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Ultrasonographic biometry of cyclic and non-cyclic ovaries of queens

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Key words: Ultrasonography, Morphology, Cyclic ovaries, Non-cyclic ovaries, Queen

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Abstract

In order to evaluate the morphological characteristics and ultrasonographic biometrical echo characteristics of cyclic and non-cyclic ovaries in queens, the studies were carried out during the year 2012. Ultrasonographic biometry of left ovaries of non-cyclic queens showed 10.05 ±2.40 mm length, 5.27±1.11 mm width, 3.20±0.33 mm thickness, 25.1±2.71 mm circumference, 0.14±0.08 g weight and 0.40±0.13 cm^2 volume; while their right ovaries showed 10.35±4.34 mm length, 4.70±0.90 mm width, 2.90±0.62 mm thickness, 24.10±8.93 mm circumference, 0.16±0.10 g weight and 0.40±0.17 cm^2 volume. The examination on left ovaries of queens showed 3.75 ± 0.95 primary follicles, 3.75±0.50 secondary follicles, 3.25±1.50 tertiary follicles; while their right ovaries of queens showed 4.00±1.41 primary follicles, 3.25±1.25 secondary follicles, 3.00±1.15 tertiary follicles. It was concluded that the health and body condition score was significantly better for cyclic queens as compared to non-cyclic queens. Morpho-biometry measurements were higher in case of left ovaries than the right ovaries. Ultrasonographic biometry measurements were higher for left ovaries than the right ovaries of queens. Number of secondary follicles differed significantly in left and right ovary and non-significant for primary and tertiary follicles; there were non-significant differences in Morpho-biometry measurements in non-cyclic and cyclic queens.

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Introduction

Ovariohysterectomy is a surgical procedure in which both ovaries and most of the uterus are removed from the body. It is most commonly performed to prevent reproduction, which consequently helps to control pet overpopulation. It is a common surgical procedure performed in general practice for which the benefits. It is important to establish the norms of reproductive parameters. One such parameter in the cat is the reproductive potential expressed as the number and quality of follicles. It is important to evaluate this parameter as a co-relation between number of primordial follicles and Graafian follicles ≥1 mm (Sattergren, 1964). In contrast, veterinarians in the United States almost exclusively use the ventral midline approach for ovariohysterectomy in small animals, although the lateral flank approach is commonly used in bovine and equine species.

The lateral flank approach has been described for both dogs and cats. However, its use in small animals has failed to gain widespread acceptance in the United States, perhaps because of differences in surgical ideology, anesthesia protocols, and postoperative management. Recently, there has been renewed interest in the lateral flank approach among veterinarian associated with feral animal and shelter medicine program. Several factors induce morpho-physiological adaptations in animals and could contribute to the modification of the reproductive efficiency. Ultrasonography is a simple, reliable and non-invasive imaging technique without secondary effects. Application of real time ultrasonography in veterinary practice has developed to become the most efficient diagnostic tool for managing reproduction. Ultrasonography, using the reflections of high-frequency sound waves to construct an image of a body organ (a sonogram); commonly used to observe fetal growth or study bodily organs. Ultrasonography of ovaries measurement accurately predicted ovaries weight, the small degree of additional accuracy achieved over measurement by calipers does not justify the use of sonography in each case. However, if ovaries ultrasound scan is being performed, the ultrasonic measurements could be used to predict whether it is cyclic or non-cyclic by measuring the numbers of primary, secondary and tertiary follicles present on the ovary. Development of extension education programs to train practitioners to use ultrasound for routine reproductive examinations is a critical step toward rapid implementation of this technology.

Materials and methods

Eight healthy queens aged between seven weeks to three years were used in this study. The cats and were procured from villages surrounding to Tandojam. They were kept at Indoor Patient Ward (IPW), Department of Surgery and Obstetrics, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam. Cats were allowed to adapt to their surroundings for minimal period of two weeks before surgery. They were vaccinated against Distemper, Canine Adenovirosesept, Canine Parvovirosis, Leptospirosis (inactivated leptospiracanicola and inactivated leptospiraic terohaemorrhagiae) and Rabies (Hexadog "Merial Co. Karachi, Pakistan" 1 ml/dog). All the cats were dewormed with combating (Phizer Co. USA) at least fourteen days prior to operation. Feeding would be withheld twelve hours before operation. Access to water intake was allowed freely.

Experimental design

Eight queens were ovariohysterectomies to collect the ovaries for ultrasonographic biometry.

Surgical procedure

Routine pre-operative measures such as sterilization of instruments, preparation of patient, preparation of surgeon etc. was taken before surgery. The cats were premeditated with acetyl promazine at the dose rate of 0.05mg/kg body weight I/M. general anesthesia was induced with diazepam (0.5-1.0mg/kg) and ketamine (5.0-10.0mg I/v). Strict aseptic measures and close monitoring was performed during surgery. The cats were premeditated with acetyl promazine at the dose rate of 0.05Mg/kg body weight I/M. General anesthesia was induced with diazepam (0.5mg/kg i/v) and ketamine (10.0 mg I/v and maintained with boosting doses when needed. Strict aseptic measures and close monitoring was performed during surgery.

The surgical instruments were sterilized in autoclave for 30 minutes. The hair over and around the incision site were clipped with electric hair clipper. The area was scrubbed thoroughly and washed with water and soap. When surgical area was dried then tincture of iodine was painted.

Anesthetized animals were placed in dorsal recumbency on operation table. Four sterilized towels were used for draping the incision site. These towels were held in fixed position with towel clamps. The right ovary was squeezed out by traction against the skin of the scrotum between the thumb and index finger. Single median pre-scrotal incision about 3 cm in length was given over skin and subcutaneous tissue. Incision through spermatic fascia was continued until the ovary and its covering were open. The ovary was still attached to the tunica parietals vaginalis by the ligament.

The ovary was removed in the same manner through the same skin incision. Ovary of cats and toms will be collected and Ultrasonographically measured for biometry. A course of antibiotic cover with injection of Amoxicillin 1gm.I/M daily will be given for five days post-operative to ensure complete safety and to prevent infection.

Antiseptic dressing was applied on the wound daily for first three days and then wounds were left uncovered and will be disinfected with alcohol 70% daily till healing of the wound is complete. No diet was given to pets for 12 hours after surgery and then, only liquid nutritive diet (milk and bread) was given for further two days. Then normal diet (bread, meat and milk) were given till termination of experiment.

Observation and Record

All the animals was observed twice daily (morning and evening) for physiological function such as respiratory rate, body temperature, defecation, urination, feeding , drinking, behavior and activity, gait, posture and voice for next fifteen days. Following parameters were recorded in each animal twice daily in morning and evening.

Ultrasound imaging of the Ovary

All the cats under study were examined. The ovary of each animal was scanned while restrained in the dorsal position without using any sedative using a B-mode real time ultrasound scanner (Honda 2000 vet Tokyo, Japan) equipped with a multifrequency 5-10 MHz linear-array transducer.

The skin was washed before the application of ultrasound gel to improve the penetration of sound waves through the skin. Prior to scanning, the ovary was pulled down very gently. Each ovary was scanned, by placing transducer directly on the skin. For transverse view, the transducer will be placed perpendicularly to its long axis while moving it from dorsum to the ventral edge of the ovary, which produced a round image of the ovaries.

For longitudinal view, the transducer was placed vertically parallel to the long axis of the ovary. The volume and circumference was correlated with age and live body weight in cats.

Results

The present study was carried out during the academic year 2011-12 to evaluate the morphological characteristics of cyclic and non-cyclic ovaries in queens; study and compare ultra sonographic biometrical echo characteristics of ovaries in cat and to determine best, reliable and accurate method of biometry of ovaries in cat. The data on various relevant aspects are presented in Tables 1 to 6 and the results are interpreted as follows:

Health and body condition score of cyclic and non-cyclic queens

The data in regards to health and body condition score of cyclic and non-cyclic queens are shown in Table-1, which indicated that there was significant ($P<0.05$) difference in age, body weight and body condition score (before) in cyclic and non-cyclic queens; while the differences in body condition score (after) were non-significant ($P>0.05$) between cyclic and non-cyclic queens. The observations on cyclic queens showed 2.82±0.23 years of average age, 3.2±0.29 kg body weight, 2.25±0.95 BCS (before) and 2.75±0.50 BCS (after); while in non-cyclic queens average age was 1.55±0.42 years, 1.82±0.23 kg body weight, 2.0±0.81 BCS (before) and 2.50±0.57 BCS (after).

Table 1. Health and body condition score of cyclic and noncyclic queens.

Parameters	Cyclic Queens Mean ± SD	Non-Cyclic Queens Mean ± SD	P-value	Significance
Age (years)	2.82 ± 023	1.55 ± 0.42	0.02	*
Body Weight (kg)	3.2 ± 0.29	1.82 ± 0.23	0.003	**
BCS (before)	2.25 ± 0.95	2 ± 0.81	0.046	*
BCS (after)	2.75 ± 0.5	2.5 ± 0.57	0.07	NS

* = significant
** = highly significant
NS = non significant

Morpho-biometry of ovaries in cyclic and non-cyclic queens

The data in regards to morpho-biometry of ovaries in cyclic and noncyclic queens are shown in Table 2, which showed that there was significant (P<0.05) difference in length, thickness.

Circumference and weight of left and right ovaries of cyclic and non-cyclic queens; while the differences in width of ovaries were non-significant (P>0.05). The examination on left ovaries of cyclic queens showed 10.25±3.77 mm length, 5±1.63 mm width, 4.75±1.50mm thickness, 17.75±7.93 mm circumference and 0.19 ± 0.14 g weight; while their right ovaries showed 8.37±1.25mm length, 5 ± 1.41mm width, 3.87 ± 0.85mm thickness, 13.85 ± 3.84mm circumference and 0.14±0.11 g weight.

The examination on left ovaries of non-cyclic queens showed 9.75±0.95mm length, 5.5±1.00mm width, 3.75±0.50mm thickness, 16.25±3.40mm circumference and 0.14±0.08g weight; while their right ovaries showed 9.12±0.85mm length, 4.75±0.50mm width, 3.75±1.50mm thickness, 15.00±5.09 mm circumference and 0.16±0.10g weight.

Table 2. Morpho-biometry of ovaries in cyclic and non cyclic queens.

Measurements	Cyclic left ovary Mean±SD	Cyclic right ovary Mean±SD	Non cyclic left ovary Mean ± SD	Non cyclic right ovary Mean±SD	P-value	Significance
Length (mm)	10.25 ±3.77	8.37 ± 1.25	9.75±0.95	9.12±0.85	0.04	*
Width (mm)	5 ± 1.63	5 ± 1.41	5.5± 1	4.75±0.5	0.08	NS
Thickness (mm)	4.75 ± 1.5	3.87± 0.85	3.75± 0.5	3.75±1.5	0.003	**
Circumference (mm)	17.75± 7.93	13.85± 3.84	16.25± 3.40	15±5.09	0.001	**
Weight (gm)	0.19± 0.14	0.14±0.11	0.14±0.08	0.16±0.10	0.02	*

* = significant
** = highly significant
NS = non significant

Ultra sonographic biometry of ovaries in cyclic and non-cyclicqueens

The data in regards to Ultrasonographic biometry of ovaries in cyclic and non-cyclic queens are shown in Table-3, which indicated that there was significant (P<0.05) difference in width, circumference and weight of left and right ovaries of cyclic and non-cyclic queens; while the differences in length, thickness and volume of ovaries were non-significant (P>0.05). The examination on left ovaries of cyclic queens showed 10.40±1.93mm length, 5.6±0.46mm width, 3.52±1.44mm thickness, 27.35±3.87mm circumference, 0.19±0.14g weight and 0.40±0.04cm² volume; while their right ovaries showed 9.32±2.29mm length, 4.65±1.53mm width, 3.62±1.65mm thickness, 22.75±5.84mm circumference, 0.14±0.11g weight and 0.40±0.18cm² volume. Ultrasonographic biometry of left ovaries of non-cyclic queens showed 10.05±2.40mm length, 5.27±1.11mm width, 3.20±0.33mm thickness, 25.1±2.71mm circumference, 0.14±0.08g weight and 0.40±0.13cm² volume; while their right ovaries showed 10.35±4.34mm length, 4.70±0.90mm width, 2.90±0.62mm. Thickness, 24.10±8.93 mm circumference, 0.16±0.10g weight and 0.40±0.17 cm² volume.

Table 3. Ultra sonographic biometry of ovaries in cyclic and noncyclic queens.

Measurements	Cyclic Left ovary Mean ± SD	Cyclic Right ovary Mean ± SD	Non Cyclic Left ovary Mean ± SD	Non Cyclic Right ovary Mean ± SD	P-value	Significance
Length (mm)	10.4±1.93	9.32 ±2.29	10.05 ±2.40	10.35 ±4.34	0.06	NS
Width (mm)	5.6±0.46	4.65 ±1.53	5.27 ±1.11	4.7 ±0.90	0.021	*
Thickness (mm)	3.52±1.44	3.62 ±1.65	3.2 ±0.33	2.9 ±0.62	0.072	NS
Circumference (mm)	27.35±3.87	22.75±5.84	25.1 ±2.71	24.1 ±8.93	0.002	**
Weight (gm)	0.19±0.14	0.14±0.11	0.14±0.08	0.16 ±0.10	0.021	*
Volume (cm^2)	0.40± 0.04	0.40±0.18	0.40±0.13	0.40±0.17	1.00	NS

* = significant
** = highly significant
NS = non significant

Ultra sonographic biometry of follicles in queens

The data in relation to ultrasonographic biometry of follicles queens given in Table-4, indicated that there was significant (P<0.05) difference in the number of secondary follicles of left and right ovaries of queens; while the differences in number of primary follicles and tertiary follicles were non-significant (P>0.05). The examination on left ovaries of queens showed 3.75±0.95 primary follicles, 3.75±0.50 secondary follicles, 3.25±1.50 tertiary follicles; while their right ovaries of queens showed 4.00±1.41 primary follicles, 3.25±1.25 secondary follicles, 3.00±1.15 tertiary follicles.

Table 4. Ultrasonographic biometry of follicles in queens.

Measurements	Follicle on Left ovary Mean ± SD	Follicle on Right ovary Mean ± SD	P-value	Significance
Primary follicles (Nos.)	3.75±0.95	4±1.41	0.060	NS
Secondary follicles (Nos.)	3.75±0.5	3.25±1.25	0.046	*
Tertiary follicles (Nos.)	3.25±1.5	3±1.15	0.092	NS

* = significant
** = highly significant
NS = non significant

Comparison of morpho-biometry of ovaries in cyclic and non cyclic queens

The data pertaining to morpho-biometry of ovaries in cyclic and non cyclic queens given in Table-5, showed that there was significant (P<0.05) difference in the thickness of ovaries of cyclic and non-cyclic queens; while the differences in length, width.

Circumference, volume and weight of ovaries of cyclic and non-cyclic queens were non-significant (P>0.05). The examination of ovaries of cyclic queens showed 9.31±2.78mm length, 5.00±1.41mm width, 4.31±1.22 mm thickness, 15.8±6.13mm circumference, 0.40±0.12cm^2 volume and 0.16±0.12g weight; while ovaries of non-cyclic queens showed 9.43±0.90mm length, 5.12±0.83 mm width, 3.75±1.03mm thickness, 15.62±4.06mm circumference, 0.40±0.14cm^2 volume and 0.15±0.08g weight.

The number of primary, secondary and tertiary follicles in cyclic queens was 3.87±1.12, 3.50±0.92 and 3.12±1.24, respectively; while in non-cyclic queens the primary, secondary and tertiary follicles were not existed.

Table 5. Comparison of Morpho-biometry of ovaries in cyclic and non cyclic. Queens.

Measurements	Cyclic queens Mean ± SD	Non-Cyclic queens Mean ± SD	P-value	Significance
Length (mm)	9.31 ±2.78	9.43±0.90	0.062	NS
Width (mm)	5 ±1.41	5.12±0.83	0.078	NS
Thickness (mm)	4.31±1.22	3.75±1.03	0.023	*
Circumference (mm)	15.8±6.13	15.62±4.06	0.072	NS
Volume (cm^2)	0.40 ±0.12	0.40 ± 0.14	1.00	NS
Weight (gm)	0.16±0.12	0.15±0.08	0.932	NS
Primary follicles (Nos.)	3.87±1.12	-	-	-
Secondary follicles (Nos.)	3.5±0.92	-	-	-
Tertiary follicles (Nos.)	3.12±1.24	-	-	-

* = significant, ** = highly significant, NS = non significant

Comparison of Ultrasonographic biometry in cyclic and non cyclic queens

The comparison of ultrasonographic biometry in cyclic and non cyclic queens was made and the data in regards to comparison of ultrasonographic biometry is given in Table-6, which indicated that there was significant ($P<0.05$) difference in the thickness of ovaries of cyclic and non-cyclic queens; while the differences in length, width.

Circumference, volume and weight of ovaries of cyclic and non-cyclic queens were non-significant ($P>0.05$).

The examination of ovaries of cyclic queens showed 9.86±2.04mm length, 5.12±1.16mm width, 3.57±1.43mm thickness, 25.05±5.20mm circumference, 0.40±0.12cm^2 volume and 0.16±0.12g weight; while ovaries of non-cyclic queens showed 10.20±3.25mm length, 4.98±0.98mm width, 3.05±0.48mm thickness, 24.06±6.13 mm circumference, 0.40±0.14cm^2 volume and 0.15±0.08g weight. The number of primary, secondary and tertiary follicles in cyclic queens was 3.87±1.12, 3.50±0.92 and 3.12±1.24, respectively; while in non-cyclic queens the primary, secondary and tertiary follicles were not existed.

Table 6. Comparison of Ultrasonographic biometry in cyclic and noncyclic queens.

Measurements	Cyclic queens Mean ± SD	Non-Cyclic queens Mean ± SD	P-value	Significance
Length (mm)	9.86±2.04	10.2±3.25	0.066	NS
Width (mm)	5.12±1.16	4.98±0.98	0.082	NS
Thickness (mm)	3.57±1.43	3.05±0.48	0.026	*
Circumference (mm)	25.05±5.20	24.6 ±6.13	0.092	NS
Volume (cm^2)	0.40±0.12	0.40±0.14	1.00	NS
Weight (gm)	0.16±0.12	0.15±0.08	0.821	NS
Primary follicles (Nos.)	3.87±1.12	-	-	-
Secondary follicles (Nos.)	3.5±0.92	-	-	-
Tertiary follicles (Nos.)	3.12±1.24	-	-	-

* = significant, ** = highly significant, NS = non significant

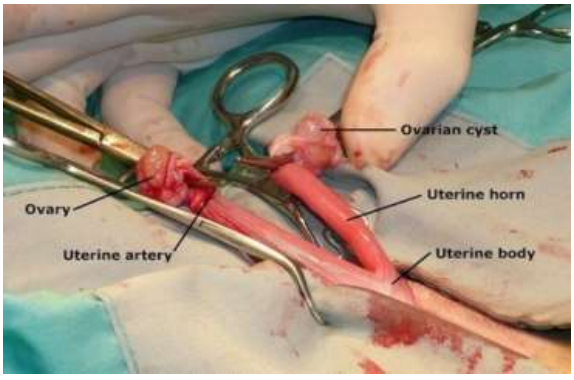

Fig. 1. Performing Ovariohysterectomy.

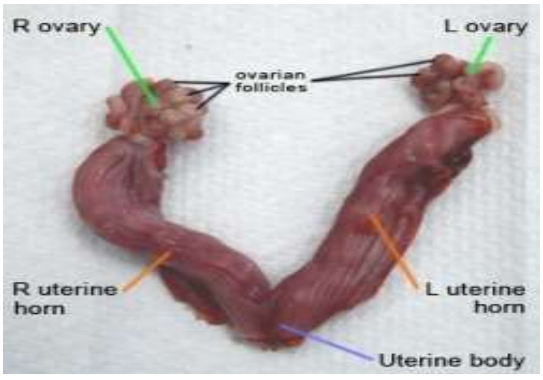

Fig. 2. Reproductive tract of Queen.

Fig. 3. Right non cyclic ovary.

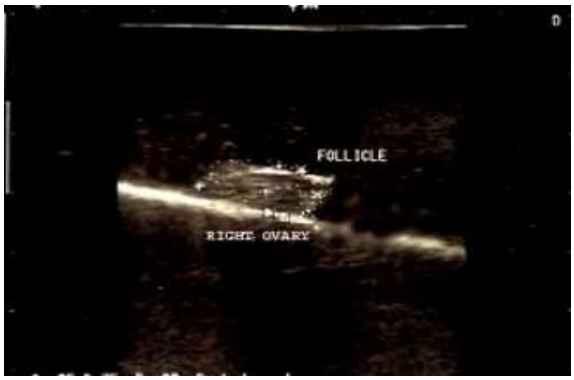

Fig. 4. Right cyclic ovary.

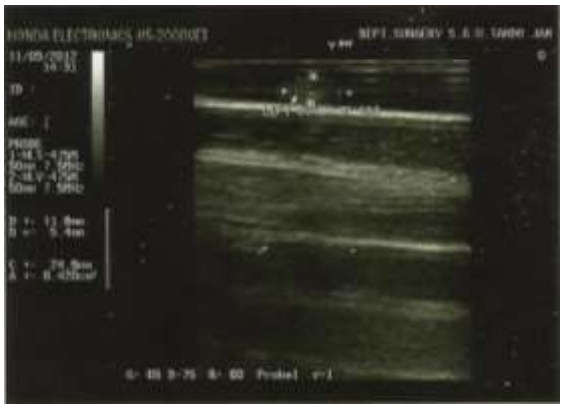

Fig. 5. Left non cyclic ovary.

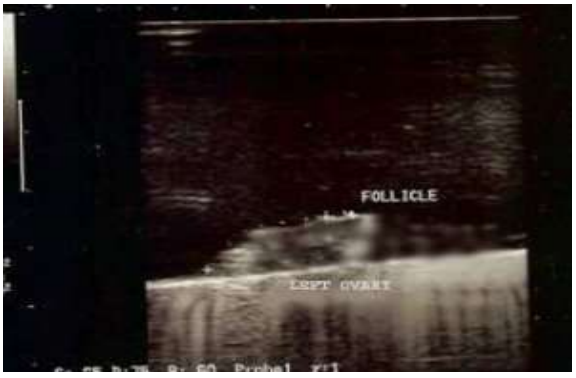

Fig. 6. Left cyclic ovary.

Discussion

The studies were carried out to evaluate the morphological characteristics and ultrasonographic biometrical echo characteristics of cyclic and non-cyclic ovaries in queens. The study on cyclic queens showed 2.82±0.23 years of average age, 3.2±0.29 kg body weight, 2.25±0.95 BCS (before) and 2.75±0.50 BCS (after); while in non-cyclic queens average age was 1.55±0.42 years, 1.82±0.23kg body weight, 2.0±0.81 BCS (before) and 2.50±0.57 BCS (after). The examination on left ovaries of cyclic queens showed 10.25±3.77mm length, 5±1.63mm width, 4.75±1.50 mm thickness, 17.75±7.93 mm circumference and 0.19±0.14g weight; while their right ovaries showed 8.37±1.25mm length, 5±1.41mm width, 3.87±0.85mm thickness, 13.85±3.84mm circumference and 0.14±0.11g weight. In non-cyclic queens 9.75±0.95mm length, 5.5±1.00mm width, 3.75±0.50mm thickness, 16.25±3.40mm circumference and 0.14±0.08g weight; while their right ovaries 9.12±0.85mm length, 4.75±0.50mm width, 3.75±1.50mm thickness, 15.00±5.09 mm circumference and 0.16±0.10g weight.

The left ovaries of cyclic queens were 10.40±1.93mm in length, 5.6±0.46mm width, 3.52±1.44 mm thickness, 27.35±3.87mm circumference, 0.19±0.14g weight and 0.40±0.04cm^2 volume; while their right ovaries showed 9.32±2.29mm length, 4.65±1.53mm width, 3.62±1.65mm thickness, 22.75±5.84mm circumference, 0.14±0.11g weight and 0.40±0.18cm^2 volume. Rohlertz *et al.,* (2012) also showed similar findings and reported significant differences in the morpho-biometry measurements in cyclic and noncyclic cats.

Catbagan *et al.,* (2011) carried out ovariohysterectomy studies on cats and found that there was marked variation in biometrical measurements of left and right ovaries examined by morphological characteristics and ultrasonographic biometrical echo characteristics of cats. Place *et al.,* (2011) studied biometry of left and right ovaries of cats and found significant difference when examined by different methods. Park *et al.,* (2011) reported that size and weight of left ovary were higher than those of right ovary at same age.

Ultrasonographic biometry of left ovaries of non-cyclic queens showed 10.05±2.40mm length, 5.27±1.11mm width, 3.20±0.33mm thickness, 25.1±2.71mm circumference, 0.14±0.08g weight and 0.40±0.13 cm^2 volume; while their right ovaries showed 10.35±4.34mm length, 4.70±0.90mm width, 2.90±0.62mm thickness, 24.10±8.93mm circumference, 0.16±0.10g weight and 0.40±0.17cm^2 volume. The examination on left ovaries of queens showed 3.75±0.95 primary follicles, 3.75±0.50 secondary follicles, 3.25±1.50 tertiary follicles; while their right ovaries of queens showed 4.00±1.41 primary follicles, 3.25±1.25 secondary follicles, 3.00±1.15 tertiary follicles. It was concluded that the health and body condition score was significantly better for cyclic queens as compared to non-cyclic queens. Morpho-biometry measurements were higher in case of left ovaries than the right ovaries.

Ultrasonographic biometry measurements were higher for left ovaries than the right ovaries of queens. Number of secondary follicles differed significantly in left and right ovary and non-significant for primary and tertiary follicles; there were non-significant differences in Morpho-biometry measurements in non-cyclic and cyclic queens. These results are further in agreement with those of Steagall *et al.,* (2009) who reported that left and right ovaries in cat differ in biometrical measurements. Singh *et al.,* (2009) reported that linear regression coefficients between body surface area versus ovaries length and diameter were 0.73 and 0.58 respectively. Belsito *et al.,* (2008) conducted ultrasonographic examination of ovaries in cyclic and noncyclic cats and suggested marked variation in the measurements and volume of ovaries. Pollarii and Bonnett (2008) studied to determine the frequency of postoperative complications following elective surgeries (castration, ovariohysterectomy) of dogs and cats to evaluate the use of electronic medical records for research. The consolidated findings of Vaisanenm *et al.,* (2007) indicated that there was a significant variation in the determinations of left and right ovaries of cyclic and non-cyclic cats for their morpho-biometry and ultrasonographic measurements. Coe *et al.,* (2007) concluded that 96 per cent performed ovariohysterectomy on cats via flank laparotomy rather than a midline coeliotomy.

Moser *et al.,* (2007) concluded that although sonographic ovaries measurement accurately predicted ovaries weight, the small degree of additional accuracy achieved over measurement by calipers does not justify the use of sonography in each case. However, if ovaries ultrasound scan is being performed, the ultrasonic measurements could be used to predict whether it is cyclic or non cyclic by measuring the numbers of primary, secondary and tertiary follicles present on the ovary.

References

Belsito KR, Vester BM, Keel T, Graves TK, Swanson KS. 2008. Impact of ovariohysterectomy and food intake on body composition, physical activity, and adipose gene expression in cats. Journal of Animal Science **20(2),** 287-292.

Catbagan DL, Quimby JM, Mama KR, Rychel JK, Mich PM. 2011. Study the effects of ovariohysterectomy and biometry of ovaries using ultrasound machine in cats. Journal of Veterinary Medicine **72(4),** 461-466.

Coe RJ, Grint MA, Tivers MS, Hotston A. 2007. Comparison of flank and midline approaches to the ovariohysterectomy of cats. Journal of Veterinary Medicine **19(3),** 566-572.

Moser FB, Eilts BE and Williams DB. 2007. Ultrasonic measurement of queens ovaries. Journal of Veterinary Medicine **2(5),** 380-344.

Park M, Singh AM, Yahia M. 2011. Ovaries biometry and its relationship with body weight and semen output of queens. Journal of Surgery and Obstetrics **12(3),** 55-59.

Place NJ, Hansen BS, Cheraskin JL, Cudney SE, Flanders JA, Newmark AD, Barry B, Scarlett JM. 2011. Study morpho-biometry in female cats. Journal of Veterinary Surgery **4(1),** 22-27.

Pollari FL, Bonnett T. 2008. Evaluation of postoperative complications following elective surgeries of dogs and cats at private practices using computer records. Journal of Animal Science **47(4),** 738-745.

Rohlertz M, Ström HB, Holst and Axner E. 2012**.** Comparison of ultrasonography and biometry of ovaries in cats. Journal of Animal Sciences **17(2),** 291-298.

Settergren I. 1964. The ovarian morphology in clinical gonadal hypoplasia with some aspect of its endocrine relation. In Acta *Veterinarian Scandinviea*. Supp. I. Copenhagen p. 150-153.

Singh SS, Kelly AM, Konde LJ. 2009. Ovaries ultrasound in the normal cats. Journal of Veterinary Radiology **31(4),** 195-199.

Steagall PVM, Taylor PM, Rodrigues MA, Ferreira TH, Min to BW, Aguiar AJA. 2009**.** Ultraonography biometry of ovaries in cats. Journal of Animal Science **38(2),** 332-336.

Vaisanenm MA, Tuomikoski SK, Vainio OM. 2007. Behavioral alterations and severity of pain in cats recovering at home following elective ovariohysterectomy or castration. Journal of Small Animal Science **23(1),** 236-242