



Assessment of uteroplacental haemodynamics, combined uteroplacental thickness and serum progesterone levels in bitches with primary uterine inertia and obstructive dystocia

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Abstract

The present study was undertaken to evaluate uteroplacental artery haemodynamics, combined thickness of the uterus and placenta (CTUP) and serum progesterone concentrations in bitches with dystocia. A total of twelve (n = 12) pregnant bitches presented at the time of parturition were subjected to ultrasonographic examination, including B-mode and colour Doppler assessment. Doppler parameters such as resistive index (RI) and pulsatility index (PI) were recorded, along with serum progesterone estimation to document physiological alterations associated with the whelping process. The animals were divided into two groups: Group 1 (bitches affected with primary uterine inertia) and Group 2 (bitches affected with obstructive dystocia). Data were analysed using the Student's independent (unpaired) t-test and the results are expressed as mean $\pm$ standard error. Differences between groups were considered significant at $p < 0.05$. No significant differences were observed in haemodynamic indices (RI and PI) and CTUP between the two groups, indicating that uteroplacental perfusion was preserved in both conditions. Serum progesterone levels declined in both groups, suggesting that luteolysis of the corpus luteum had occurred irrespective of the type of dystocia.

Keywords: Dystocia, CTUP, uteroplacental artery, progesterone

Ultrasonography is a valuable, non-invasive diagnostic modality widely employed in canine obstetrics for monitoring advanced pregnancy and assisting in the management of parturition. Assessment of physiological parameters such as serum progesterone concentration, combined thickness of the uterus and placenta (CTUP), and Doppler indices of the uteroplacental artery provides important information regarding the progression and normality of the whelping process. Recent advancements in ultrasonographic techniques, including Doppler imaging, have further enhanced the evaluation of uterine vascularity and placental perfusion in canines.

In dogs, a precipitous decline in serum progesterone concentration to levels below approximately 2 ng/mL is regarded as the principal endocrine signal initiating parturition and is predictive of whelping within the subsequent 12–24

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h (Concannon et al., 1989). Canine pregnancy is entirely dependent on luteal progesterone, as the placenta does not contribute significantly to progesterone production. Failure of adequate progesterone withdrawal or altered uterine responsiveness to declining progesterone has been implicated in dystocia, particularly in cases of primary uterine inertia. However, endocrine changes alone may not fully explain the variability observed in the onset and progression of parturition.

Alongside hormonal changes, the combined thickness of the uterus and placenta (CTUP) serves as a valuable ultrasonographic indicator of placental development and maturation. Under normal gestational conditions, CTUP increases progressively with advancing pregnancy due to placental growth and uterine wall remodeling. However, studies have shown that CTUP values remain relatively consistent during late gestation and may not exhibit significant variation immediately prior to whelping. In support of this, Princy et al. (2023) reported that CTUP in bitches did not show significant changes during the final week of gestation and remained within normal limits (≤ 1.2 cm), thereby ruling out conditions such as placentitis or risk of abortion. The mean CTUP values recorded were 0.92 ± 0.03 cm a few days before parturition, 1.13 ± 0.08 cm one to two days prior to whelping, and 0.99 ± 0.10 cm during active whelping. Deviations from established reference ranges may indicate placental pathology, including placentitis, placental insufficiency, or premature placental separation (Gaikwad et al., 2017). Despite these advancements, differentiating between primary uterine inertia and obstructive dystocia in bitches remains a clinical challenge, as reliable diagnostic indicators for early distinction are limited. Furthermore, Doppler evaluation of the uteroplacental arteries reflects haemodynamic adaptations required to meet increasing foetal metabolic demands during late gestation. A progressive decrease in vascular resistance, indicated by declining resistive index (RI) and pulsatility index (PI), is expected as gestation advances, reflecting improved uteroplacental perfusion. Alterations in these Doppler indices may provide early indications of compromised uteroplacental circulation. Nevertheless, available literature on uteroplacental haemodynamics in dystocic bitches remains limited, particularly at the time of parturition.

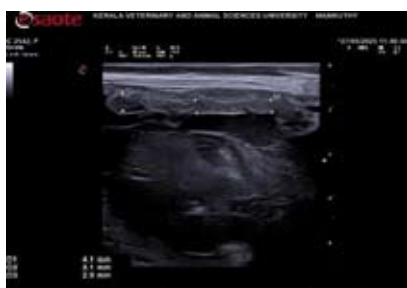


Fig 1. Sonographic measurement CTUP

Despite the availability of ultrasonographic and hormonal diagnostic tools, there is a lack of integrated studies evaluating CTUP, uteroplacental Doppler haemodynamics, and progesterone concentrations simultaneously in different types of dystocia. This gap limits the ability to distinguish between primary uterine inertia and obstructive dystocia using objective clinical parameters. Therefore, the present study was undertaken to evaluate and compare CTUP, uteroplacental arterial Doppler indices (resistive index and pulsatility index), and serum progesterone concentrations in bitches affected with primary uterine inertia and obstructive dystocia during whelping, with the aim of identifying clinically useful indicators for the diagnosis and management of dystocia.

Materials and methods

Experimental animals

The study was conducted at the Teaching Veterinary Clinical Complex (TVCC), College of Veterinary and Animal Sciences, Mannuthy, and the University Veterinary Hospital, Kakkal. A total of twelve ($n = 12$) pregnant bitches of small to medium sized bitches (e.g., Shih-tzu, Beagle, Spitz and Siberian husky), aged between 18 months and seven years, were included in the study.

Animals presented at the time of parturition with dystocia were classified into two groups based on clinical and obstetrical findings. Group I ($n = 6$) comprised bitches with primary uterine inertia, characterized by complete cervical relaxation in the absence of effective uterine contractions for at least four hours, with no evidence of foetal obstruction. Group II ($n = 6$) included bitches diagnosed with obstructive dystocia, characterized by the presence of strong uterine contractions with failure of foetal expulsion due to mechanical obstruction such as foeto-pelvic disproportion, malpresentation, or oversized foetus.

Vaginoscopic examination

Vaginal examination was performed using a rigid sigmoidoscope (Welch Allyn, Skaneateles Falls, NY) to assess changes associated with the whelping process. Parameters evaluated included cervical relaxation,



Fig 2. Pulsed wave doppler haemodynamics of Uteroplacental artery



Fig 3. Presentation of foetal bag

characteristics of vaginal discharge, and the presence of foetal membranes. (Fig 3 and 4).

The examination was carried out with the animal in lateral recumbency or standing position. Following lubrication with liquid paraffin, the sigmoidoscope was gently introduced into the vaginal canal in a craniodorsal direction at approximately 45°, and the vaginal canal was visualised using a fibre-optic light source.

Transabdominal ultrasonography

Transabdominal ultrasonography was performed using a real-time ultrasound scanner equipped with a linear transducer operating at 4–15 MHz. The abdominal area was prepared by clipping and applying acoustic coupling gel. For assessment of CTUP, animals were positioned in dorsal recumbency on a padded examination table. A linear transducer was used to obtain high resolution images of uteroplacental unit. Sonographic images were acquired from the ventral abdominal region at the level of the dense zony placenta. Images were frozen when the uterine wall and placental layers were clearly delineated. Using electronic calipers, CTUP was measured perpendicular to the uterine wall from the outer serosal surface of the uterus to the inner border of the placental layers adjacent to the anechoic amniotic fluid. For each animal measurements were obtained from three different sites and the mean of the three measurements was calculated and used for statistical analysis.

Colour doppler ultrasonography

Uteroplacental arteries were identified adjacent or between gestational sacs using B-mode ultrasonography. Colour Doppler ultrasonography was subsequently employed to confirm the presence and direction of blood flow within the vessels. Once identified, a pulse wave doppler sample gate was positioned over the vessel to obtain spectral wave forms. Three consecutive wave forms were recorded and frozen for analysis. Peak systolic velocity (PSV) and End diastolic velocity (EDV) were determined by manual tracing of the wave forms, and mean values were calculated. Pulsatility index and Resistivity index were automatically computed by the ultrasound system software.



Fig 4. Cervical plug lysis

Serum progesterone estimation

The serum progesterone was measured using a fully automated chemiluminescence immunoassay analyzer (CL-900i, Mindray, Shenzhen, China) using a standard kit (PROG-CLIA, Mindray, China). The components of P4 reagent kit included paramagnetic microparticles coated with goat anti-mouse IgG in TRIS buffer with preservative, progesterone-alkaline phosphatase conjugate in TRIS buffer with preservative and monoclonal anti P4 antibody in TRIS buffer with preservative.

The assay was based on competitive immunoassay principle wherein P4 present in the sample competed with progesterone – alkaline phosphatase conjugate for binding to specific monoclonal anti-progesterone antibodies. The formed antigen-antibody complexes were magnetically captured using paramagnetic microparticles coated with goat anti-mouse IgG. Following washing, the bound enzyme conjugate catalyzed the substrate to produce a chemiluminescent signal, which was measured as relative light units. The P4 concentration was inversely proportional to the emitted signal and was quantified using a calibration curve. The P4 concentration was determined using a calibration curve and results were expressed as ng/ml.

Statistical analysis

Data were analysed using the Student's independent (unpaired) t-test, as the two groups consisted of different animals. Results are presented as mean $\pm$ standard error (SE). Differences between groups were considered statistically significant at $p < 0.05$.

Results & Discussion

Evaluation of uteroplacental structure, haemodynamics, and endocrine status revealed no significant differences between bitches affected with primary uterine inertia (PUI) and those with obstructive dystocia (OD), indicating that both conditions were not associated with alterations in uteroplacental morphology, blood flow, or systemic progesterone concentrations.

The combined thickness of the uterus and placenta (CTUP) recorded in bitches with PUI ($8.60 \pm$

Table 1. CTUP in primary uterine inertia and obstructive dystocia

Variable	PUI	OD	t-value	P-value
CTUP (mm)	8.60 ± 0.26	8.50 ± 0.39	0.215 ^{ns}	0.834

ns non-significant

Table 2. Resistivity index, pulsatility index and systolic/Diastolic (SV/DV) ratio of uteroplacental artery in bitches affected with PUI and OD

Variable	PUI	OD	t-value	P-value
Resistivity index	0.46 ± 0.01	0.46 ± 0.03	0.273 ^{ns}	0.790
Pulsatility index	0.61 ± 0.02	0.58 ± 0.02	1.021 ^{ns}	0.331
SV/DV ratio	1.99 ± 0.04	1.97 ± 0.06	0.328 ^{ns}	0.750

ns non-significant

Table 3. Serum progesterone concentration in PUI and OD

Variable	PUI	OD	Z-value	P-value
P4 ng/mL	0.99 ± 0.16	1.17 ± 0.21	0.663 ^{ns}	0.522

ns non-significant

0.26 mm) was comparable to that observed in OD cases (8.50 ± 0.39 mm), with no statistically significant difference between the two groups ($p = 0.834$) (Table 1).

Doppler ultrasonographic evaluation showed comparable uteroplacental arterial haemodynamics between the two groups. The resistive index (RI) was identical in both PUI (0.46 ± 0.01) and OD (0.46 ± 0.03) groups ($p = 0.790$). Similarly, the pulsatility index (PI) showed no significant difference, with mean values of 0.61 ± 0.02 in PUI and 0.58 ± 0.02 in OD ($p = 0.331$). The systolic to diastolic velocity (SV/DV) ratio was also comparable between PUI (1.99 ± 0.04) and OD (1.97 ± 0.06) groups ($p = 0.750$) (Table 2).

Serum progesterone concentrations were low in both groups, with mean values of 0.99 ± 0.16 ng/mL in PUI and 1.17 ± 0.21 ng/mL in OD, showing no statistically significant difference ($p = 0.522$) (Table 3).

CTUP is considered a reliable ultrasonographic indicator of placental development and uteroplacental integrity during late gestation (Gaikwad et al., 2017). In the present study, CTUP values in both PUI and OD groups were within the expected range for late gestation and did not differ significantly, indicating the absence of placental pathology such as placentitis, edema, or premature separation. These findings suggest that placental structural integrity is maintained irrespective of the type of dystocia.

Doppler assessment of uteroplacental circulation revealed no significant differences in RI, PI, or SV/DV ratio between the two groups. Normally, late gestation is associated with reduced vascular resistance to ensure adequate foetal oxygen and nutrient supply (Blanco et al., 2020). The comparable Doppler indices observed in both PUI and OD groups indicate that uteroplacental perfusion was not compromised, suggesting that haemodynamic

insufficiency is unlikely to be a primary factor in the pathogenesis of dystocia in these cases.

Serum progesterone concentrations in both groups were below 2 ng/mL, consistent with normal luteolysis and initiation of parturition (Concannon et al., 1977; 1989). The absence of significant differences between groups indicates that endocrine changes associated with parturition occur normally in both conditions. Similar findings have been reported by Johnson (2008), where progesterone decline was observed despite ineffective uterine contractions.

These results support the concept that primary uterine inertia is not primarily an endocrine disorder but may be associated with impaired myometrial responsiveness to hormonal and mechanical stimuli. Factors such as altered calcium metabolism, receptor insensitivity, or local molecular signalling pathways may play a more significant role in its pathophysiology.

The present study has certain limitations that should be considered while interpreting the findings. The small sample size ($n = 12$) may limit the statistical power of the study. Additionally, the absence of a normal healthy control group restricts direct comparison with physiological parturition. Further studies with larger sample sizes and inclusion of control animals are required to validate these findings.

Conclusion

The present study demonstrated that CTUP, uteroplacental arterial Doppler indices, and serum progesterone concentrations did not differ significantly between bitches with primary uterine inertia and obstructive dystocia. These findings indicate that uteroplacental morphology, perfusion, and endocrine changes during

parturition remain comparable in both conditions. The results further imply that primary uterine inertia is unlikely to be associated with impaired uteroplacental circulation or inadequate progesterone decline, and may instead be related to dysfunction at the level of the myometrium. Further studies are warranted to elucidate the underlying mechanisms and improve diagnostic approaches.

Conflict of interest

The authors declare that they have no conflict of interest.

References

- Al-Bassam, M. A., Thomson, R. G., & O'Donnell, L. (1981). Normal postpartum involution of the uterus in the dog. *Canadian Journal of Comparative Medicine*, 45(3), 217–222.
- Blanco, P. G., Rodríguez, R., Rube, A., Arias, D. O., Tórtora, M., Díaz, J. D., & Gobello, C. (2011). Doppler ultrasonographic assessment of maternal and fetal blood flow in abnormal canine pregnancy. *Animal Reproduction Science*, 126(1–2), 130–135. <https://doi.org/10.1016/j.anireprosci.2011.04.016>
- Concannon, P. W., & Hansel, W. (1977). Prostaglandin F_{2α}-induced luteolysis, hypothermia, and abortions in beagle bitches. *Prostaglandins*, 13(3), 533–542. [https://doi.org/10.1016/0090-6980\(77\)90030-2](https://doi.org/10.1016/0090-6980(77)90030-2)
- Concannon, P. W., McCann, J. P., & Temple, M. (1989). Biology and endocrinology of ovulation, pregnancy and parturition in the dog. *Journal of Reproduction and Fertility, Supplement*, 39, 3–25.
- De Freitas, L. A., Mota, G. L., Silva, H. V. R., Carvalho, C. F., & da Silva, L. D. M. (2016). Can maternal-fetal hemodynamics influence prenatal development in dogs? *Animal Reproduction Science*, 172, 83–93. <https://doi.org/10.1016/j.anireprosci.2016.07.005>
- England, G. C. (1998). Ultrasonographic assessment of abnormal pregnancy. *Veterinary Clinics of North America: Small Animal Practice*, 28(4), 849–868. [https://doi.org/10.1016/S0195-5616\(98\)50081-2](https://doi.org/10.1016/S0195-5616(98)50081-2)
- Gaikwad, S. M., Gulavane, S. U., Gatne, M. M., Sachdeva, G., Dalvi, S. H., & Kumbhar, U. B. (2017). Ultrasonographic measurements of the combined thickness of the uterus and placenta in canines. *Journal of Bombay Veterinary College*, 24, 83–87.
- Johnson, C. A. (2008). High risk pregnancy and hypoluteoidism in the bitch. *Theriogenology*, 70, 1424–1430.
- Kim, Y., Travis, A. J., & Meyers-Wallen, V. N. (2007). Parturition prediction and timing of canine pregnancy. *Theriogenology*, 68(9), 1177–1182. <https://doi.org/10.1016/j.theriogenology.2007.08.001>
- Kimberely, E. T., Casal, M. L., O'Donnell, P. A., & Haskins, M. E. (2006). Effect of pregnancy on complete blood cell counts and serum biochemical profiles in dogs. *Theriogenology*, 66, 670–676.
- Kimura, T., & Kotani, K. (2018). Perinatal veterinary medicine-related evaluation in hematological and serum biochemical profiles of experimental beagles throughout pregnancy and parturition. *Animal Model and Experimental Medicine*, 1, 282–294. <https://doi.org/10.1002/ame2.12043>
- Kutzler, M. A., Mohammed, H. O., Lamb, S. V., & Meyers-Wallen, V. N. (2003). Accuracy of canine parturition date prediction from the initial rise in preovulatory progesterone concentration. *Theriogenology*, 60, 1187–1196.
- Princy, J., Magnus, P. K., Jayakumar, C., Simon, S., & George, A. (2023). Combined thickness of uterus and placenta, foetal heart rate oscillations and progesterone concentration in last week of canine gestation. *Journal of Veterinary and Animal Sciences*, 54(2), 472–476.
- Troedsson, M. H., Renaudin, C. D., Zent, W. W., & Steiner, J. V. (1997). Transrectal ultrasonography of the placenta in normal mares and mares with pending abortion: A field study. *Theriogenology*, 47, 915–922. (Add DOI if available)
- Zoné, M. A., & Wanke, M. M. (2001). Diagnosis of canine foetal health by ultrasonography. *Journal of Reproduction and Fertility Supplement*, 57, 215–219. ■