

## 猫胚の子宮内移送について

誌名	Japanese journal of veterinary science
ISSN	00215295
著者	筒井, 敏彦 天野, 正 清水, 敏光
巻/号	51巻3号
掲載ページ	p. 613-617
発行年月	1989年6月

## Evidence for Transuterine Migration of Embryos in the Domestic Cat

Toshihiko TSUTSUI, Tadashi AMANO, Toshimitsu SHIMIZU, Ikuko MURAO, and George H. STABENFELDT<sup>1)</sup>

*Department of Reproduction, Nippon Veterinary and Zootechnical College, 1-7-1 Kyonan-cho, Musashino, Tokyo 180 Japan* <sup>1)</sup>*Department of Reproduction, School of Veterinary Medicine, University of California, Davis, CA 95616*

(Received 6 December 1988/Accepted 17 February 1989)

**ABSTRACT.** A total of 169 pregnant cats presented for ovariohysterectomy were examined for the number of corpora lutea (CL) and the number of fetuses per uterine horn. The implantation rate and the frequency of occurrence of transuterine migration of embryos were calculated. The average number of CL was  $5.6 \pm 1.9$  (mean  $\pm$  SD; range, 2–11), the average number of fetuses was  $4.5 \pm 1.4$  (range, 1–8) and the average implantation rate was  $84 \pm 20\%$ . Transuterine migration occurred in 69/169 cats (40.8%). In animals with a 100% implantation rate, transuterine migration occurred in 50/84 cats (59.5%). The number of embryos that migrated ranged from 1–3 per animal and embryos moved from the uterine horn ipsilateral to the ovary with the larger number of CL in 66/69 cats (95.7%). As a result of transuterine migration, the difference in the number of fetuses between uterine horns as compared with the difference in the number of CL between ovaries was smaller in 54 cats (78.3%), unchanged in 8 cats (11.6%) and larger in 7 cats (10.1%). These results indicate that cats tend to equalize the number of fetuses between uterine horns by transuterine migration of embryos.—**KEY WORDS:** cat, embryo, transuterine migration.

*Jpn. J. Vet. Sci.* 51(3): 613–617, 1989

Transuterine migration of embryos, which results in an optimal spacing of embryos within both uterine horns, is common in litter-bearing animals. It has been reported to occur in 40 to 50% of pregnant sows [2, 6, 7] and bitches [1, 8, 12]. However, little information is available in the cat on transuterine migration [9, 10].

This study was done to document the occurrence and estimate the incidence of transuterine migration in the domestic cat.

### MATERIALS AND METHODS

**Animals:** A total of 169 domestic cats of unknown age and parity were used. These cats were among animals presented for ovariohysterectomy at the Veterinary Hospital of Nippon Veterinary and Zootechnical College from 1980 to 1986. The date of copulation and conception was unknown in most of the animals, and only cats found

pregnant upon surgical opening were used in the study. Stage of pregnancy was estimated to range from implantation (Day 13–14 of pregnancy) to late gestation. The genital organs were examined either in a fresh state or after fixation in 10% formalin solution.

**Number of corpora lutea (CL) and number of fetuses:** The number of ovulations was estimated by the number of CL in the ovaries. The number of CL was determined by external examination of the ovary with active CL being defined as follows: form—round with a 3 mm diameter and raised 2 mm above surface of the ovary; color—pinkish with evidence of blood vessels on the surface. All structures characteristic of CL were incised and examined internally for size (4–5 mm) and color (yellow) indicative of active CL. Small whitish yellow CL about 1–2 mm in size were judged to be from the previous cycle.

Each uterine horn was opened and the number of fetuses was recorded. Transuterine migration of embryos was estimated to have occurred prior to implantation when the number of fetuses in a given horn was greater than the number of CL present in the ipsilateral ovary.

*Statistical analyses:* The significance of differences among mean values was determined using Student's *t* test. Also, the F test was used to judge any existence of correlation.

## RESULTS

Transuterine migration was observed in 69/169 cats (40.8%). In animals with a 100% of their ova fertilized and implanted, the rate of transuterine migration was 59.5% (50/84) but only 22.4% (19/85) in animals with less than 100% implantation. The larger the difference in the number of CL between ovaries in an individual animal, the higher the observed frequency of transuterine migration (Table 1). In 66 of 69 cats (95.7%), transuterine migration occurred from the side with the ovary containing the greater number of CL to the side with fewer CL. Transuterine migration occurred in 2 cats (2.9%) in which CL numbers were the

same in each pair of ovaries, and in 1 cat (1.4%) from the horn ipsilateral to the ovary which contained fewer CL. The number of embryos that migrated ranged from one to three. Migration of more than three embryos was not observed (Table 1). In the 69 cats in which transuterine migration of embryos occurred, the difference in the number of fetuses between the left and right uterine horns decreased in 54 cats (78.3%), was unchanged in 8 cats (11.6%) and increased in 7 cats (10.1%). The next result was that 57 cats had a difference of 1 or no difference as concerns the distribution of fetal numbers between uterine horns (Table 2). Eleven of the remaining 12 cats that underwent transuterine migration had a difference of 2 or 3 fetuses between horns (Table 2).

Cats averaged  $5.6 \pm 1.9$  CL (mean  $\pm$  SD; range 2–11) with an equal distribution between ovaries (left  $2.8 \pm 1.6$ , range 0–7; right  $2.8 \pm 1.6$ , range 0–8). The number of CL per ovary was the same in 26 cats (15.4%), greater in the left ovary in 75 cats (44.4%) and greater in the right ovary in 68 cats (40.2%).

The implantation rate was 100% in 84 animals (49.7%) and exceeded 80% in animals with ovaries containing 1–8 CL. A

Table 1. The relationship of the number of embryos undergoing transuterine migration/cat as a function of the difference in ovulatory rates between ovaries

Difference in no. of CL between ovaries	No. of cats	No. of embryos migrating/cat			Migration rate (%)
		1	2	3	
0	2	2	0	0	8 ( 2/26) <sup>a)</sup>
1	12	10	2	0	25 (12/48)
2	20	20	0	0	44 (20/46)
3	20	14	5	1	61 (20/33)
4	12	5	6	1	92 (12/13)
5	1	0	1	0	100 ( 1/ 1)
6	1	0	0	1	100 ( 1/ 1)
7	1	0	1	0	100 ( 1/ 1)
Total	69	51	15	3	

a) Number of animals with transuterine migration/total number.

Table 2. Distribution of fetuses in uterine horns in cats in which transuterine migration of embryos occurred

Difference in no. of CL between ovaries	No. of cats	Difference in no. of fetuses between uterine horns				
		0	1	2	3	4
0	2	0 <sup>a)</sup>	0	2	0	0
1	12	<u>1</u>	7	1	3	0
2	20	14	<u>6</u>	0	0	0
3	20	5	13	<u>0</u>	<u>1</u>	1
4	12	5	3	3	<u>1</u>	0
5	1	0	1	0	0	<u>0</u>
6	1	1	0	0	0	0
7	1	0	1	0	0	0
Total	69	26	31	6	5	1

a) Underlined numbers indicate animals in which no net change in total number occurred.

Table 3. Relationship between number of corpora lutea, number of fetuses and implantation rate in pregnant cats

No. of CL per animal	No. of cats	Average no. of fetuses (range)	Implantation rate (%)
2	1	2.0 ( - )	100
3	16	2.8±0.4 (2-3)	94±13.0
4	42	3.5±0.7 (1-4)	89±17.4
5	35	4.5±0.7 (2-5)	90±13.8
6	29	4.9±1.2 (2-6)	82±20.5
7	22	5.6±1.3 (2-7)	81±18.5
8	10	6.6±1.2 (5-8)	83±15.0
9	7	4.4±0.7 (3-5)	49± 8.1
10	4	5.3±0.8 (4-6)	53± 8.3
11	3	6.3±1.2 (5-8)	58±11.3
Total	169	4.5±1.4 (1-8)	84±19.5

sharp decline in the implantation rate was noted for animals with 9-11 CL (49% to 58%) (Table 3). On the assumption of a 100% fertilization rate, an overall implantation rate of 84±20% (range 25% to 100%) was calculated. The fetal number (left 2.3±0.9, range 1-6; right 2.2±0.9, range 0-5) between uterine horns was not different ( $P>0.05$ ).

#### DISCUSSION

This study was limited by the fact that the exact number of fetuses that migrated between uterine horns prior to implantation could not be determined. Transuterine migration could be determined only by estimation of the difference in CL number per ovary vs fetal number per uterine horn. Techniques to determine the occurrence of

pregnancy in the domestic cat, such as ultrasonography or transabdominal palpation, are not effective until days 12–13 and 13–14, respectively [3]. By this time transuterine migration is complete and implantation begins [4, 5]. Thus the percentage of animals in which transuterine migration occurred (40.8%) may represent a conservative estimate. The rate of transuterine migration reported in other litter-bearing animals, i.e. about 40% in pigs [2, 6, 7] and 50% in dogs [12], are similar to that found for the cat.

The 84% implantation rate, as determined in this study, is based on the assumption that all ovulated oocytes were fertilized. While the rate of fertilization appears to be high in the cat, it is likely that fertilization failure does occur. Telfer and Gosden [11] reported a finding of 3.6% polyovular follicles in cats, unknown factor which could have influenced our estimated percentage of transuterine migration. However, if these cats had a similar incidence of polyovular follicles, this would not have greatly influenced our results. In addition, of the 169 cats used in this study, no cases were observed in which fetal number exceeded the number of CL.

In view of a sharp decline in the implantation rate noted between animals with eight and nine CL per animal, it would appear that six to seven fetuses are about the maximal number that can be maintained to term. This assumption is also based on a decreased implantation rate less than 80% for cats with more than nine CL (Table 3). The occurrence of a decreased fertilization rate in conjunction with a higher ovulation rates is another possible explanation for the reduced number of implantation sites

observed.

**ACKNOWLEDGEMENTS.** Supported by the Science Research Promotion Fund of the Japanese Private School Promotion Foundation.

#### REFERENCES

1. Bonnet, R. 1897. Beitrage zur Embryologie des Hundes. *Anat. Hefte.* 9: 419–430.
2. Corner, G. W. 1923. The problem of embryonic pathology in mammals, with observations upon intra-uterine mortality in the pig. *Am. J. Anat.* 31: 523–545.
3. Davidson, A. P., Nyland, T. G., and Tsutsui, T. 1986. Pregnancy diagnosis with ultrasound in the domestic cat. *Vet. Radiol.* 27: 109–114.
4. Denker, H. W., Eng, L. A., and Hamner, C. E. 1978. Studies on the early development and implantation in the cat. *Anat. Embryol.* 154: 39–54.
5. Denker, H. W., Eng, L. A., Mootz, U., and Hamner, C. E. 1978. Studies on the early development and implantation in the cat: I. Cleavage and blastocyst formation. *Anat. Anz.* 144: 457–468.
6. Dziuk, P. J., Polge, C. P., and Rowson, L. E. A. 1962. Migration of pig embryos following egg transfer. *J. Anim. Sci.* 21: 1021.
7. Dziuk, P. J., Polge, C. P., and Rowson, L. E. A. 1964. Intra-uterine migration and mixing of embryos in swine following egg transfer. *J. Anim. Sci.* 23: 37–42.
8. Gunther, V. S. und Bucklisch, W. 1967. Die innere Eiuberwanderung. *Biol. Zentralbl.* 86: 681–690.
9. Hill, J. P. and Tribe, M. 1924. The early development of the cat. *Quart. J. Micr. Sci.* 68: 513–602.
10. Markee, J. E. and Hinsey, J. C. 1933. Internal migration of ova in the cat. *Proc. Soc. Exp. Biol.* 312: 267–270.
11. Telfer, E. and Gosden, R. G. 1987. A quantitative cytological study of polyovular follicles in mammalian ovaries with particular reference to the domestic bitch (*Canis familiaris*). *J. Reprod. Fertil.* 81: 137–147.
12. Tsutsui, T. 1975. Studies on the reproduction in the dog: VI. Ovulation rate and transuterine migration of the fertilized ova. *Jpn. J. Anim. Reprod.* 21: 98–101.

## 要 約

猫胚の子宮内移送について：筒井敏彦・天野 正・清水敏光・村尾育子・George H. Stabenfeldt<sup>1)</sup>（日本獣医畜産大学獣医臨床繁殖学教室，<sup>1)</sup>Dept. of Reproduction, University of California, Davis）——猫胚の子宮内移送の発現状況を明らかにするため、妊娠子宮169個の黄体数、胎子数を観察し、次の結果を得た。1頭あたりの黄体数は2-11個、平均 $5.6 \pm 1.9$  (SD) 個で、左右卵巣の黄体数の間には負の相関関係が認められた ( $P < 0.05$ )。また胎子数は1-8頭、平均 $4.5 \pm 1.4$ 頭で、左右子宮角内の胎子数の間には相関関係は認められなかった。着床率は25-100%で平均 $83.9 \pm 19.5$ %であった。胚の子宮内移送は69頭 (40.8%) に認められ、1頭あたり移送胚は1-3個であった。黄体数の多い側の子宮角から少ない側への移送が66頭 (95.7%)、少ない側から多い側への移送が1頭 (1.4%)、左右黄体数の等しい例での移送は2頭 (2.9%) であった。移送の結果、左右黄体数の差よりも左右子宮角内の胎子数の差が小さくなったものが54頭 (78.3%)、変らなかったものが8頭 (11.6%)、逆に多くなったものが7頭 (10.1%) であった。このことから猫においても胚の子宮内移送によって、左右子宮角内の胎子数が均等化することが認められた。