

DOPPLER INDICES OF UMBILICAL ARTERY, UTERO-PLACENTAL ARTERY AND FETAL AORTA DURING NORMAL GESTATION IN BITCHES

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ABSTRACT

Twelve pregnant bitches of different breeds were examined at weekly interval, from fifth week of gestation onward, to determine changes in blood flow of umbilical artery, utero-placental artery and fetal aorta. Doppler ultrasonography aided alterations in doppler indices viz. peak systolic velocity (PSV), end diastolic velocity (EDV), pulsatility index (PI) and resistance index (RI) of above vessels were assessed. The umbilical and uteroplacental arteries of pregnant bitches and the abdominal aorta of fetuses showed progressive increase in PSV and EDV ($p < 0.05$) and decrease in RI and PI ($p < 0.05$) from week 5 to week 8 of pregnancy. In brief, these alterations reflected an increase in perfusion in these arteries, which closely followed increases in fetal dimensions and growth with an increase in gestational age in bitches.

Keywords: Bitches, Blood flow, Canine, Doppler ultrasound, Pregnancy

INTRODUCTION

Conventional two-dimensional ultrasonography is used routinely in small animal reproduction to reveal and check canine pregnancy (Bondestam *et al.*, 1983; England *et al.*, 1990). The different parameters studied through ultrasonography would show fetal development, serve to estimate fetal age and can reveal growth retardation (England *et al.*, 1990). Nevertheless, the reasons for developmental alterations cannot be found in many cases. A better evaluation of the course of pregnancy can be achieved by monitoring the fetal supply with nutrients and oxygen, of which the maternal utero-placental and fetal vascularization are indicators. A simple, non-invasive technique to show maternal and fetal circulations that are extremely valuable is doppler ultrasonography. Considering the importance of doppler to pregnancy and the recent studies of vascular indices in pregnant animals, the present study was undertaken with the objective to evaluate blood flow in the maternal and fetal arteries in pregnant bitches.

MATERIALS AND METHODS

Twelve pregnant bitches (age, 2-5 yr) of different breeds viz. Spitz (3), Labrador retriever (5), Pug (2) and Non-descript breed (2) were subjected to two-dimensional ultrasonographic examination in combination with colour and pulse wave Doppler for the assessment of fetal growth and well-being.

Animals were positioned in dorsal recumbency or in lateral recumbency (if required) after clipping of hair in the ventral abdominal region. Pregnancy diagnosis was confirmed by ultrasonographic examination (Aloka) using a sector probe of 3.5–7.5 MHz. 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 and thereafter; fetal ecobiometry was performed for the assessment of fetal age.

Two dimensional ultrasonographic examinations in combination with colour and pulse wave Doppler were performed at weekly intervals from week 5 till week 8 of gestation. For the assessment of maternal and fetal circulation, the spectral waveform analysis of blood flow of fetal aorta, umbilical artery and uterine artery

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was carried out and was examined in the most caudal fetus. The fetal aorta was imaged throughout its arch with the cauda vena cava parallel to the abdominal aorta (Figure 1). The umbilical artery was measured on the free fluctuating portion of the umbilical cord between the conceptus and the gestational sac (Figure 1). The utero-placental arteries in the neighbourhood of the gestational sac or between the two gestational sacs were examined (Figure 1). In particular, the vessels were visualised by colour doppler then a pulse wave sample volume was placed exactly in the centre of the colour-coded blood flow and the wave forms with at least three consecutive cardiac cycles were recorded (Figure 1). The indices measured for each vessel and automatically calculated for each wave form by software of ultrasound scanner were, a) Peak Systolic Velocity (PSV), b) End-Diastolic Velocity (EDV), c) Resistance index (RI), and d) Pulsatility index (PI).

RESULTS AND DISCUSSION

The spectral waveforms obtained from umbilical artery provide information on placental resistance to blood flow and hence indirectly the placental health and function. In the present study, systolic and diastolic flow of umbilical artery was first detected at week 5 of gestation in bitches. Perfusion in the umbilical arteries increased from week 7 of gestation onwards which resulted in decreases of PI and RI ($p < 0.05$, Table 1). Others also reported major decreases of RI and PI in the umbilical arteries of pregnant bitches (Miranda and Domingues, 2010).

Increased resistance in the fetal aorta reflects compensatory vasoconstriction in the fetal body and absence of diastolic flow in the fetal aorta implies fetal acidaemia (Mires, 2008). In the present study, abdominal aorta of the fetuses showed progressive increase for PSV and EDV and decrease for RI and PI, between week 5 to 8 of pregnancy ($p < 0.05$, Table 1). When first detected, no diastolic flow was observed in the majority of fetal abdominal aorta examined, whereas, slow diastolic flow was noticed from week 6

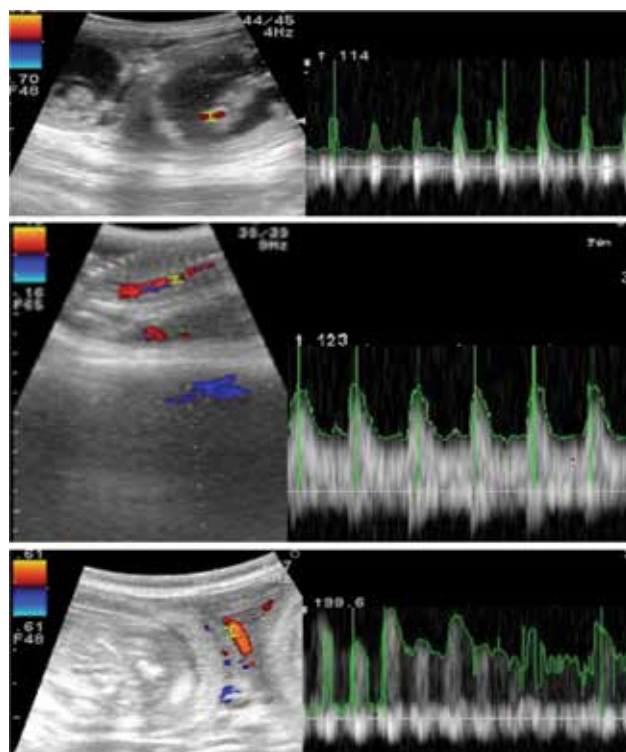


Figure 1: Doppler ultrasonographs showing position for recording (doppler gate, green indicator on vessels, left side) from umbilical artery (upper), fetal aorta (middle) and utero-placental artery (lower) in a pregnant bitch along with their respective spectral waveforms (right side)

of pregnancy in bitches. This was in accordance with an earlier report (Feliciano *et al.*, 2013).

During week 5 of pregnancy, the utero-placental arteries showed an increase in the PSV and at week 6 of pregnancy there was an increase of PSV and EDV ($p < 0.05$, Table 1). From week 5 to 8 of gestation, the PI and RI in uterine artery revealed a consistent decrease ($p < 0.05$, Table 1), which indicated that as gestational age advances in bitches and the fetal size increases, the perfusion in these arteries also increases. In the abnormal bitches, EDV ceased to increase when RI shifted to an increasing trend (Blanco *et al.*, 2011).

It brief, serial Doppler evaluation of umbilical artery, uterine artery and fetal abdominal aorta in pregnant

Table 1: Doppler indices in umbilical artery, fetal aorta and utero-placental artery of pregnant bitches (n=12)

Index	Week of Pregnancy				p-value
	5	6	7	8	
Umbilical artery					
PSV, cms ⁻¹	21.86±1.8	23.52±1.3	27.59±6.9	30.70±6.8	*
EDV, cms ⁻¹	1.96±3.38	3.37±3.79	6.22±7.04	6.21±3.55	*
PI	1.11±0.31	1.01±8.02	0.92±0.16	0.89±0.16	*
RI	0.90±0.54	0.85±0.52	0.80±0.36	0.77±0.33	*
Fetal aorta					
PSV, cms ⁻¹	39.40±2.9	42.94±2.5	45.78±3.7	49.33±4.6	*
EDV, cms ⁻¹	0.37±0.25	1.52±0.64	3.59±0.72	6.51±3.80	*
PI	1.21±0.55	1.20±0.69	1.00±0.23	0.91±0.11	*
RI	0.98±0.69	0.95±0.79	0.91±0.59	0.85±0.51	*
Utero-placental artery					
PSV, cms ⁻¹	23.23±1.7	24.35±1.8	24.46±2.4	25.07±2.7	*
EDV, cms ⁻¹	9.73±3.80	11.89±0.34	12.82±0.68	13.00±0.48	*
PI	0.75±0.06	0.74±0.03	0.65±0.06	0.60±0.05	*
RI	0.54±0.06	0.53±0.41	0.46±0.03	0.43±0.04	*

*p<0.05; PSV, Peak Systolic Velocity; EDV, End Diastolic Velocity; PI - Pulsatility Index; RI - Resistance Index

bitches could help to evaluate fetal growth and fetal wellbeing and could also be widely used in diagnosing and even preventing many cases of abnormal gestation before other sonographic signs appeared.

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