

Superfetation or Arrested Embryonic Development of the Cat?

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ABSTRACT

Background: If eggs are fertilized in different estrous cycle periods, such phenomenon is called superfetation. This phenomenon is occurred when an already pregnant animal manifests estrus (super-estrus), and mating in that estrus is fertile. Common criteria for assuming a case of superfetation includes the finding of malformed cubs in the uterus during ovariohysterectomy or delivery after a shorter birth interval than the expected length of pregnancy was. This report presents a rare case of different embryonic/fetal phases of kittens, diagnosed during emergency ovariohysterectomy due to pathological vaginal discharge.

Case: A 2-year-old domestic cat was brought for clinical examination due to vaginal discharge. According to the anamnestic data, the cat was not in the pregnancy status. The vaginal secretion was deviated from characteristic physiological color and smell, and the vaginal examination revealed open cervix with no fetus in the birth canal. An ultrasound examination confirmed the pregnancy and also differences in size and structure of the gestational sacs. One ultrasound finding showed the existence of developed fetus, while the other finding showed only the gestational sac of the embryonic stage of pregnancy. Since no cardiac activity was observed of the developed fetus and because of presence of vaginal discharge, ovariohysterectomy was performed. The autopsy of uterus reported differently developed fetuses. Embryonic and fetal phases of fetuses were recorded inside one pregnant uterus of the cat.

Discussion: If superfetation occurs, fertilization must occur after the tertiary follicles have been induced to ovulate by copulatory behavior of the pregnant animal. Cats can exhibit copulatory behavior similar to estrus during pregnancy, without a significant increase in serum estradiol or luteinizing hormone (LH), suggesting that such activity may not be related to endocrinology or reproductive physiology. In the case of induced/provoked ovulation which cats have, mating is not only necessary for depositing sperm, but also for activating ovulation. In the presence of an active corpus luteum, it is not clear whether copulation can induce ovulation. Therefore, superfetation cannot be assumed, but also not excluded, based on observed copulations during pregnancy. Furthermore, superfetation has never been definitively demonstrated in domestic cats, despite case reports which reported kittens in different stages in uterus. It has been reported in mice with superfetation that implantation zones of new embryos were often located at the caudal end of the uterine horn, near the cervix. In the present case report, the same phenomenon was noted in cat, where less developed gestational sac of the embryonic phase of the fetus was visible caudally. Due to this fact, there was space remained at the cranial end of the uterus for continued implantation of older fetus. In the current case, because the patient did not get to the physiological term of delivery and neither did 2 separate deliveries in shorter period of time, superfetation was not clearly distinguished from the arrested development of fetuses. In one case report, with also presented differently developed fetuses in the uterus of a pregnant cat, the cat was also diagnosed with paraplegia, which caused dystocia. There was also ovariohysterectomy performed, so it cannot be concluded whether a 2nd birth would take place in the following period. The phenomenon of superfetation has been used to denote a condition in which the uterus contains embryos of different stages of development. Such findings also could be the result of the pathological conditions in which the growth and development of fetuses do not occur in the uterus, so it could not be said with certainty that was a case of superfetation. According to mentioned above, it could be concluded that the findings of differently developed fetuses were more likely to correspond with delayed development of the embryo than to superfetation, but this cannot be asserted with certainty either.

Keywords: reproduction, ovariohysterectomy, super-estrus.

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INTRODUCTION

In contrary to other domestic animals which have spontaneous ovulation, cats have provoked ovulation which is the result of stimulation of the mucous membrane of the vagina [9]. The male, with his cornified villi on the glans penis, during mating, creates a decisive stimulus for the release of the ovulatory LH wave [2]. During one estrus, a greater number of matings can occur and the frequency determines the magnitude of the ovulatory LH wave [9]. If eggs are fertilized in different estrous cycle periods, such phenomenon is called superfetation [2]. This phenomenon occurs when an already pregnant animal manifests estrus (super-estrus), and mating in this estrus is fertile [2]. Superfetation, or rather pregnancies similar to superfetation, have been reported in numerous species including humans, domestic animals and rodents [3,5,7,8]. In the reproduction of cats, the phenomenon of superfecundation is also recognized, and it occurs when cat becomes pregnant by 2 different males, in 1 or 2 coitus separated in time. Common criteria for assuming a case of superfetation include the findings of malformed cubs in the uterus during routine ovariohysterectomy or delivery after a birth interval shorter than expected length of pregnancy. Often, the occurrence of superfetation is inferred, due to the lack of other explanations for reproductive disorders [4]. This report presents a rare case of different embryonic and fetal phases of kittens.

CASE

A 2-year-old domestic cat was brought to the Veterinary Clinic of the Department of Veterinary Medicine, Faculty of Agriculture, University of Novi Sad, Serbia, for clinical examination due to vaginal discharge. According to the anamnestic data, the cat was not previously in the pregnancy status, and it was only assumed that the current status could be pregnancy. By the results of general clinical examination, only the body temperature was 39.2°C and deviated from physiological limits during the triassic period. The vaginal secretion deviated from the characteristic physiological color and smell, and the vaginal examination revealed an open cervix with no fetus in the birth canal. After general clinical examination and vaginal examination, the ultrasound examination was performed [BPU 60 Vet¹], using a micro convex probe, frequency 8 MHz, in B mode. An ultrasound examination confirmed the pregnancy, but also the differences in the size and structure of the gestational sacs. One ultrasound finding showed the existence of a developed fetus, i.e. its cranial structures (Figure 1), while the other finding showed only the gestational sac of the embryonic stage of the pregnancy (Figure 2). Since no cardiac activity was observed in developed fetus and also the presence of vaginal secretions, it was decided to perform an urgent ovariohysterectomy. Surgical intervention was approved by the consent of the animal's owner.

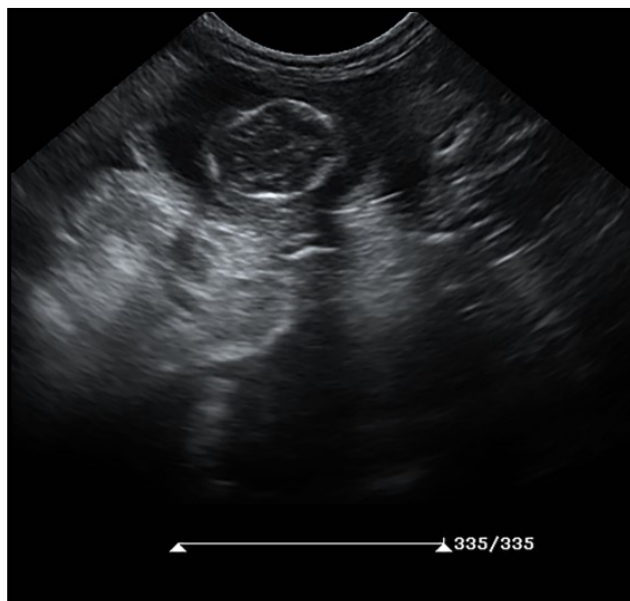


Figure 1. Ultrasound findings of the cranial part (head) of the fetus.

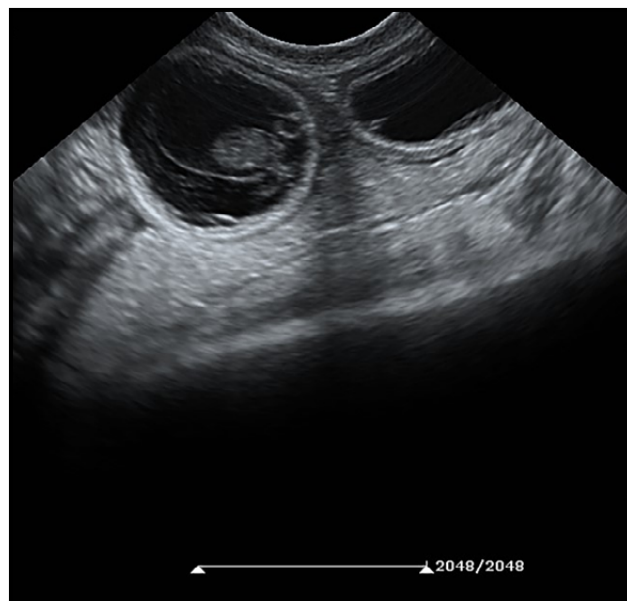


Figure 2. Ultrasound findings of different gravity sacs.

Sedation of the patient, as part of the premedication of general anesthesia, was performed using xylazine [Xylased^{®2} - 2 mg/kg, I.M.]. After premedication, the surgical field was prepared with all procedures of good surgical practice. The induction and maintenance of general anesthesia was performed by administration of ketamine [Ketamidol^{®3} - 10 mg/kg, I.M.]. Laparotomy was performed through the *linea alba*. The uterus was extracted and observed. The previous diagnosis established by ultrasound was confirmed (Figure 3).

The ovariohysterectomy procedure was performed by placing 2 ligatures on each ovarian suspensory ligament with accompanying blood vessels and one ligature on the caudal part of the ovary, while 2 ligatures were placed on the cranial part of the cervix. Absorbable multifilament suture - poliglicole acid [PGA⁴, USP 2/0], was used for ligation of structures of the reproductive tract. After the ovariohysterectomy, the abdominal cavity was closed with a simple continuous suture, absorbable monofilament - polydioxanone [Monosorb⁴, USP 2/0]. The subcutaneous tissue was sutured with absorbable monofilament - polydioxanone⁴, with a simple continuous suture. Skin suturing was performed with non-absorbable surgical suture - polyamide [Nylon⁴, USP 2/0], with simple knot suture pattern.

After the surgical intervention, pharmacotherapy included the parenteral application of antibiotics with prolonged action [Shotapen^{®5} - 1 mL/25 kg]. Potentially infectious material (uterus) was evaluated in the Laboratory of Pathology at the Department of Veterinary Medicine, Faculty of Agriculture, University of Novi Sad. The material was opened with compliance

with all biosecurity measures. The necropsy indicated differently developed fetuses. On that occasion, 2 different stages of pregnancy, i.e. embryonic and fetal phase, were recorded inside 1 pregnant uterus of a cat (Figure 4). No pathological signs were observed on the fetus or embryo.

DISCUSSION

If ovulation occurs during pregnancy, the complete development and maturation of the follicles must occur [9]. Besides, if superfetation occurs, fertilization must occur after the tertiary follicles have been induced to ovulate by copulatory behavior in the pregnant animal [1]. However, it is well known that mares show spontaneous ovulation during the gestational period as a mechanism to establish the accessory luteum (corpus luteum) which then supports the ongoing pregnancy [7]. Also, cats can exhibit copulatory behavior similar to estrus during pregnancy, without a significant increase of estradiol or luteinizing hormone (LH) in serum, suggesting that such activity may not be related to endocrinology or reproductive physiology [1]. In the case of induced (provoked) ovulation such as cats have, mating is not only necessary for depositing sperm, but also for activating ovulation [9].

In the presence of an active corpus luteum, it is not clear whether copulation can induce ovulation. Therefore, superfetation cannot be assumed, and also not excluded, based on observed copulations during pregnancy [4]. Furthermore, superfetation has never been definitively demonstrated in domestic cats, despite case reports showing kittens in different ages

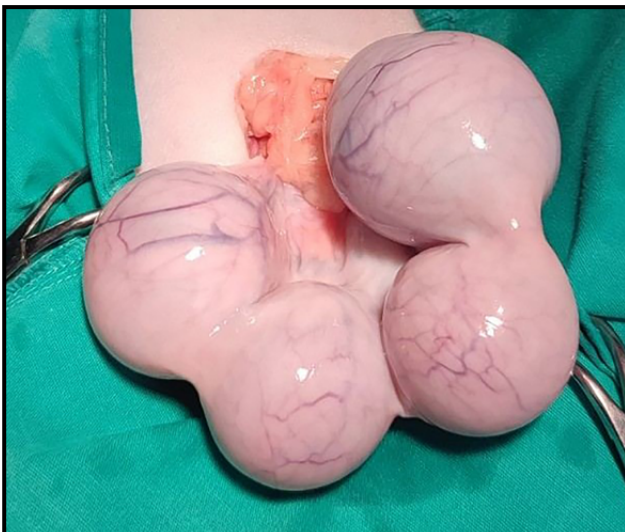


Figure 3. Different sizes of gravity sacs after laparotomy.

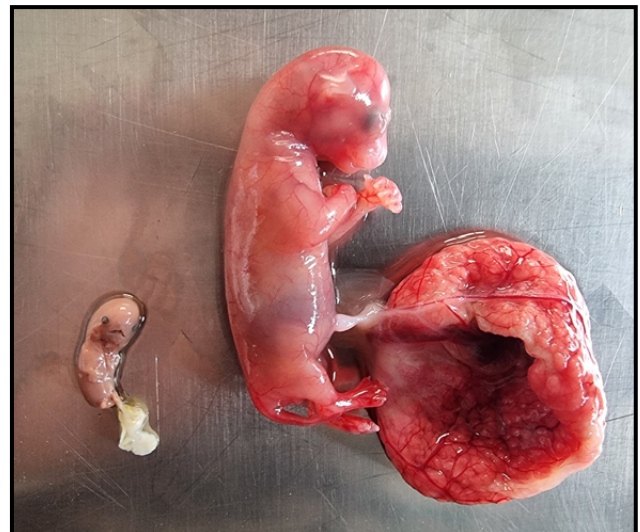


Figure 4. Embryonic phase (left) and phetal phase (right) in cat.

in uterus [1,6]. It remains unclear how the sperm is deposited, if it is known that the mucus plug of the cervix in pregnancy represents the 1st line of defense [9]. Therefore, even if it is theoretically possible for sperm to pass through the pregnant uterus, there is a risk of transmitting venereal diseases to fetuses. On the other hand, the placenta zonaria, characteristic of carnivores [2,9], represents a mechanical obstacle for the passage of spermatozoa to the oviduct, so the passage of sperm would theoretically be possible only before successful implantation [4].

Additionally, it has been reported [5] that in mice with superfetation, the implantation zones of new embryos are often located at the caudal end of the uterine horn, near the cervix. In the present case report, the same phenomenon was noted in the cat, where less developed gestational sac of the embryonic phase of the fetus were visible caudally (Figure 3), which was later confirmed when the uterus was opened. Due to this fact, space remains at the cranial end of the uterus for continued implantation of older fetus. In cats, there is another important phenomenon that can distinguish them from most other domestic animals - superfecundation, which is defined as fertilization by successive mating of oocytes belonging to the same ovulation cycle, sometimes by different males (multiple paternity). In differences with superfecundation, superfetation involves fertilization of oocytes from different ovulation cycles [2].

In the current case, true superfetation could not be distinguished from the arrested development of fetuses, for the reason that the patient did not get to the physiological term of delivery, but neither did 2 separate deliveries in a shorter period of time. In a recent case report [6], as well as in our case, differently

developed fetuses in the uterus of a pregnant cat were shown. In contrast to this case report, cat was also diagnosed with paraplegia, which caused a dystocia [6]. Also, an ovariohysterectomy was also performed, so it could not be concluded whether a 2nd birth would take place in the following period.

The phenomenon of superfetation has been used to denote a condition in which the uterus contains embryos of different stages of development. Such finding may be the result of pathological conditions in which the growth and development of fetuses do not occur in the uterus, so it could not be said with certainty that it was the case of superfetation [4]. Although superfetation is rare and abnormal condition, many cases have been reported in humans, domestic animals and rodents, but do not seem to be satisfactorily explained [3-5,7,8].

Taking into the consideration all mentioned above, in present case report, it could be concluded that the findings of differently developed fetuses was more likely to correspond to delayed development of the embryo than to superfetation, but this could not be asserted with certainty either. More reports such current could contribute to the understanding of various endocrinological and fertilization phenomena in feline reproduction.

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