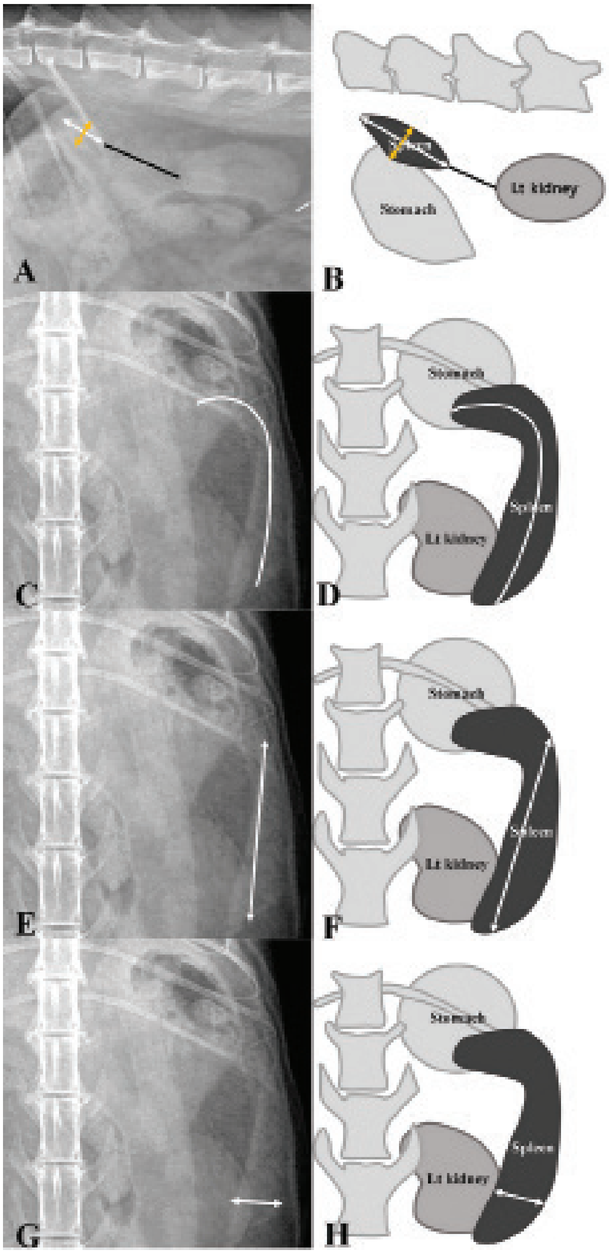

Figure 1—Radiographic images (A, C, E, and G) and corresponding diagrams (B, D, F, and H) depicting measurements of the spleen in healthy cats in a study to investigate radiographic variables for correlation with splenic size as estimated with CT in this species. Images in panels A and B show measurements obtained on lateral views in the study; the remaining measurements were obtained on ventrodorsal views. A and B—The WSH (white arrow) was measured in a straight line from the cranial to the caudal margin of the splenic head at the widest craniocaudal dimension. The HSH (yellow arrow) was measured in a straight line at the widest dorsoventral dimension, perpendicular to the WSH. The distance from the caudal border of the splenic head to the cranial pole of the left kidney (black line) was measured in a straight line on the same view. C and D—The TLS was measured by connecting the point from the start of the splenic head to the end of the splenic tail through a curved midline. E and F—The SLS was measured in a straight line from the point where the splenic body folded to the end of the splenic tail. G and H—The WS was measured in a straight line at the widest lateromedial dimension, perpendicular to the curvilinear long axis of the spleen. Lt = left.

radiographic measurement and the corresponding CT measurement were also investigated. For these analyses, the mean value of the measurements from the 2 observers was used. Interobserver agreement of the measurements was also determined. Finally, the radiographic variable with the greatest reliability for estimation of CT-derived splenic volume was selected (on the basis of Spearman correlation analysis and Bland-Altman analyses) to estimate splenic size in part 2.

Part 2

Electronic medical records were searched to identify healthy adult cats that had undergone radiography at Chonnam National University Veterinary Teaching Hospital from January 1, 2017, to June 30, 2019. The search terms used included adult, cat, CBC, radiography, serum biochemical analysis, and ultrasound. To be selected for the study, cats were required to be > 1 year of age, have no abnormal findings on CBC and serum biochemical analysis, and have no underlying diseases identified that could affect splenic size, such as anemia, infections, or heart failure. In addition, the cats were required to have the following: no abnormal findings on ultrasonographic examination of the spleen, right lateral and ventrodorsal radiographic views of the abdomen obtained without anesthesia or sedation, and clearly visible splenic margins on radiographic images.

Splenic size was estimated for each cat by measurement of the variable selected for this purpose in part 1 of the study. The locations of the splenic head and tail were assessed by the same method that was used in part 1.

Statistical analysis

Statistical analyses were performed by 1 author (YJ) who used commercially available software[h] under supervision of 1 statistician. Normality of the splenic volume on CT was assessed with the Shapiro-Wilk test, and results indicated the data were nonparametric. Spearman correlation analysis was used to assess associations between the CT- and splenic volume–derived variables and the remaining variables measured with each modality and to assess the associations between radiographic and CT measurements for each variable. Spearman correlation analysis was also used to investigate associations between the radiographic variable selected as the most reliable estimator of splenic size and body weight. Agreement between radiographic and CT measurements for selected variables was evaluated with Bland-Altman analysis, and a 1-sample t test was performed to calculate the mean bias. Finally, agreement between the 2 observers for the measurements of interest was analyzed by calculating the ICC and 95% CIs for the data sets in both parts of the study. Cutoffs used to evaluate the ICC were as follows: < 0.4 = poor agreement, 0.41 to 0.6 = moderate agreement, 0.61 to 0.79 = good agreement, and > 0.8 = excellent agreement.[19] Values of $P < 0.05$ were considered significant.

Results

Part 1

Animals enrolled in the prospective portion of the study included 6 domestic shorthair cats and 1 each of the following breeds: Russian Blue, Turkish Angora, Scottish Fold, and Highland Fold. The mean ± SD age was 4.25 ± 1.94 years (range, 2 to 8 years), and the mean ± SD body weight was 5.28 ± 1.72 kg (range, 3.4 to 10 kg). There were 5 males (3 sexually intact and 2 neutered) and 5 females (3 sexually intact and 2 spayed).

The splenic head was visible on the lateral radiographic view for 9 of 10 cats, and the WSH and HSH were measured for 9 cats. However, the distance between the spleen and left kidney was measured for 8 cats because of partial superimposition of the splenic head and left kidney in another cat. The spleen was visible on the ventrodorsal view for all cats, and the TLS, SLS, and WS were measured for all cats. The caudal border of the splenic head was located from the caudal part of L1 to the middle part of L2, and the caudal border of the splenic tail was located from the caudal part of L3 to the caudal part of L5.

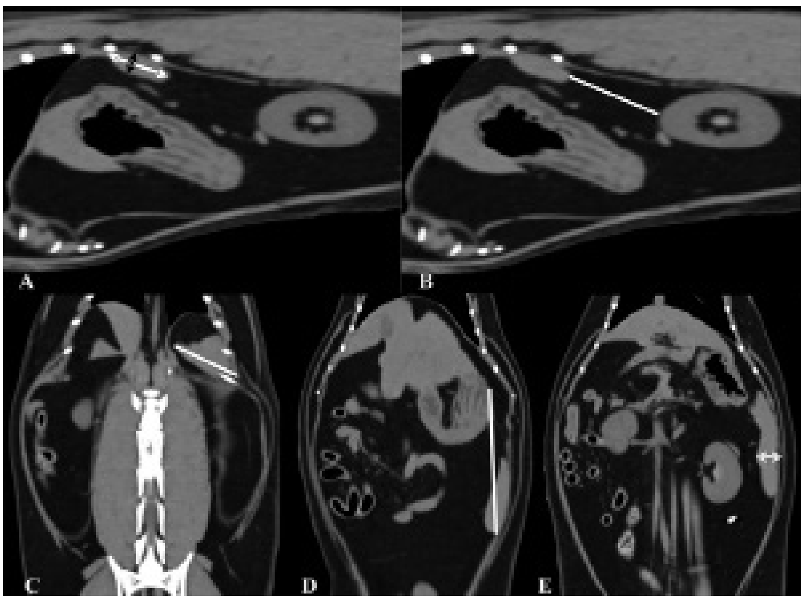

Figure 2—Multiplanar reconstructed parasagittal (A and B) and dorsal plane (C through E) CT images depicting measurement of the spleen in healthy cats (slice thickness, 1 mm). A—The WSH (white arrow) was measured in a straight line at the widest craniocaudal dimension, showing the maximal section of the splenic head. The HSH (black arrow) was measured in a straight line at the widest dorsoventral dimension, perpendicular to the WSH. B—The distance from the caudal border of the splenic head to the cranial pole of the left kidney was measured in a straight line in the same plane. C—The length of the splenic head was measured on dorsal plane images in a straight line connecting the point where the splenic head first appeared during assessment of each of the sagittal CT images (from the most medial to left most lateral) to the point where the splenic body first appeared (the location of the splenic fold) during evaluation of all transverse CT images (from the most cranial to the most caudal). Then, the TLS was calculated as the sum of SLS and the length of the splenic head. D—The SLS was measured in a straight line connecting the point from where the splenic body folded to the point where the splenic tail ended. E—The WS (arrow) was measured in a straight line at the widest lateromedial dimension, perpendicular to the long axis of the spleen.

On CT, all required variables were measured on parasagittal (WSH and HSH) and dorsal plane (length of the splenic head, SLS, and WS) images for all cats. The caudal border of the splenic head was located from the caudal part of T13 to the caudal part of L1, and the caudal border of the splenic tail was located from the caudal part of L3 to the cranial part of L6. The median CT-derived splenic volume was 19.05 cm^3 (range, 10.25 to 46.13 cm^3).

All radiographic variables measured on the ventrodorsal views (TLS, SLS, and WS) were significantly correlated with splenic volume **(Table 1)**. However, no radiographic variables measured on the lateral views were significantly correlated with splenic volume. All CT variables measured on dorsal plane images (TLS, SLS, and WS) were also significantly correlated with splenic volume, whereas only 2 of 3 variables measured on parasagittal plane images (WSH and HSH) had this result.

Table 1—Results of Spearman correlation analysis for associations of splenic variables measured on radiographic and CT images with CT-derived splenic volume for 10 healthy cats enrolled in a study to investigate radiographic variables for correlation with splenic size as estimated with CT in this species.

		Radiographic measurement		CT measurement	
Variable	**No. of cats**	r_S	***P* value**	r_S	***P* value**
WSH	9	0.183	0.637	0.636	0.048
HSH	9	0.217	0.576	0.709	0.022
DSLH	8	0.367	0.332	0.297	0.405
TLS	10	0.657	0.039	0.964	0.000
SLS	10	0.818	0.004	0.867	0.001
WS	10	0.636	0.048	0.794	0.006

DSLH = Distance between the splenic head and left kidney. Missing measurements were attributable to difficulty locating limits of the splenic head (n = 1) and partial superimposition between the left kidney and splenic head (1).

Table 2—Median (range) measurements for splenic variables measured on radiographic and CT images and results of Spearman correlation analysis between measurements obtained with each modality for the 10 cats in Table 1.

Variable	No. of cats	Radiography	CT	r_S	*P* value
WSH	9	24.58 (17.11–30.49)	22.80 (16.29–33.98)	0.400	0.286
HSH	9	10.49 (6.76–14.78)	10.27 (6.95–15.88)	0.376	0.332
DSLH	8	21.94 (5.14–31.24)	21.58 (13.21–29.67)	0.794	0.006
TLS	10	163.00 (135.00–274.00)	106.91 (84.05–158.34)	0.663	0.037
SLS	10	72.53 (52.80–112.53)	84.29 (53.66–125.55)	0.818	0.004
WS	10	21.40 (15–48.65)	13.78 (11.13–21.00)	0.503	0.130

All measurements are in millimeters.
See Table 1 for remainder of key.

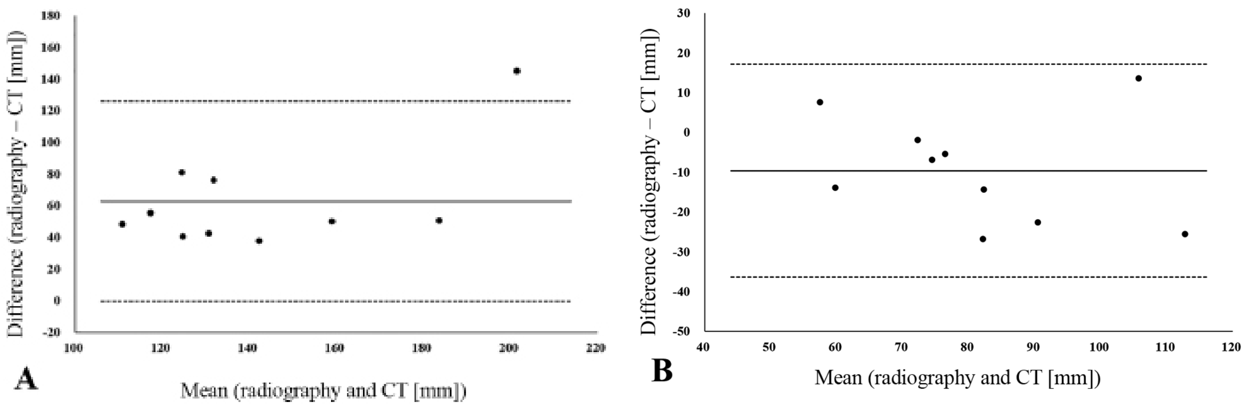

Figure 3—Bland-Altman plots of agreement between radiographic and CT measurements of the TLS (A) and SLS (B) for 10 healthy cats. The solid line indicates mean difference (bias), and dotted lines indicate the 95% limits of agreement.

Table 3—Results of interobserver agreement analysis (ICC [95% CI]) for measurements of splenic variables on radiographic and CT images for the 10 cats in Table 1.

Variable	No. of cats	Radiography	CT
WSH	9	0.970 (0.866–0.993)	0.996 (0.985–0.999)
HSH	9	0.982 (0.992–0.996)	0.988 (0.951–0.997)
DSLH	8	0.998 (0.990–0.999)	0.999 (0.996–1)
TLS	10	0.979 (0.905–0.995)	0.978 (0.911–0.995)
SLS	10	0.990 (0.956–0.998)	0.997 (0.990–0.999)
WS	10	0.818 (0.266–0.955)	0.974 (0.897–0.994)

See Table 1 for key.

The median and range measurements and results of correlation analysis for radiographic and CT variables are summarized **(Table 2)**. Of the variables that were significantly correlated with splenic volume, the radiographic measurements of TLS and SLS were significantly correlated with the respective CT measurements. Bland-Altman analysis of agreement between radiography and CT for measurement of the TLS revealed a significant ($P < 0.001$) mean bias of 62.73 mm (95% limits of agreement, –0.53 to 125.96 mm; **Figure 3**). The same analysis for SLS revealed a mean bias of –9.61 mm (95% limits of agreement, –36.36 to 17.14 mm), which was not significant ($P = 0.053$). Agreement between the 2 observers for all splenic variables measured on radiographic and CT images was excellent **(Table 3)**.

On the basis of the results of experiments in part 1 of the study, the SLS was considered the most reliable radiographic variable for the estimation of splenic size in cats. This variable was subsequently assessed for a larger sample of cats in part 2 of the study.

Part 2

Twenty-eight cats met the inclusion criteria for the retrospective portion of the study. The sample included domestic shorthair cats (n = 15), Scottish Fold (3), Turkish Angora (2), Siamese (2), Russian Blue (2), and Highland Fold, Persian, Ragdoll, and Manx (1 each). The mean ± SD age was 4.59 ± 2.96 years (range, 1 to 10 years), and the mean body weight was 4.83 ± 1.61 kg (range, 2.7 to 10 kg). There were 11 males (3 sexually intact and 8 neutered) and 17 females (3 sexually intact and 14 spayed).

The spleen was visible on the ventrodorsal radiographic view for all cats. The median SLS was 57.87 mm (range, 34.72 to 105.44 mm; 95% CI, 52.62 to 63.64 mm). Interobserver agreement for measurement of SLS was excellent; the ICC was 0.975 (95% CI, 0.945 to 0.988). There was a significant ($P = 0.042$) correlation between SLS and body weight ($r_S = 0.386$).

The location of the splenic head and tail was assessed in 22 cats; 4 cats that each had 6 lumbar vertebrae and 2 cats with vertebral malformations in the thoracolumbar region were excluded from this part of the investigation. The caudal border of the splenic head was located from the cranial part of L1 to the caudal part of L2, and the caudal border of the splenic tail was located from the caudal part of L2 to the caudal part of L5.

Discussion

In the present study, TLS and SLS measured by means of radiography and CT were each significantly correlated with CT-derived splenic volume. Additionally, the radiographically measured TLS and SLS were significantly correlated with the respective CT-measured values. Calculation of the ICC revealed excellent interobserver agreement for these measurements, and on Bland-Altman analysis of agreement between radiographic and CT measurements, the bias for SLS but not TLS was nonsignificant. Although the sample size was small, our study results indicated that SLS was a reliable radiographic factor for estimation of splenic size in healthy cats.

In our study, the CT-derived splenic volume was used as the gold standard for splenic size. To our knowledge, the effects of technical variables such as positioning, gastric distension, or use of contrast medium on CT measurement of the splenic volume have not been assessed in cats. In the study reported here, splenic volume and measurements of splenic dimensions were determined on non–contrast-enhanced images because the spleen was clearly delineated owing to the presence of abdominal fat in all cats and because this eliminated the possible effects of contrast medium on the splenic measurements. The CT portion of the study was performed with the cats in the same dorsally recumbent position used for ventrodorsal radiographic views to minimize possible positional effects on measurements obtained with the 2 modalities. The measurements obtained on lateral radiographic views were compared with those in parasagittal planes of the reconstructed CT images; thus, the distance between the splenic head and left kidney measured on a right lateral radiograph could be expected to differ from that made on a CT image reconstructed from imaging data obtained with the cat in dorsal recumbency. Better correlation between parasagittal CT and lateral radiographic measurements of the distance between the splenic head and left kidney may have been achieved by obtaining the CT images with the cats placed in the same lateral recumbent position as for radiography.

The splenic margins were clearly delineated on radiographic images owing to abundant intraperitoneal fat in most cats. The spleen was consistently observed to be tongue-like, with a segmental fold and the tail wider than the head or body of the organ on ventrodorsal radiographs. In all cats, the spleen was found without remarkable changes in shape along the long axis; therefore, the radiographic measurements could be performed consistently, similar to the CT measurement. In people, the radiographically measured vertical length from the tip of the spleen to its intercept with the diaphragm is reported as the best statistical estimator of splenic weight.[20] On CT, the maximal height of the spleen, which is the longest dimension between poles of the spleen in the coronal plane, has the strongest correlation with splenic volume in people.[14] However, this value is not strictly equivalent to TLS or SLS in our study. Although both radiographic and CT measurements of TLS and SLS were significantly correlated with splenic volume in cats of our study, the Bland-Altman analysis revealed significant bias in the radiographic TLS measurements, compared with the TLS assessed by CT. Bland-Altman analysis revealed good agreement between radiography and CT without bias only for SLS. Thus, SLS was considered the most useful radiographic factor that had correlation and agreement with the CT measurement of splenic size in cats.

Investigators of previous studies[7,8] used the WSH and HSH on lateral views and WS on ventrodorsal views for radiographic assessment of splenic size in cats. In particular, the WS was measured with various methods according to splenic shape (which was divided into 3 categories) in 1 study.[7] For spleens with a solely triangular soft tissue opacity or those that comprised 2 contiguous soft tissue structures with a triangular shape, the measurement was made at the widest point of the triangle, perpendicular to the long axis of the spleen. For spleens with a soft tissue fusiform shape with tapering ends, the measurement was made at the widest point perpendicular to the long axis. Finally, the mean WS was found to be 9.2 ± 2.3 mm on radiographic evaluation; however, it did not correlate with the ultrasonographic measurement of 8.0 ± 1.6 mm.[7] The WS in that study[7] was smaller than the median of 21.4 mm and the mean (24.44 ± 4.6 mm; data not shown) WS determined by radiography in our study. We considered that this difference may have been related to the measurement methods or anesthesia conditions. In our study, WS was measured at the widest point of the spleen without shape classification and with the cats under general anesthesia. We used alfaxalone as the anesthetic induction agent because it is known to have a low degree of cardiovascular and blood pressure suppression effects at low doses in cats.[21] Although we are not aware of a study that investigated the effects of alfaxalone on the splenic volume in cats, alfaxalone has been reported to increase splenic volume in dogs.[18] We administered a smaller dose, compared with the dose given to dogs in the previous study,[18] but splenic size may have been influenced by alfaxalone.

In the aforementioned study,[7] the splenic head was identified on right lateral radiographic views for only 24 of 100 healthy cats. In another study,[8] radiographic measurements of the WSH and HSH on right lateral views varied substantially between 2 observers. In our study, the splenic head was observed for most (9/10) cats on lateral radiographs, and WSH and HSH were measured with excellent interobserver agreement on both radiographic and CT images. The observers were allowed to modify magnification and contrast settings at the workstations when assessing the radiographs in the present study, and this possibly made the splenic head more visible. However, the radiographic measurements of WSH and HSH did not correlate with the respective CT measurements or the splenic volume.

In our study, the radiographically measured WS appeared slightly greater than that measured by CT. This finding and the lack of correlation with WS measured by CT could have been attributable to the fact that the folded part of the spleen would be included in the measurement of the widest point during radiographic measurement, or slight rotation of the spleen when cats were placed in lateral recumbency could have affected the radiographic measurement. Although radiographic images were obtained with the cats placed directly on the table, the distance to the film can induce magnification of an object. This could have resulted in some measurements of splenic dimensions, including WS, being larger on radiographic images than those on CT images.

In people, splenomegaly is predicted if the splenic margin is beyond the inferior third of the left kidney, with high specificity (93.30%) but low sensitivity (19.60%).[12] In our study, the caudal border of the splenic head was located from the cranial part of L1 to the caudal part of L2, and the caudal border of the splenic tail was located from the caudal part of L2 to the caudal part of L5 on radiographic images for all healthy cats, and the distance from the splenic head to the left kidney on radiographic or CT images had no correlation with the splenic volume.

Our study had several limitations. First, the measurements used to assess CT volume of the spleen and the correlation between radiographic variables and CT dimensional variables in the prospective part of the study were obtained with the cats under anesthesia. Anesthesia was required to perform a CT scan for cats in a dorsally recumbent position similar to that used for radiography. We performed radiography and CT in each cat immediately after induction of anesthesia; however, a possible effect of the anesthetic agent on splenic size could not be eliminated. Second, in the retrospective part of the study, radiography was performed without food withholding in some cats, so the degree of gastric distension varied. We are not aware of any study that assessed technical factors affecting splenic size in cats; thus, it was unknown whether gastric dilation could substantially influence the measurements of splenic dimensions. However, there were only 2 cats with gastric dilation in our study, and the measurements obtained were similar to those of the remaining cats. The beam center, respiratory phase, and positioning for radiography were also consistent for all cats. Third, the spleen was considered normal without cytologic or histologic examination. However, all cats were considered healthy on the basis of physical condition, results of hematologic analysis, and ultrasonographic examination of the spleen. Fourth, measurements on radiographs can be subjective to a certain degree. Finally, a relatively small number of cats was used for these investigations.

Overall, our results indicated that SLS on ventrodorsal radiographic views was significantly correlated with splenic CT volume, was in agreement with CT measurements of SLS, and had excellent interobserver agreement, making this a useful indicator of splenic size in healthy cats. The median SLS on radiographs obtained without sedation or anesthesia was 57.87 mm (range, 34.72 to 105.44 mm), with a 95% CI of 52.62 to 63.64 mm. Because of the small sample size, further studies are required with a larger sample of cats to establish reference values. Additional studies are needed to investigate whether SLS is a useful measure to differentiate cats with normal splenic size from cats with pathological splenomegaly.

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Footnotes

a. Alfaxan, Careside Co Ltd, Gyeonggi-do, South Korea.
b. Terrell, Piramal Critical Care Inc, Bethlehem, Pa.
c. EVA-HF525, Gemss-Medical Systems Co Ltd, Seongnam-si, South Korea.
d. FDX4343R, Gemss-Medical Systems Co Ltd, Seongnam-si, South Korea.
e. Siemens Emotion 16, Siemens Medical Systems, Forchheim, Germany.
f. PACS, Infinitt Healthcare Co Ltd, Seoul, South Korea.
g. Somatom Emotion, Siemens Medical Systems, Forchheim, Germany.
h. SPSS Statistics for Windows, version 21.0, IBM Corp, Armonk, NY.

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