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Postpartum uterus involution observed by real-time ultrasound scanning and vaginal cytology in Van cats

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Abstract

Objectives The objective was to investigate postpartum uterus involution by real-time ultrasonography and vaginal cytology in Van cats.

Methods This study included 15 healthy Van cats belonging to the Van Cat Research Centre (Yuzuncu Yil University, Van, Turkey). Starting 24 h postpartum, ultrasonographic measurements were performed on the placental and interplacental uterine horn regions every day. Decreases in the diameters and uterine content were considered as criteria for uterine involution. Vaginal discharge samples were collected every day for 4 weeks postpartum. The smears were stained with Papanicolaou stain.

Results The average diameters of placental and interplacental regions (IPRs) in the uterine horns were 3.12 ± 0.29 cm and 2.36 ± 0.43 cm, respectively, at 24 h postpartum. Placental regions (PRs) shrank faster than IPRs. At 48 h postpartum, it became difficult to distinguish PRs from IPRs in the uterine horns. The uterine horns could be seen in the abdominal cavity up to 5.60 ± 0.99 days postpartum. The mean of the last assessable diameter of the uterine horns from days 4 to 7 in all cats was 0.49 ± 0.07 cm. The vaginal epithelial cells appeared to be under the effect of oestrogen for 4 weeks postpartum.

Conclusions and relevance The morphological involution of the uterus completes, to a large extent, within the first 48 h postpartum in Van cats. A more detailed hormonal analysis would contribute greatly to the understanding of the physiological processes involved in this period. Although postpartum involution appeared complete by 5.60 ± 0.99 days after parturition in Van cats, histological verification of this finding is needed.

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Introduction

Puerperium is a physiological period after parturition in which uterine involution occurs. Complete uterine involution is essential for the establishment of future gestations. Uterine involution involves regeneration of endometrial tissue, a reduction in uterine blood flow and endometrial vascularity, as well as a reduction in smooth muscle mass.[1,2] There is also elimination of bacterial contamination.

Numerous complications such as metritis, subinvolution of placental sites, fetal retention, retained placenta or haemorrhage can occur in the postpartum period.[3,4] Differentiation between the normal involution process and these diseases may be clinically difficult.[5] Serial ultrasonographic evaluation of the diseased reproductive tract can be helpful in evaluating response to the therapy.[4]

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Uterine involution in domestic mammals has been investigated in all species but most extensively in the cows and ewes.[6,7] Literature on the normal puerperium of the cat is limited. Knowledge of the normal ultrasonographic appearance of uterine involution should be of clinical benefit in the management of postpartum queens.[4,5] Vaginal cytology can be used in clinical situations of reproductive abnormalities in the cat.[8] There is only one study related to vaginal cytology of the puerperal period in the cat.[9] Therefore, the aim of this study was to investigate postpartum uterine involution by real-time ultrasonography and vaginal cytology in Van cats. To our knowledge, this is the first observation of cytological and uterine real-time ultrasonic assessment during the uncomplicated feline postpartum period.

Materials and methods

Animals

This study included 15 healthy Van cats belonging to the Van Cat Research Centre. Van cats are an endemic breed of Van province (Eastern Anatolia, Turkey). These cats have colourful eyes and long or short white fur (Figure 1a, b). In this study, the average age of the cats was 4.3 ± 1.4 years, and their average weight was 3.2 ± 0.6 kg. Parturition occurred normally 62.93 ± 3.45 days after mating and was followed by an uneventful clinical puerperium in all cases. Each queen delivered 2–5 kittens.

Ultrasonography

The cats were clipped on the ventral surface of the abdomen prior to abdominal ultrasonography. The female cats were gently restrained in dorsal recumbency without sedation. Acoustic gel was applied to the transducer and coupled directly to the skin. Ultrasonography (Honda Electronics, HS-1500, 7.5 MHz linear-array transducer) was used to identify the uterine body in a

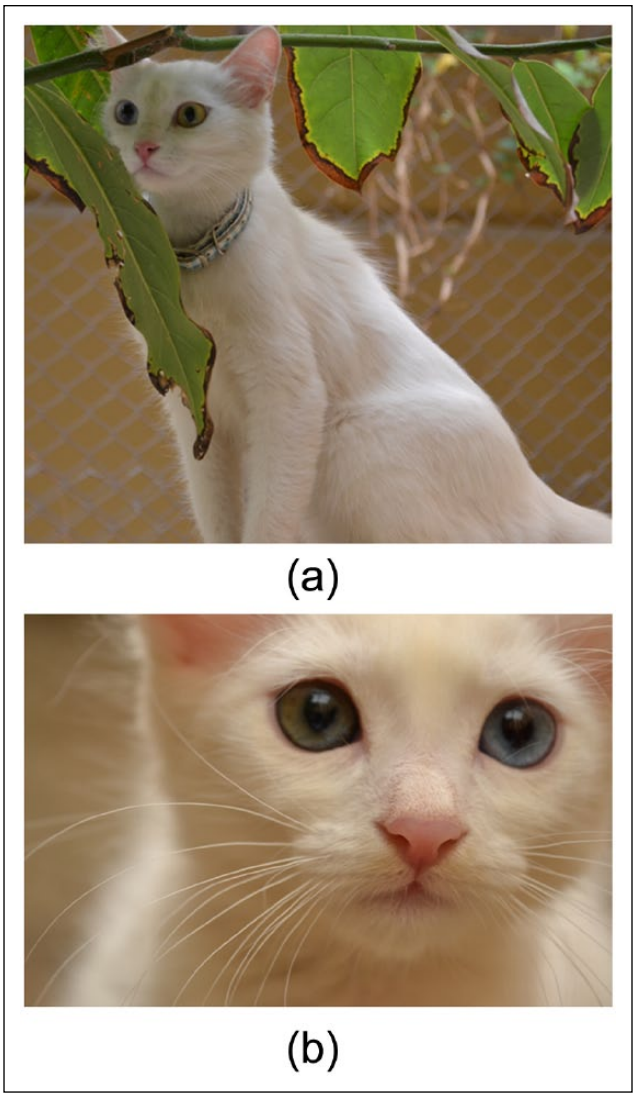


Figure 1 (a,b) Typical Van cat with white fur and different eye colours

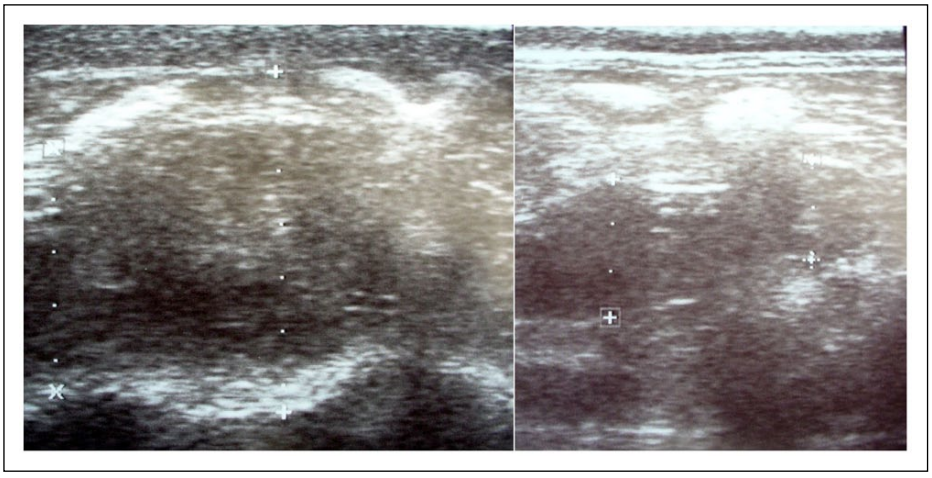


Figure 2 Ultrasonographic images of the uterine horn (right: [+] = non-distinguishable region as placental or interplacental; left [+] = placental region; X = interplacental region)

Table 1 Ultrasonographic uterine diameter measurements up to 168 h postpartum in Van cats*

Cats (n = 15)	Hours postpartum								
	24		48		72	96	120	144	168
	PR (cm)	IPR (cm)	PR (cm)	IPR (cm)	NDR (cm)	NDR (cm)	NDR (cm)	NDR (cm)	NDR (cm)
1	3.37	2.75	1.83	1.75	1.08	0.82	0.72	0.64	0.61
2	2.87	2.05	1.20	1.05	0.83	0.71	0.63	ND	
3	2.38	1.37	0.58	0.54	0.49	0.47	ND		
4	3.07	2.50	1.78	1.50	0.92	0.72	0.60	0.56	ND
5	3.38	2.79	1.89	1.79	1.04	0.77	0.59	0.51	ND
6	3.19	2.53	1.65	1.53	1.02	0.83	0.67	0.55	0.50
7	3.12	1.88	1.12	0.88	0.72	0.63	0.53	0.42	ND
8	2.93	2.27	1.35	1.27	0.89	0.53	0.44	ND	
9	3.42	2.72	1.88	1.72	1.00	0.79	0.67	0.57	ND
10	3.07	2.14	1.21	1.14	0.85	0.47	0.40	ND	
11	2.81	1.87	0.91	0.87	0.50	0.46	ND		
12	3.43	2.81	1.93	1.81	0.93	0.52	0.47	ND	
13	3.48	2.85	1.90	1.85	1.02	0.79	0.60	0.52	
14	3.20	2.56	1.67	1.56	1.02	0.72	0.59	0.50	0.44
15	3.06	2.34	1.50	1.34	0.89	0.49	0.41	ND	
Mean ± SD	3.12 ± 0.29†	2.36 ± 0.43†	1.49 ± 0.42‡	1.37 ± 0.40‡	0.88 ± 0.18	0.65 ± 0.14			

*In all measurements kitten size was not evaluated
†$P < 0.001$
‡$P > 0.05$
PR = placental region; IPR = interplacental region; NDR = non-distinguishable region (placental or interplacental); ND = not discernible

transverse axis. Both uterine horns were assessed immediately cranial to the uterine body bifurcation. Starting 24 h postpartum, ultrasonographic measurements were undertaken on the placental and interplacental horn regions (Figure 2) every day. Both uterine horns were assessed immediately cranial to the uterine body bifurcation. The zonary placenta takes the form of a band. When imaged in the longitudinal plane, the placental region (PR) appears as characteristic two hyperechoic thick bands, one on either side of the uterine wall. In this way, this part of the uterus can be easily differentiated from the other interplacental region (IPR). Total uterine diameters were measured in the transverse section of the left and right uterine horns. According to kittens per queen, a minimum of two or a maximum of four different ampulla (gestational chamber) regions in each uterus were evaluated in all animals. During all different time periods of the study, similar measurements were conducted at the identical points. Two measurements were taken for placental and interplacental sites, and mean horn diameters were calculated by averaging the diameters. Total uterine diameter was defined as the serosal to serosal distance.[5,9] All measurements were taken as leading edge to leading edge. A decrease in the diameters and uterine content were considered the criteria for uterine involution. Ultrasonographic visualisation of uterine horns in the abdominal cavity is very difficult in a non-pregnant cyclic cat. Bifurcation of the uterus into the uterine horns can sometimes be imaged; the horns are typically difficult to image unless enlarged because of hormonal influence during the oestrous cycle, pregnancy or because of a pathology.[4] Therefore, non-pregnant cats were not used as controls in the study. However, in the study, daily ultrasonic examinations were continued until the horn was difficult to see in the abdominal cavity, as in a non-pregnant cat.

Vaginal cytology

After queening, vaginal discharge was collected daily by a swab for 4 weeks postpartum in all animals. The discharge was then smeared on a slide, stained (Papanicolau stain)[10] and observed using light microscopy at the Institute of Histology, University of Yuzuncu Yil. The slides were examined by light microscope at 100×, 400× and 1000× magnifications. The percentages of erythrocytes and neutrophils were determined by counting a minimum of 100 cells (including vaginal epithelial cells) in each discharge smear.[11]

Statistical analyses

Data were analysed by the statistical package MDP/Dynamic, release 7.0.[12] Means ± SD were calculated and compared using Student's *t*-test.

Results

No abnormalities occurred during gestation or parturition in any of the queens. Placentation and interplacentation sites were identified. At 24 h postpartum, the mean diameters of PR and IPR in the horns were 3.12 ± 0.29 cm and 2.36 ± 0.43 cm, respectively (P <0.001) (Table 1). PRs shrank faster than IPRs. From 48 h postpartum, it became quite difficult to distinguish PRs from IPRs in the horns. The horns could be seen in the abdominal cavity in all 15 cats up to day 5.60 ± 0.99 postpartum. The mean of the last assessable diameter of the horns from days 4 to day 7 in all cats was 0.49 ± 0.07 cm.

Vaginal cytology revealed declining amounts of erythrocytes (75%) and leukocytes (15%) on the first 3 days postpartum, and increasing numbers of superficial nucleated cells (70%) after the fifth day. The percentage of erythrocytes and neutrophils gradually diminished to 0% and 1%, respectively, at the end (after 4 weeks) of the study.

Discussion

The ultrasonographic appearance of the postpartum uterus has been described but evaluation of uterine involution is rarely indicated in a standard practice.[13–16] The feline placenta is endotheliochorial in structure and zonary in shape.[17,18] Therefore, there will be PRs and IPRs in the postpartal uterus. To the best of our knowledge, the process of involution after the queening of these two different regions has also not yet been studied.

A preliminary study regarding postpartum uterine involution has been reported only in six cats.[5] These researchers indicated that overall uterine thickness on day 1 postpartum was 1.66 cm. In our study, performed in 15 Van cats, the uterine diameters were significantly thicker 24 h after queening (PR: 3.12 ± 0.29 cm; IPR 2.36 ± 0.43 cm). The differences between our results and those of Ferretti et al suggest that the speed of postpartum uterine involution in cats might be influenced by diverse factors such as the greater number of cats in the current study, breed difference, ultrasound operator experience and the image quality of the ultrasound machine.[5]

The present study shows that the PR shrank faster than the IPR. In particular, between 24 and 48 h after queening, a 50% reduction in this region was noted. In addition, our results demonstrated that postpartum morphological involution appeared to be complete by day 5.60 ± 0.99 after parturition. The average diameter of the uterus, which we measured during this period (about 0.5 cm), showed full agreement (although we did not have a non-pregnant control group) with the uterine diameters of the non-pregnant cats. This suggestion is also supported indirectly by Chatdarong et al,[19] who showed that the normal uterine outer diameter in a cat varies from 0.39 to 0.70 cm, depending on the stage of the oestrous cycle. Postpartum uterine diseases are less frequent in cats. The rapid feline uterine involution may contribute to this lower prevalence.[9]

Similar to the findings of Chatdarong et al in non-pregnant cats,[19] Ferretti et al reported that at days 14 and 28 postpartum, the uterus could still be identified ultrasonographically, with mean diameters of 0.62 cm and 0.47 cm, respectively.[5] However, the results of our study demonstrated that in this period (after postpartum day 6), the genital tract of a cat is available for a new pregnancy. However, Ackerman reported that, by using ultrasonography and plain radiography, the non-pregnant uterus of the cat is occasionally mistaken for intestinal loops.[20] In our study, the uterus was easily detected for an average of up to day 5.60 ± 0.99 after parturition. Ultrasonographic examinations were not performed after this period. In agreement with the results of Ackerman,[20] ultrasonographic identification of the uterus from other abdominal organs was very difficult after day 5.60 ± 0.99 postpartum. The reason why the uterus (and also endometrial and myometrial thickening) cannot be distinguished from the abdominal organs after this period may be interpreted as the complete elimination of postpartum vaginal discharge, which allows visualisation by ultrasound.

Relevant to the topic, a new bi-dimensional and Doppler ultrasonographic study in 12 cats attracted our attention.[9] However, the design of that study was very different from ours. In that work, the reduction in uterine dimension was not examined daily. Examinations were performed only on postpartum days 4, 11, 18 and 25. In our study, these periods were not included in the critical regression process of involution, which occurs within the first 2 days postpartum. According to these investigators, uterine involution was completed by day 25 after parturition. However, the cats can show a new oestrus (not investigated in the study by Blanco et al[9]), depending on the number of nursing kittens, 7–10 days after parturition.[17] This feature of cats supported our findings that morphological uterine involution is completed by day 5.60 ± 0.99 after parturition.

The duration of normal postpartum lochial discharge, which may be difficult to determine because of the frequent cleaning of the vulva after parturition, has not been reported in queens.[9] Similar to other species, cytological evaluation of this discharge might be useful for the early diagnosis of postpartum disorders (all inflammatory infections of the uterus and vagina).[21,22] According to our results, increasing numbers of superficial nucleated cells after day 5 in the four postpartum weeks are new findings. This condition points to a high level oestrogen but we do not know the real events taking place. Postpartum hormonal studies in this period are needed.

Conclusions

The morphological involution of the uterus completes, to a large extent, within the first 48 h postpartum in Van cats. A more detailed hormonal analysis would

contribute greatly to the understanding of physiological processes involved in this period. Although postpartum involution appeared complete by day 5.60 ± 0.99 day after parturition in Van cats, histological verification of this finding is needed.

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Conflict of interest The authors do not have any potential conflicts of interest to declare.

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