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Haemodynamic changes in uterine artery in pregnant, nonpregnant and pyometra affected bitches

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Abstract
Ten no. of non-pregnant bitches in diestrous phase (control group /Group I) were selected along with 120 nos of pregnant bitches (Group II) and 10 nos of bitches showing symptoms of pyometra (Group III) were selected for study of haemodynamics parameters of uterine artery. In pregnant healthy bitches the indices (PSV and EDV) of uterine artery increased progressively with the evolution of pregnancy. RI values found in case of normal dioestrus and pregnant bitches were higher than that of pyometric group bitches. The mean systolic peak velocity in canine uterine artery of nonpregnant dioestrus bitches was 20 cm/s. RI values were ranging between1 - 1.52 (mean of RI =1.280). There is significant difference in the haemodynamic parameters between pregnant and non pregnant animal. PSV and EDV of pregnant animal is comparatively higher than non pregnant dioestrus bitches, but RI value of NP bitches were higher than pregnant bitches and PI values were almost zero. Normal dioestrus and pregnant bitches showed lower blood flow velocities and higher hemodynamic indices when compared to pyometra groups. The blood flow in the uterine artery increases significantly during pyometra and pregnancy which can be used as an important parameter for evaluation of reproductive functionality of bitches.

Keywords: Uterine artery, pregnant, pyometra, haemodynamics

Introduction

Two dimensional B-mode ultrasonography, augmented with colour doppler and Spectral doppler (Triplex doppler), have been used clinically for obstetrics and gynecology in various animal species. Triplex doppler allows quantitative and qualitative assessments of blood flow and helps in examination of blood velocity, blood direction and blood type to be obtained in real time. The quantitative evaluation includes resistive index (RI) and pulsatility index (PI) of the Uterine artery (UA) and Umbilical artery (Uma). It is found that Triplex Doppler assessment of the UA and Uma characteristics are useful tools for predicting abnormal pregnancy incase of bitches (Miranda *et al.,* 2010) [9]. Doppler ultrasonography has been used in the assessment of maternal and fetal blood flow during pregnancy in many species (Blanco *et al*., 2008) [4]. This is a non invasive technique to evaluate the flow velocity and resistance index (RI) within vessels. Pyometra in bitches is a hormonally mediated acute or chronic polysystemic diestrual disorder, is the most common genital disease in bitches and results in high mortality if not treated (Singh *et al*., 2010 and Jena *et al*., 2013) [11, 8]. Ultrasonographic characteristics of pyometra vary depending upon the extent of involvement and nature of content. Extensive involvement depicts round hypoechoic to anechoic areas placed side by side covering the complete abdomen while moderate involvement exhibits hypoechoic, roughly round structure ventral to ventro-lateral to the anechoic urinary bladder in transverse section Mild involvement is more readily visualised on longitudinal section as mixed anechoic to hypoechoic tubular structure (Pande *et al.,* 2006 and Singh *et al.,* 2010) [10, 11].

Materials and Methods

The Research work was carried out at TVCC in collaboration with the Department of Animal Reproduction, Gynaecology and Obstetrics, College of Veterinary Science & A.H., OUAT, Bhubaneswar. Ten no. of non-pregnant bitches in diestrous phase (control group /Group I) were selected along with 120 nos of pregnant bitches (Group II) and 10 nos of bitches showing symptoms of pyometra (Group III) were selected for study of haemodynamics parameters of

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uterine artery. Two dimensional ultrasonographic evaluations of the uterus was carried out by using (3 -11 MHz) convex probe of a real time doppler ultrasonography machine (ALOKA PROSOUND ALPHA 6). The widest cross sectional area of the uterus was taken using B-mode ultrasonography. Then colour doppler was conducted to localize uterine arteries at both sides of the uterine body and pulse wave Doppler was performed to obtain the waveform. The angle of insonation was adjusted manually and measurements with an angle less than 30° were only considered for analysis. Three consecutive waveforms with maximum Doppler shift included in the study. Uterine artery haemodynamic parameters like Peak systolic Velocity (PSV; cm/s), End diastolic Velocity (EDV; cm/s), Resistive Index (RI) and Pulsatility Index (PI) were measured from the routine procedure.

Results and Discussion

PSV, EDV, PI and RI values pregnant animal ranges between 0.09 - 25.99cm/s, 0.05 -15.95cm/s, 0.57 - 0.81 and 0.49 - 0.63 respectively. Similarly in non- pregnant animal PSV, EDV, PI and RI values ranges between 23.02 - 28.61cm/s, 3.01-9.07cm/s, 0 and 1- 1.52 respectively. The respective values in pyometra bitches ranged between 67.30 – 72.12 cm/s, 25.43 – 29.56 cm/s, 1.11 – 1.24, 0.20 – 0.33. The mean values of PSV (cm/s) has been recorded as 26.117±0.652, 20.308 ± 0.473, EDV values as 9.459±0.660, 5.407±0.478, PI values as 0.980 ±0.037,0 and RI values as 0.594±0.013 and 1.280±0.059 respectively in both pregnant and non-pregnant animals. The mean values of PSV and EDV, PI, RI in Pyometric bitches has been recorded as 69.006 ± 0.473, 27.570 ± 0.452, 1.15±0.013, 0.246±0.016 Statistically, there is significant difference between the mean values of pregnant, non-pregnant and pyometra affected animal at ($P< 0.05$) level.

In pregnant healthy bitches the indices (PSV and EDV) of uterine artery increased progressively with the evolution of pregnancy as reported previously by Umamageswari *et al*. (2018)[13], likewise the PI and RI decrease progressively. The increase of PSV and EDV values demonstrates the necessity of the body to intensify the maternal foetal circulation with consequent nutrient infusion and tissue development and there is an increasing demand to meet the vital organs (brain and heart), organs of the abdominal cavity and the placental bed. In general physiological behavior of blood flow for the vascular indices observed is due to the development of gestational structures and maturation of placental and foetal circulation. In early pregnancy, the simultaneous presence of high values of RI and PI and the absence of diastolic flow in the umbilical arteries characterize a blood flow of high resistance. The progressive development of the fetal circulation coupled with the appearance of a diastolic peak velocity in these arteries, the values of RI and PI decrease in the umbilical artery similar to the findings of Miranda *et al.* (2010) [9] and Amalia *et al.* (2015) [2]. The reduction of RI and PI of maternal fetal blood flow is secondary to the perfusion increase of the vessels and fetal size increase. Maternal-fetal Doppler (associated with power technology) is a useful technique for the diagnosis of pathological pregnancies and hemodynamic changes in the main vessels involved in pregnancy of bitches. It is important to note that out of all the parameters mentioned above, the PSV and EDV are highly variable parameters because of the fact that these values are dependent upon the speed of the blood flow through the vessel, the velocity of the sound, the angle of insonation of

the doppler beam and the operating frequency of the doppler beam. The angle of insonation is the angle between the Doppler ultrasound beam and the direction of blood flow in the vessel examined. Depending on the angle of insonation, the perceived blood flow velocities may be lower or higher than the actual velocities (Blanco *et al.,* 2008) [4]. The remaining two parameters i.e. PI and RI however, are indices of the blood flow and are angle independent. It is very easy to determine and gives an idea about the diastolic flow of the vessel. The RI is a ratio of the difference between the PSV and EDV to that of the EDV. It gives an idea about the resistance to blood flow in the vessel. As the diastolic blood flow increases, the RI decreases. The RI values range from 0 to 1. Values close to 0 signify a very low flow resistance, while a value of 1 signifies cessation of flow. The PI provides differentiated information on the absence of end diastolic flow in a vessel. These two indices are therefore, arguably the best parameters for doppler flow analysis of a blood vessel (Golaszewski *et al.,* 2003) [6].

The most common problem faced during the doppler evaluation was difficulty in obtaining the waveform of a vessel. Many times, the vessel could be imaged on colour doppler mode. When a pulsed wave doppler mode was switched on, even with the doppler gate placed in the middle of the vessel, the waveform could not be obtained. At such times, the positioning of the bitch or the probe position had to be changed to obtain the waveform. Other times, the waveform was obtained but the lower velocities, like those of diastolic velocities in the umbilicus or aorta, could not be obtained. At such times, only the systolic wave appeared, hinting towards an abnormal blood flow in the vessel. While in reality, when the pulsed wave repetition frequency (PRF) was reduced, the diastolic velocities could be obtained and the waveform would show a diastolic wave as well. Hence to avoid erroneous waveform analysis, operator experience is important.

In the present study bitches suffering from pyometra showed significantly higher resistance Doppler waveform of uterine arteries as compared to other groups. RI values found in case of normal dioestrus and pregnant bitches were higher than that of pyometric group bitches which is similar to as reported by Batista *et al*., (2016) [3]. Normal dioestrus and pregnant bitches showed lower blood flow velocities and higher hemodynamic indices when compared to pyometra groups similar to the findings of Gal *et al.,* (2012) [5]. During inflammatory process, there is increased in blood flow, vasodilatation and angiogenesis are present. According to Heap *et al*., (1975) [7] and Still *et al*., (1978) [12], increase in the intrauterine concentration of prostaglandin E may result in an increase in the uterine perfusion. In addition to prostaglandin, nitric oxide a potent vasodilator is also released locally in several mammalian species during endometrial inflammation. in this study normal dioestrus/Control animal shows RI value below 0.75, thus this threshold value could be used for differential diagnosis between diseased and healthy uterus. Doppler examination of uterine arterial flow in pyometric bitches will improve the clinical outcome, avoids unnecessary surgery and preserve the reproductive tract in valuable bitches. Uterine artery blood flow of bitches suffering from pyometra was higher not only from normal bitches but also from pregnant females. Doppler velocimetric evaluation helps in differential diagnosis of pregnancy and pyometra from healthy non-pregnant uterus, whenever clinical symptoms and ultrasonographic findings are

inconclusive. The mean systolic peak velocity in canine uterine artery of nonpregnant dioestrus bitches in our study was 20 cm/s. RI values were ranging between1 - 1.52 (mean of RI =1.280). There is significant difference in the haemodynamic parameters between pregnant and non pregnant animal. PSV and EDV of pregnant animal is comparatively higher than non pregnant dioestrus bitches, but RI value of NP bitches were higher than pregnant bitches and PI values were almost zero similar to the finding of Alvarez *et al.*, (2005) [1].

Table 1: Haemodynamic changes in uterine artery between pregnant, non-pregnant and pyometric bitches

Sl. No	Animal	Number	Haemodynamic Parameters			
			PSV (cm/s)	EDV (cm/s)	PI	RI
1	Non pregnant	10	20.308ª±0.473	5.407ª±0.478	0ª±0	1.280ª±0.059
2	Pregnant	120	26.117ᵇ±0.652	9.459ᵇ±0.660	0.980 ᵇ±0.037	0.594ᵇ±0.013
3	Pyometra	10	69.006ᶜ±0.473	27.570ᶜ±0.452	1.15ᵇ±0.013	0.246ᶜ±0.016

Significant difference in PSV, EDV, PI and RI values with superscript of a, b and c at ($P< 0.05$) level.

Conclusion
The PI, RI, PSV and EDV values varied significantly between non-pregnant, pyometra and pregnant bitches. The blood flow in the uterine artery increases significantly during pyometra and pregnancy which can be used as an important parameter for evaluation of reproductive functionality of bitches.

References
1. Alvarez AC, Liste F. ultrasonographic characterization of the uterine artery in the nonestrus bitch ultrasound. Med. & Biol 2005;31(12):1583-1587.
2. Amalia TG, Elaine MUG, Daniela Aparecida AG, Tilde RF. The use of Doppler evaluation of the canine umbilical artery in prediction of delivery time and fetal distress. Animal Reproduction Science 2015;154:105-112.
3. Batista PR, Gobello C, Rube AY, Corrada A, Tortora M, Blanco PG. Uterine blood flow evaluation in bitches suffering from cystic endometrial hyperplasia (CEH) and CEH-pyometra complex. Theriogenology 2016;85:1258-1261.
4. Blanco PG, Arias DO, Gobello C. Doppler ultrasound in canine pregnancy. J. Ultrasound Med 2008;27:1745-50.
5. Gal V, Angriman DSR, Szulczewiski CR, Celeghini ECC, Papa PC, Vannucchi C. Uterine Doppler velocimetry in bitches with cystic endometrial hyperplasia-pyometra. 7th International Symposium on Canine and Feline Reproduction ISCFR 2012
6. Golaszewski T, Deutinger J, Bernaschek G. Gebelik s›ras›nda maternal damarlarda Doppler sonografik fizyoloji. In:Schmidt W, Kurjak A (eds) (Çevirenler; Tanr›verdi H, Ertan AK). Obstetri ve Jinekolojide Renkli Doppler Sonografi. ‹stanbul: Nobel T›p Kitabevleri. 2003, 122-19.
7. Heap RB, Poyster NL. Prostaglandins in pyometrial fluid from the cow, bitch ad ferret. Br J Pharmacol 1975;55:515-8.
8. Jena B, Rao KS, Reddy KCS, Raghavender KBP. Comparative efficacy of various therapeutic protocols in the treatment of pyometra in bitches. Veterinarni Medicina 2013;58(5):271-276. https://doi.org/10.17221/6809-VETMED
9. Miranda SA, Domingues SFS. Conceptus ecobiometry and triplex Doppler ultrasonography of uterine and umbilical arteries for assessment of fetal viability in dogs Theriogenology 2010;74:608-617.
10. Pande N, Prabhakar S, Gandotra VK, Honparkhe M, Nanda AS. Efficacy of different techniques for diagnosis of pyometra in female dogs. Indian Journal of Animal Reproduction. 2006;27:31-33.
11. Singh KP, Singh B, Singh JP, Sing SV, Singh P, Singh HN. Diagnostic and therapeutic management of pyometra in female doges. Intas Polivet 2010;11:86-87.
12. Still JG, Greiss JF. The effect of prostaglandins and other vasoactive substances on uterine blood flow and myometrial activity. Am J Obstet Gynecol 1978;130:1-8.
13. Umamageswari J, Sridevi P, Joseph C. Doppler indices of umbilical artery, utero-placental artery and fetal aorta during normal gestation in bitches. Indian Journal of Animal Reproduction 2018;39(1):41-43.