

# Correlation of Gestational Sac Diameter, Fetal Heart Diameter, and Fetal Head Diameter to Gestational Age of Local Cats (*Felis Domesticus*) Pregnancy in Indonesia

Analisa Wisnu Wardhana<sup>1</sup>, Aulia Firmawati<sup>1</sup>, Albiruni Haryo<sup>2</sup>, Kevin Ersananda<sup>3</sup>, Nabila Safira<sup>3</sup>,  
Tiara Balqhis<sup>3</sup>

<sup>1</sup>Department of Anatomy and Histology, Faculty of Veterinary Medicine, Brawijaya University

<sup>1</sup>Department of Reproduction, Faculty of Veterinary Medicine, Brawijaya University

<sup>2</sup>Department of Pathology, Faculty of Veterinary Medicine, Brawijaya University

<sup>3</sup>Student of Program Study of Veterinary Medicine, Faculty of Veterinary Medicine, Brawijaya University

**Keywords:** Domestic Cat, Gestational Sac Diameter, Fetal Head Diameter, Fetal Heart Diameter, Ultrasonography.

**Abstract:** Fetal development in domestic cat can be monitored using ultrasonography to control viability, maintain the nutrition care, and drug use. Due to control the viability of foetuses, this study observed the correlation of gestational sac diameter, fetal head diameter, and fetal heart diameter compared to gestational age. This study was performed by using 9 queens that divided into three groups. The first group measured the gestational sac diameter, the second group measured the fetal head diameter, and the third group measured the fetal heart diameter. Gestational sac diameter and fetal head diameter are measured by specific formula, while the fetal heart diameter calculated by measuring point to point of heart edge and compare to head diameter to verify the gestational age. As the result, the gestational sac diameter, the fetal head diameter, and the fetal heart rate of domestic cat in Indonesia have correlation to gestational age and also can be used to estimate the gestational edge.

## 1 INTRODUCTION

The *Felis domesticus* is local breed of cat in Indonesia (Madyantari, 2016). It has short hair with different color which depend on the alel frequency. The average of body length of this cat is 76 cm with 2-3 kg of female body weight and 3-4 kg of male body weight (Mariandayani, 2012).

Pregnancy in cats and fetal development can be detected using several methods such as abdominal palpation, radiography, and ultrasonography. The abdominal palpation is the cheapest way to detect pregnancy but only can detected in second trimester of cat pregnancy and has low accuracy so that can make a false pregnancy. The radiography has more accuracy but only can determine the number of fetuses and can not determine the viability of fetuses. The ultrasonography is a high accuracy method to detect pregnancy because of ability to evaluate the viability, organ development, and number of fetuses (Purohit, 2010).

Investigation of fetal development has been studied in recent years, but it is rarely investigated in domestic cat especially in Indonesia. Early detection and investigation of fetal development are important to maintain the nutritional care, prevent of dangerous drug use for the fetal, and the viability of fetal its self (Machun *eat al*, 2011). This aim of this study was to evaluate the correlation between gestational sac diameter, fetal head diameter, and fetal heart diameter to gestational age using ultrasonography.

## 2 MATERIALS AND METHOD

The study used nine samples of queens and it is divided into 3 groups, based on gestational age (GA) (0-20 days, 21-40 days, and 41-60 days). Every group have different method to find accurated gestation age. First group will use gestation sac diameter (GSD) to find the accuracy gestation age with specific formula (**figure 1**). The second group was measured the fetal heart diameter. The fetal heart diameter can be

detected by freeze the image (**figure 2**) that is characterized as hypoechoic with anechoic lumen and then measuring point to point of the heart image. The last group was measured head diameter. It can be performed by detect the line between the outer edges of head (the farthest edge) that has highest (white) opacity (**figure 3**) and the gestational age can be measure using the specific formula.

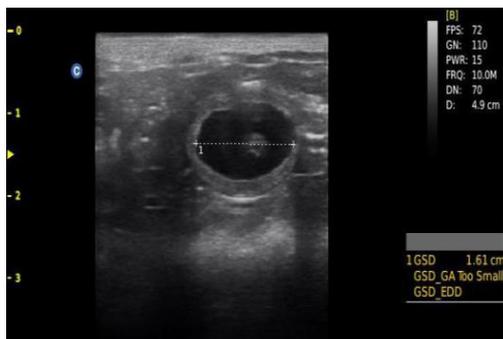


Figure 1. Measurement of Gestational Sac Diameter



Figure 2. Measurement of Fetal Heart Diameter



Figure 3. Measurement of Fetal Head Diameter

### 3 RESULT

Formulation for calculating gestation age in the queens using extrafetal structures in early pregnancy (0-20 days) is:

$$GA = 1,368x - 11,566$$

x = inner chorionic circumference (mm)

The gestation sac diameter of 3 queens were evaluated. The earliest sign of pregnancy in queen is the presence of gestational sac, which is appeared like a small circular anechoic structure at ultrasound. There were no significant differences between the three cats for GSD for early gestation age (**Table 1**).

Table 1. Data of Gestation Sac Diameter (GSD) (cm) of Domestic Cat during Pregnancy

Cats Name	Gestation Sac Diameter	Formula	Results GA (days)
Gempi	1.61	GA = 1.368(16.1) - 11,566	10
Titty	2.03	GA = 1.368(20.3) - 11,566	16
Cippy	1.49	GA = 1.368(14.1) - 11.566	8

Fetal heart diameter is measured by detecting point to point of heart edge and compare to the head diameter to verify the gestational age. The data were collected in **Table 2**.

Table 2. Data of Fetal Heart Diameter (cm) of Domestic Cat during Pregnancy

Cats Name	Days	Fetal Heart Diameter
Gempi	21	0.6
Mimi	31	0.73
Meme	32	0.78

Correlation between fetus head diameter with gestational age can be measured by the formula below and the result is shown in **Table 3**.

$$GA = 25 \times HD + 3$$

Table 3. Data of Fetal Head Diameter of Domestic Cat during Pregnancy

Cat Name	Head Diameter (cm)	Formula	Results GA (days)
Putty	2.0	$GA = (25 \times 2.0) + 3$	53
Nana	1.76	$GA = (25 \times 1.76) + 3$	47
Betty	2.1	$GA = (25 \times 2.1) + 3$	55

## 4 DISCUSSION

Gestational sac was first detected between days 8 and 12 of gestation in cat (Lopate, 2018). As this study performed, the gestational sac diameter can be measured in days 8 of gestational age. The formula to measured the gestational sac diameter in early gestational age between 0 - 20 days indicates that the alteration of gestation sac diameter will affect gestational age of the fetus. But, the gestational sac not too elongate, the result of gestation age of measured gestational sac 1.41 cm is 8 days and in 1.61 cm the gestation age at 10 days, and the result of gestational age when gestational sac diameter in 2.03 cm is 16 days. So, if the gestational sac diameter elongate 0,2 cm then the gestational age will be increased 2-3 days. This is also explained in recent study of Zambelli *et al.* (2002) that gestational sac diameter has correlation to gestational age.

The first detection of fetal heart rate by ultrasonography can be measured between 16-18 days of pregnancy (Zambelli *et al.*,2002). The measurement of heart diameter is helpful for determining the fetal viability (Oral H *et al.*, 2007). Fetal heart diameter is important to be measured for ealier detection of heart abnormalities and screening of fetal congenital heart disease (Sylwestrzak *et al.*, 2018). In this study, we collected data of heart diameter in last trimester of pregnancy cats and shown that in days 21 the fetal heart diameter is 0.6 cm, in days 31 showed 0.73 cm in fetal heart diameter, and in days 32 showed 0.78 cm in fetal heart diameter. From that data, we can see that fetal heart diameter was correlated to gestational age, in which the greater fetal heart diameter can be measured as the older gestational age. This study revealed positive

correlation to study from Oral H *et al.* (2007) who reported that heart rate were correlated with fetal age and can be used to estimate the gestational age. Beside determine the gestational age, the fetal heart diameter were correlated to fetal size also as the study of Giannico, *et al.* (2015). The increasing of fetal heart diameter indicates the increasing of fetal size due the development of organs, in which the bigger size of fetal needed more blood supply to the whole body so that the fetal heart diameter is increasing.

Fetal head diameter can be detected at 24 days of gestational age in cat (Macun *et al.*, 2011). The diference of fetal head size can caused the deviation measurement (Nyland, 2002). The data of this study show that in 47 days, the diameter of the head is 1.76 cm, in 53 days, the diameter of head is 2 cm, and in 55 days of pregnancy the diameter of head is 2.1 cm. This collected data explained that increasing diameter of the head is indicate that the fetuses are getting older. In recent study explained that the fetal head diameter had correlation with the age of gestation (Macun *et al.*,2011).

## 5 CONCLUSION

Monitoring of fetus development is important to evaluate the fetus viability. In this study can be conclude that gestational sac diameter, fetal heart diameter, and fetal head diameter have correlation to gestational age. These parameters can be used to estimate of gestational age.

## ACKNOWLEDGEMENTS

We many thanks to LPPM and Faculty of Veterinary Medicine, Universitas Brawijaya for providing research assistance funds and supporting the completion of this research.

## REFERENCES

- Giannico, A. T., Mayumi, E., Aparecida, D., Sousa, M. G., & Froes T.R. (2016). Canine and Fetal Echocardiography: Correlation for the Analysis of Cardiac Dimension. *Ve Res Commun* 40: 11-19
- Lopate, C. (2018). Gestation Aging and Determination of Parturition Date in the Bitch and Queen Using Ultrasonography and Radiography. *Veterinary Clinics of North America: Small Anim Practice* 48(4): 617-638

- Macun, H. C., Erat, S., & Arikan, S. (2011). Comparison of Prenatal Development of Turkish Angora and Van Cats. *Veterinaarski Arhiv* 81: 671-682
- Madyantari, N., Hidayat, S. & Wahab T. (2016). Perancangan Buku Ilustrasi Kucing Di Bandung. *Jurnal e-Proceeding of Art and Design*. 3 (3): 746-753
- Mariandayani, H. N. (2012). Keragaman Kucing Domestik (*Felis domesticus*) berdasarkan Morfogenetik. *Jurnal Peternakan Sriwijaya* 1(1):10-19
- Nyland, T.G. & Mattoon J.S. (2002). *Small Animal Diagnostic Ultrasound*. USA: Elsevier.
- Oral, H., Pancarci, S. M., Gungor, O., & Kacar, C. (2007). Determination of Gestational Age by Measuring Fetal Heart Diameter with Transrectal Ultrasonograph in Sheep. *Medycyna Wet* 63(12): 1558-1560
- Purohit, G. (2010). Methods of Pregnancy Diagnosis in Domestic Animal: The Current Status. *WebMed Central Reproduction* 1(12): 1-26
- Sylwestrzak, O. & Respondek-Liberska, M. (2018). Echocardiographic Methods of Fetal Heart Size Assessment-Heart to Chest Area Ratio and Transversal Heart Diameter. *Prenat Cardio* 8(1): 20-23
- Zambelli, D., Castagnetti, C., Belluzzi, S., & Bassi, S. (2002). Correlation between the age of the conceptus and various ultrasonographic measurements during the first 30 day of pregnancy in domestic cats (*Felis catus*). *Theriogenology* 57: 1981-1987.

