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CASE REPORT

Doppler Evaluation of Fetal and Feto-Maternal Vessels During Dystocia in Cats: Four Cases [1]

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Abstract

Doppler ultrasonography has been becoming an essential tool in veterinary medicine, especially in theriogenology. It has being widely used for the evaluation of fetal well-being in pathologic pregnancies in human medicine. The paper highlights the usage of Doppler ultrasonography in veterinary obstetrical pathologies with a review of literature of human and veterinary medicine. Four cats with dystocia and their fetuses were evaluated for fetal and maternal hemodynamics. As a conclusion, flow velocity of the fetal and feto-maternal vessels can inform us of the existence of the pathology related to gestation and also can help choosing the method of treatment in veterinary medicine.

Keywords: *Cat, Dystocia, Doppler ultrasonography, Feto-maternal vessel*

Kedilerde Güç Doğum Sırasında Fötal ve Föto-Maternal Damarların Doppler Değerlendirilmesi: Dört Olgu

Özet

Doppler ultrasonografi, başta teriyojenoloji olmak üzere veteriner hekimlikte sıklıkla başvurulan yöntemlerden biri olmaya başlamıştır. İnsanlarda özellikle patolojik gebeliklerde fötal iyilik halinin değerlendirilmesi amacıyla yaygın olarak kullanılmaktadır. Bu makalede, tıp ve veteriner hekimliğinde yer alan literatürlerin derlenmesiyle beraber, veteriner obstetrik patolojilerde Doppler ultrasonografi kullanımının aydınlatılması amaçlanmıştır. Güç doğum şikayeti bulunan dört adet kedi ve bu kedilere ait fötuslarda fötal ve maternal hemodinamik değerlendirilmiştir. Sonuç olarak, fötal ve föto-maternal damarlara ait akım hızlarının gebelik patolojilerinin belirlenmesinde kullanılabileceği ve güç doğum olgularında tercih edilecek tedavi metodunun belirlenmesinde yardımcı olabileceği düşünülmüştür.

Anahtar sözcükler: *Kedi, Güç doğum, Doppler ultrasonografi, Föto-maternal damar*

INTRODUCTION

Doppler ultrasonography (D-USG) is a non-invasive technique which enables us to follow the physiologic and physiopathologic differences in the circulation between mother and fetus. However D-USG alone is not sufficient for the evaluation of fetal well-being, but this technique enables the doctor to diagnose fetal distress earlier than other tests [1]. Obstetric D-USG gives the doctor a reliable opportunity to review maternal and fetal hemodynamics by investigating the vessels like the umbilical artery and vein, uteroplacental arteries, fetal thoracic aorta, fetal caudal vena cava and fetal cerebral artery [2,3]. Abnormal vascular placental development in fetal and/or maternal compartments may be an indicator of intrauterine growth restriction, fetal distress and early pregnancy failure [4,5].

Both in medical science and veterinary gynaecology, using D-USG with the aim of monitoring pregnancy and research is becoming increasingly widespread. There are

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limited number of studies [3,6,7] about feline fetal D-USG. This is the first report of fetal D-USG in cats with dystocia. The present paper contains the evaluation of maternal and fetal haemodynamic characters of four cats diagnosed with dystocia.

CASE HISTORIES

The presented four cases were referred to the Department of Obstetrics and Gynaecology, Faculty of Veterinary Medicine, Istanbul University, Turkey. The patient's information was documented in *Table 1*. After a detailed anamnesis and physical examination, existence of the fetal heartbeat of each fetus was checked with B-mode real-time ultrasonography (MyLab 5-Vet ESAOTE®, Genova, Italy) using a microconvex probe of 5 MHz. Immediately after the recording of a fetal heart rate, pulsed-wave Doppler (PWD) sonography was performed to the most caudal fetus. First, the vessel was visualized using Color-Doppler mode and subsequently the PWD sonography mode of the device was turned on. The *angle* of *insonation* was approximately 60° in all examinations. Pulsatility (PI) and resistance index (RI) of umbilical artery, uteroplacental artery, fetal thoracic aorta and fetal inferior vena cava were recorded and the waveform of each vessel was assessed qualitatively.

The cat and her kittens in Case 1 and the kittens in Case 2 and 4 died within 24 h of the operation while the other cats and kittens in Case 3 recovered. The fetal heart rates and Doppler findings are presented in *Table 1*.

There was a high resistance in the umbilical artery of Case 1 and 4 and in the fetal aorta of Case 1 and 2. PI values of fetal vena cava were high in Case 1, 2 and 4.

According to qualitative Doppler waveform analysis, a decreased "a" wave during atrial systole was detected in the inferior vena cava of Case 2 *(Fig. 1)*. Also decreased end diastolic flow in fetal aorta was clearly seen in the same fetus *(Fig. 2)*.

DISCUSSION

There are many techniques of Doppler analysis. However, analyzing the pulsatilty of the Doppler waveform is one of the widely accepted approaches in clinical use.

Table 1. *Case information, fetal heart rates and Doppler indices of the cats*
Tablo 1. *Olgulara ilişkin bilgiler, fötuslara ait Doppler bulguları ve kalp atım sayıları*

Information	**Case 1**		**Case 2**		**Case 3**		**Case 4**	
Age	4-year-old		4-year-old		3-year-old		6-year-old	
Breed	Mixed-breed		Mixed-breed		Siamese		Persian	
History	The cat had been struck by a car fifteen days ago		Vaginal bleeding which had begun 3h before		Lower respiratory tract infection		Given birth to a kitten 10 h before. The second and dead kitten was taken out from the birth canal 5 h later	
Clinical findings	Haemorrhagic vaginal discharge, paraplegia, dyspnea, 35.7°C		Haemorrhagic vaginal discharge, general condition was good, 37.7°C		Severe dyspnea, muco-purulent nasal discharge, 39.7°C		General condition was good, 37°C	
Gestational age (after mating)	58th day		62nd day		58th day		63rd day	
Hematological findings	Severe anemia (RBC 3.1×10^{12}/l and HCT 22%), Leukocytosis (WBC 25.6×10^{9}/l)		In normal range		Leukocytosis (WBC 23.7×10^{9}/l)		In normal range	
Treatment	warm crystalloid (25 ml/kg NaCl 0.9%, Mediflex®, Eczacıbaşı-Baxter) and colloid (5ml/kg Gelofusine®, Irengun) i.v.		-		Amoxicillin and clavulanic acid (8.75 mg/kg SC, Synulox®, Pfiezer) and O_2 treatment for three days		-	
Operation	c-section		c-section		c-section (after 3 day medical treatment)		c-section	
Fetal heart rate (bpm)	150		125		225		189	
	PI	**RI**	**PI**	**RI**	**PI**	**RI**	**PI**	**RI**
A. umbilicalis	1.45	0.74	1.19	0.75	1.08	0.69	1.47	0.75
Fetal aorta	2.81	0.90	2.64	0.91	1.73	0.81	2.68	0.89
Fetal vena cava	1.31	0.77	1.46	0.85	0.45	0.38	1.47	0.84
Uteroplacental artery	0.45	0.36	0.31	0.27	0.59	0.44	0.65	0.49

PI: *Pulsatility,* ***RI:*** *Resistance index*

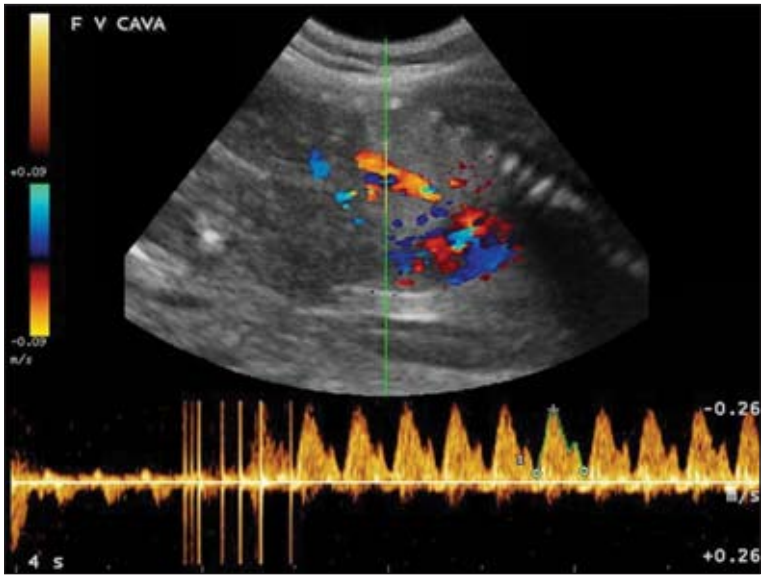
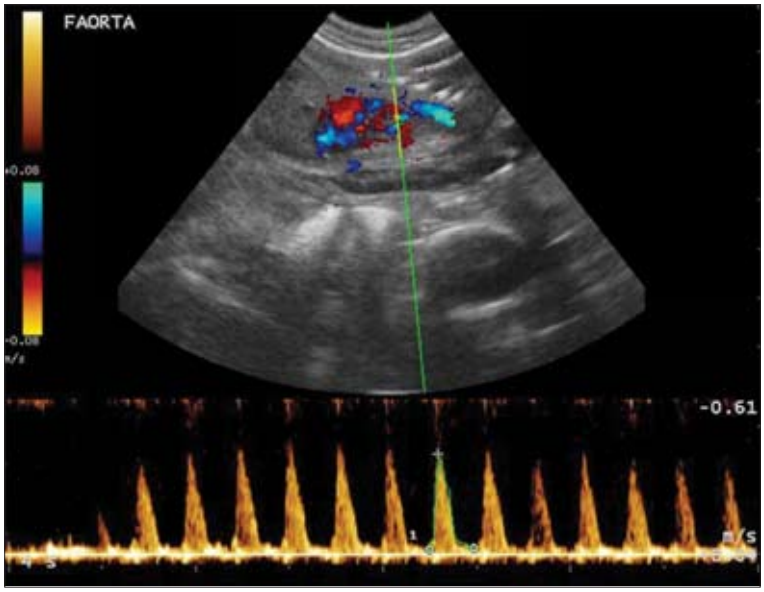


Fig 1. A decreased "a" wave during atrial systole in the inferior vena cava of Case 2

Şekil 1. Olgu 2'nin inferior vena kavasında atrial sistol boyunca şekillenen azalan "a" dalgası

Fig 2. A decreased end diastolic flow in fetal aorta of Case 2

Şekil 2. Olgu 2'ye ait fetal aortada şekillenen "azalan diyastol sonu akımı"



A Doppler index is calculated as a ratio and is, therefore, virtually angle-independent [8].

Normal fetal heart rate in kittens is 193-263bpm. The cases in which the fetal heart rates are below these levels suggest developing hypoxia and fetal distress [9]. A tentative diagnosis of hypoxia and fetal distress was given in all cases except case 3. Progressive hypoxia causes a decreased, reversed or absent end diastolic flow in thoracic aorta [2]. Indeed, a decreased end diastolic flow in fetal aorta was detected in Case 2.

Three major pathologies are described in the umbilical artery blood flow in human medicine. They are high PI and RI values; absent end diastolic flow and reversed end diastolic flow [2]. In recent studies of veterinary practice [3,6,7] it has been reported that the PI and RI of the umbilical artery progressively decrease and reach the lowest level at delivery. The PI and RI values of the umbilical artery at the prenatal period were found in the range of 1.05-1.39 and 0.70-0.75 respectively in these studies. When compared to these results, the umbilical artery RI values were in the same range as in the other research, whereas PI values in Case 1 and 4 were a little higher than the others. The high resistance in the umbilical artery of these cases may be a result of fetal distress or hypoxia. Another important pathology in the umbilical cord is the pulsation in the umbilical vein. This finding is a manifestation of a serious fetal decompensation or fetal heart failure [2,8]. However, no abnormal finding was seen in the umbilical vein of our cases.

A normal utero-placental transport is essential for the developing fetus. Otherwise, fetal growth retardation may occur and end-diastolic velocity in the descending aorta may be reduced, reflecting a change from low arterial downstream impedance to high arterial downstream impedance at fetal trunk and placental level. Consequently, pulsatility index values will be raised [10,11]. Onen et al.[10]

have stated that high PI values of fetal aorta are strongly correlated with poor pregnancy outcome, fetal distress and a high c-section rate. In the presented cases, PI values of fetal aorta were found higher in Case 1, 2 and 4 compared to the findings of Scotti et al.[3]. The increased PI value of these cases may indicate fetal distress and intrauterine fetal growth restriction. However, all of the kittens in these cases died within 24 hours of c-section.

The Doppler indices from fetal venous vessels give more reliable information about fetal acidosis than indices from arterial vessels [12]. Since the oxygenated blood comes from the placenta to the fetal heart via the inferior vena cava, alterations in the pattern of vena cava flow is an indicator of fetal condition [13]. Rizzo et al.[12] have concluded that the inferior vena cava has a greater efficiency when compared to the ductus venosus. Furthermore, ductus venosus flow is greatly influenced by other vasoactive factors [14]. Therefore, the inferior vena cava was chosen for the Doppler measurements in the presented cases. The flow velocity waveform of the inferior vena cava displays a biphasic flow profile with two peaks during ventricular systole and diastole. In contrast to the ductus venosus waveform, absence or retrograde flow may occur during atrial contraction [13,15]. A decreased "a" wave during atrial systole was detected in the inferior vena cava of Case 2. However, this condition was not identified as a pathologic condition. Mori et al.[16] reported two different abnormal waveforms in the inferior vena cava of intrauterine growth retarded fetuses: one with a high-pulsatile pattern and the other with a slight and low-pulsatile pattern. The authors explained this abnormal pattern as reduced ventricular filling caused by impaired contractility and reduced ventricular output. However, no abnormal pattern was found in the inferior vena cava of the presented cases.

The D-USG measurement of the uteroplacental blood-stream is an important tool for evaluating materno-fetal circulation [17]. Scotti et al.[3] have reported that PI and RI values of uteroplacental arteries decrease significantly as the pregnancy progresses. In spite of this, Pereira et al.[7] have indicated that PI and RI of uteroplacental arteries were invariable throughout pregnancy, except for a sudden increase of PI on Day 63. The values of PI and RI of uteroplacental arteries in Case 3 were similar to those observed by Scotti et al.[3], while the other cases were dissimilar. The higher indices in Case 1, 2 and 4 may be identified with the low perfusion in the uteroplacental sites of these cases. It is known that the higher the resistance (RI) the lower the perfusion; in addition, the increasing PI values indicate decreasing perfusion of the tissue [18,19].

The Doppler ultrasonography is routinely used in human medicine to recognize several obstetrical pathologies. Similarly, assessing the number of fetal heart-beats and flow velocity of the fetal, feto-maternal vessels can inform us of the existence of the pathology related to gestation and also can help choosing the method of treatment in veterinary medicine. This issue, however, requires more studies and more statistical analysis.

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