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## Can maternal-fetal hemodynamics influence prenatal development in dogs?



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### ABSTRACT

The goals of this study were to report embryonic and fetal ultrasound changes and compare blood flow of uteroplacental and umbilical arteries of normal and abnormal conceptus. Accordingly, from the day of mating or artificial insemination, all fetuses in 60 pregnancies were evaluated weekly. According to the ultrasound findings, the gestational age was determined and the conceptuses were divided into normal or abnormal (embryonic and fetal abnormalities). The two-dimensional ultrasound assessment consists of measuring and evaluating the echogenicity of conceptus and extra-fetal structures. Doppler velocimetry measured the resistivity index (RI) and pulsatility index (PI) of uteroplacental and umbilical arteries. Two-dimensional and Doppler measurements were expressed as mean and standard deviation. Differences between normal and abnormal groups were subject to Mann-Whitney test ( $P < 0.05$ ). Of 264 fetuses, 15.90% showed embryonic abnormalities (resorption) and 5.68% presented fetal abnormalities (congenital abnormalities, fetal underdevelopment and fetal death). We observed a reduced diameter and abnormalities in the contour of gestational vesicle, lack of viability, increased placental thickness, increased fluid echogenicity and increases in RI and PI of uteroplacental arteries of conceptuses with embryonic resorption between the 2nd and 4th weeks. Fetuses with abnormalities showed changes in the flow of uteroplacental and umbilical arteries prior to visualization of two-dimensional alterations and different vascular behavior according to the classification of the change. Results show that ultrasound is efficient for the detection of embryonic and fetal abnormalities. When combined with Doppler ultrasound, it allows early detection of gestational changes, as well as hemodynamic changes, in conceptuses with abnormalities, which may influence their development.

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### 1. Introduction

Ultrasound is an effective technique to detect abnormalities during pregnancy, such as embryonic resorption,

retarded prenatal development, fetal abnormalities, fetal distress and fetal death. However, there are only few and old works addressing pregnancy ultrasound changes in bitches (Poffenbarger and Feeney, 1986; Allen et al., 1989; Adams et al., 1991; England, 1992).

Prenatal death is common and can occur at any stage of pregnancy in mammals (Ginther, 1985; England, 1992).

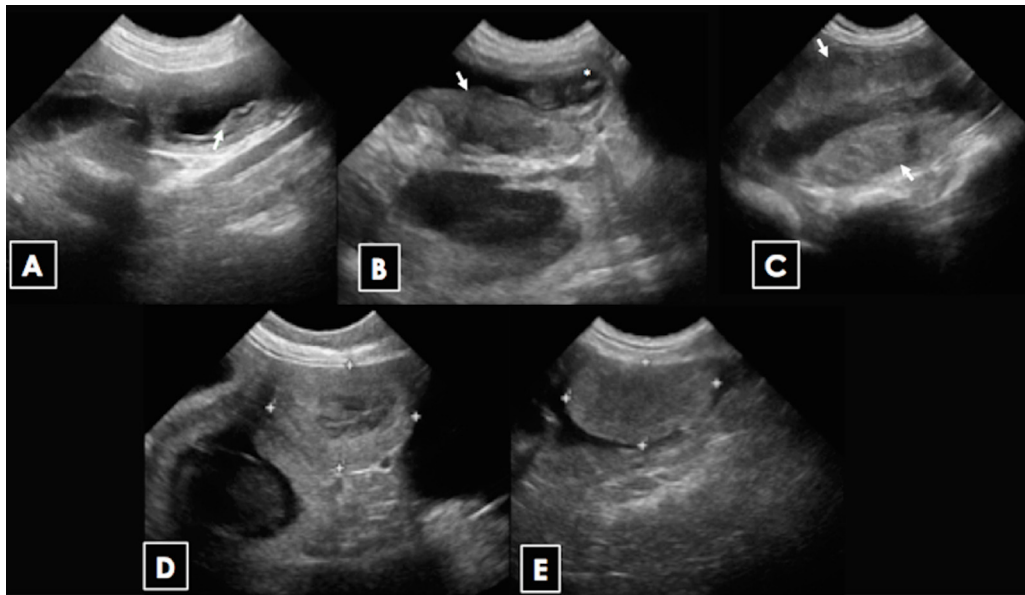
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**Table 1**

Distribution of the number of pregnancies (NP), number of conceptus counted by ultrasound (NF), number of births and average litter size (NB and LS), normal conceptus evaluated by ultrasound (NC) and ultrasound abnormalities: resorption (R), congenital abnormalities (CA), fetal underdevelopment (FU) and fetal death (FD) per breed.

Breed	Gestational Parameters				Ultrasound Abnormalities			
	NP	NF	NB and LS	NC	R	CA	FU	FD
French Bulldog	30	120	123 (4 ± 2)	104	13	2	–	1
Shiz Tzu	15	93	94 (6 ± 3)	87	5	–	1	–
Yorkshire	9	19	18 (2 ± 1)	7	6	1	2	3
Fila Brasileiro	6	32	36 (8 ± 4)	9	18	1	–	4
TOTAL	60	264	271	207	42	4	3	8



**Fig. 1.** Ultrasound monitoring of embryo resorption in a French Bulldog bitch (5 weeks duration). (A) Gestational vesicle with 2 weeks presenting irregularity of internal contour (arrow); (B) Embryo with irregular contour and gestational vesicle with walls and placenta thickened, heterogeneous, and with irregular internal contour (arrow) (during 3rd week); (C) Severe thickening of gestational vesicle walls and placenta with embryonic resorption in progress (during 4th week); (D) Clear reduction in chorionic cavity and absence of embryo (during 5th week); (E) Chorionic cavity collapse identifying final resolution of the resorption process (during 6th week).

**Table 2**

Mean ± standard deviation of the placental thickness (cm) of normal conceptus (NF, n = 210) and with gestational changes: resorption (R, n = 42), hydrocephalus (Hc, n = 2), hydrops (Hp, n = 1), gastroschisis (G, n = 1), fetal underdevelopment (FU, n = 3), fetal maceration (Ma, n = 2) and fetal mummification (Mu, n = 6) during the gestation. A total of 267 conceptus was evaluated.

Weeks	Placental thickness (cm)							
	NF	R	Hc	Hp	G	FU	Ma	Mu
3	0.14 ± 0.05 <sup>a</sup>	0.34 ± 0.07 <sup>b</sup>	–	0.12	0.11	0.13 ± 0.04	0.10	0.12 ± 0.02
4	0.24 ± 0.09 <sup>a</sup>	0.48 ± 0.09 <sup>b</sup>	0.26	0.25	0.22	0.24 ± 0.06	0.25	0.23 ± 0.01
5	0.51 ± 0.15	–	0.52	0.56	0.51	0.51 ± 0.02	0.52	0.51 ± 0.01
6	0.68 ± 0.18	–	0.63	0.66	0.60	0.63 ± 0.01	0.61	0.60 ± 0.03
7	0.72 ± 0.28	–	0.69	0.78	0.75	0.74 ± 0.0	–	0.71 ± 0.05
8	0.66 ± 0.31	–	0.61	0.72	0.74	0.64 ± 0.03	–	0.69 ± 0.04
9 <sup>a</sup>	0.77 ± 0.25	–	0.83	–	–	–	–	0.89 ± 0.05

Different superscript lower case letters in the same line indicate that there were differences between normal and abnormal fetuses ( $P < 0.05$ ).

When occurring in the first third of pregnancy, results in embryonic resorption and when in the middle or final third, it may result in mummification, maceration or abortion (England, 1998).

Ultrasound data on the incidence of spontaneous embryo resorption in dogs are scarce due to occurrence beginning of pregnancy and often feature rapid resolution

(England, 1992, 1998; England and Russo, 2006; Pacheco et al., 2006). It is reported at a frequency from 11 to 15% (England, 1992; Muller and Arbeiter, 1993; England and Russo, 2006; Pacheco et al., 2006 Pacheco et al., 2006) but that may negatively affect the final litter size or even the entire pregnancy (England, 1992, 1998). This phenomenon is characterized by lysis followed by absorption of the

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