

Conceptus ecobiometry and triplex Doppler ultrasonography of uterine and umbilical arteries for assessment of fetal viability in dogs

S.A. Miranda^{a,b,c,*}, S.F.S. Domingues^{a,b}

^a *Laboratório de Biologia e Medicina de Animais Domésticos e Silvestres da Amazônia, Medicina Veterinária, Universidade Federal do Pará (UFPA), Castanhal, PA, Brazil*

^b *Programa de Pós-Graduação em Ciência Animal, UFPA, Belém, PA, Brazil*

^c *Bolsista da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)*

Received 11 June 2009; received in revised form 25 February 2010; accepted 14 March 2010

Abstract

The objectives were to: 1) evaluate blood flow in the uterine (UA) and umbilical (Uma) arteries in the pregnant bitch, by measuring the resistive index (RI) and pulsatility index (PI); 2) to note the presence or absence of the early diastolic notch and diastolic flow in the UA and Uma flow waveforms, respectively; and 3) perform conceptus ecobiometry for fetal growth assessment during pregnancy. Six healthy bitches were examined on approximately Days -44, -42, -36, -31, -28, -25, -21, -18, -14, -8, -4, and -2 of pregnancy (whelping = Day 0). Triplex Doppler and B-mode ultrasonography were used to assess blood flow and conceptus ecobiometry. All pregnancies ended with a normal whelping and birth of live puppies. Prior to whelping, all conceptus dimensions increased significantly, whereas RI and PI of both the Uma and UA decreased significantly. For the UA, RI and PI were (mean \pm SEM) 0.95 ± 0.02 and 2.75 ± 0.41 , respectively, on Day -44, and were 0.60 ± 0.01 and 0.99 ± 0.03 on Day -4. For the Uma, RI and PI were 0.99 ± 0.01 and 2.42 ± 0.03 on Day -31, and were 0.62 ± 0.01 and 1.15 ± 0.02 on Day -4. The complete disappearance of the early diastolic notch in the UA, and the appearance of diastolic flow in the Uma occurred on Days -16 ± 5 and -21 ± 1 . The authors concluded that UA and Uma perfusion were important end points to assess fetal vitality in bitches. Furthermore, the current reference values provided a baseline for monitoring normal and abnormal pregnancies in bitches.

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Keywords: Uterine arteries; Fetoplacental circulation; Fetal development; Bitch; Gestation

1. Introduction

Associations between fetal ecobiometry and gestational age in the bitch have been studied in the context of predicting time of whelping [1–4]. Furthermore, the well-being of the canine fetus has been evaluated based on fetal movements [5,6] and heartbeat [6,7]. However,

there are few studies regarding relationships between gestational age and fetal viability in dogs, especially on the basis of blood flow characteristics. In humans, relationships among fetal size, wellbeing, and characteristics of blood flow in the uterine artery (UA) [8–11] and in the umbilical artery (Uma) [12–15], have been reported.

Two-dimensional B-mode ultrasonography, augmented with Color Doppler and Spectral Doppler (Triplex Doppler), have been used clinically for obstetrics and gynecology in women [9,15–17] and various ani-

* Corresponding author. fax: + 55 91 32018011.

E-mail address: stefania_miranda@hotmail.com (S.A. Miranda).

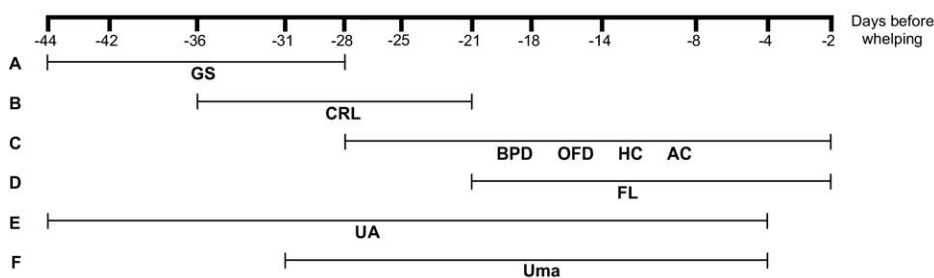


Fig. 1. Pre-whelping interval and end points assessed during ultrasonographic examinations in pregnant bitches: (A) Gestational sac diameters (GS); (B) Crown rump length (CRL); (C) Biparietal diameter (BPD), occipito-frontal diameter (OFD), head circumference (HC), and abdominal circumference (AC); (D) Femur length (FL); (E) Resistive index, pulsatility index of uterine arteries (UA) and the presence or absence of the UA early diastolic notch; and (F) Resistive index, pulsatility index of umbilical artery (Uma), and Uma diastolic flow.

mal species [18–21]. Triplex Doppler allows quantitative and qualitative assessments of blood flow [22,23]. The quantitative evaluation includes resistive index (RI) and pulsatility index (PI) of the UA [8,24–26] and Uma [18,19,25,27]. Regarding the qualitative approach, the presence or absence of an early diastolic notch in the UA flow waveform [24–26,28], and the appearance of Uma diastolic flow [19,26,27], have been characterized. It is noteworthy that Triplex Doppler assessment of the UA and Uma characteristics were useful tools for predicting abnormal pregnancy outcomes in humans [10,11,29].

Considering the paucity of reports regarding assessment of canine fetal viability, the objectives of the current study were to: 1) evaluate blood flow in the uterine (UA) and umbilical (Uma) arteries in the pregnant bitch, by measuring the resistive index (RI) and pulsatility index (PI); 2) to determine the presence or absence of the early diastolic notch and diastolic flow in the UA and Uma flow waveforms, respectively; and 3) perform conceptus ecobiometry for fetal growth assessment during pregnancy.

2. Materials and methods

2.1. Animals

Six healthy pregnant bitches of various breeds, between 1 and 5 yr of age, weighing 5–15 kg, were used. These bitches had previously had one or two pregnancies (four and two bitches, respectively), with uncomplicated pregnancies and whelpings, and live, healthy puppies. Bitches had *ad libitum* access to dry commercial dog food and water. All bitches were owned by students of the veterinary school (Universidade Federal do Pará, Brazil), who agreed to use their bitches in this study. The bitches were maintained in the owners' residence, and brought to the laboratory for each ultrasono-

graphic exam. Comprehensive reproductive histories were available regarding previous litters, and the outcome of the current pregnancy. In each of the six bitches, pregnancy was initiated by a single natural mating.

2.2. Ultrasonographic examination

Ultrasonographic examinations were done twice weekly from approximately Day -44 (whelping = Day 0) to just prior to whelping (Fig. 1). The day of the examination relative to whelping was calculated in retrospect. The onset of whelping was determined from direct communication with the owner. The intervals from mating to whelping were 60, 63, and 64 d (two bitches for each interval).

Ultrasonographic examinations were conducted with an HDI 4000 PHILIPS scanner (Philips Medical Systems, Bothel, WA, USA), equipped with multi-frequency microconvex (5–8 MHz) and linear-array (5–12 MHz) transducers. For these examinations, bitches were placed in dorsal recumbency without sedation. To ensure acoustic coupling between the transducer and skin, the abdomen was shaved (with a blade razor) and a coupling gel was applied (Aqua-sonic, Parker Laboratories Inc., Fairfield, NJ, USA). Each examination lasted ~1 h.

Initially, the uterus was located with B-mode ultrasonography, using the anechoic urinary bladder as landmark. At least one conceptus was monitored on each side of the abdomen. On Days -44 to -28, latero-lateral internal (LLI), dorso-ventral internal (DVI; Fig. 2A), latero-lateral external (LLE), and dorso-ventral external (DVE; Fig. 2B) diameters of the gestational sac were measured.

The fetus was detected ultrasonographically at Day -36; at all examinations thereafter, fetal ecobiometry was performed for assessment of fetal development. Fetal measurements included: crown rump length

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