



Original Research Article

Uterine blood flow in sheep and goats during the peri-parturient period assessed by transrectal Doppler sonography



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ABSTRACT

The aim of the present study was to evaluate uterine blood flow (UBF) during the postpartum period in small ruminants. The study involved measures of UBF in 5 ewes and 5 goats during the first 4 weeks after parturition. Transrectal quantification of UBF was assessed by determining the diameter (DM), time averaged mean velocity (TAMEAN), blood flow volume (BFV), blood flow acceleration (ACCE) and pulsatility index (PI) in the uterine arteries ipsilateral to the previously gravid uterine horn(s) at Wk 20 of gestation and every 3 days from the day of parturition (D 0) until Day 27 postpartum (D 27). The diameters of the uterine arteries decreased ($P < 0.01$) in both species during the postpartum period. The results revealed decreases ($P < 0.0001$) in BFV, ACCE and TAMEAN, while PI increased during the postpartum period in both sheep and goats. Furthermore, there were positive correlations ($P < 0.05$) between blood flow parameters in sheep and goats, respectively (BFV and DM, $r = 0.62$ and 0.58 ; BFV and ACCE, $r = 0.32$ and 0.26 ; BFV and TAMEAN, $r = 0.51$ and 0.37). There were negative correlations ($P < 0.05$) between PI and other parameters (PI and BFV, $r = -0.39$ and -0.36 ; PI and DM, $r = -0.54$ and -0.24 ; PI and ACCE, $r = -0.58$ and -0.48 ; and PI and TAMEAN, $r = -0.80$ and -0.79) in sheep and goats, respectively. Altogether, these results indicate that non-invasive Doppler ultrasound parameters provide important information toward understanding changes in the vasculature and its perfusion of the uterus during the postpartum period in sheep and goats.

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1. Introduction

The postpartum period is an important period that influences future fertility of sheep and goats (Zduńczyk et al., 2004). During this period, both uterine involution and ovar-

ian activity are critical for resumption of normal estrous cycles and establishment of the next pregnancy in sheep and goats (Zduńczyk et al., 2004; Zongo et al., 2015). The width of endometrium and myometrium decreases to the minimum by Day 14 postpartum and uterine involution is complete by Day 28 (Gray et al., 2003). Furthermore, discharge of fluids and cells from the uterus occurs directly after parturition and is generally known as lochia. Lochia is a thick brown substance produced by autolysis of red blood cells from umbilical vessels, remnant of fetal fluids and sloughed cells from the surface of caruncles (van Wyk

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et al., 1972; Sheldon and Dobson, 2004). In ewes, a thick, dark lochia is present in the uterine lumen on postpartum Days 1, 7 and 14, but not detectable on postpartum Day 28 (Gray et al., 2003).

The ability to measure changes in indices of uterine blood flow provides a promising diagnostic tool for assessing the status of uterine involution during the postpartum period in women (Kirkinen et al., 1988; Brackley et al., 1998; Mulic-Lutvica et al., 2007; Guedes-Martins et al., 2015a, 2015c). The standard Doppler parameters for assessment of uterine blood flow postpartum in cattle include time averaged maximum velocity (TAMV), blood flow volume (BFV) and pulsatility index (PI) (Krueger et al., 2009; Heppelmann et al., 2013). The changes in uterine blood flow during the postpartum period in cows were evident especially during the first four days postpartum (Krueger et al., 2009; Heppelmann et al., 2013). Heppelmann et al. (2013) reported that uterine blood flow decreased from 4312 to 1443 mL/min in cows between Days 1 and 7 postpartum and that the pulsatility index increased until Day 28 after parturition. The period of uterine involution varies from 17 to 40 days postpartum in sheep and goats (Hauser and Bostedt 2002; Degefa et al., 2006).

Non-invasive Doppler sonography has been used to study changes in uterine blood flow during normal pregnancies (Elmetwally, 2012; Elmetwally et al., 2016). During pregnancy a dramatic increase in uterine blood flow volume and a decrease in resistance impedance was found to meet the increasing nutritional demands of the developing conceptuses (fetus and placental membranes). They

also evaluated changes in uterine artery blood acceleration velocity and time averaged mean velocity (TAMEAN) for the first time during pregnancy in small ruminants. The blood flow acceleration velocity increased until week 16 in sheep and week 14 in pregnant goats, and then began to decrease until birth. The TAMEAN also increased with advancing pregnancy and then decreased significantly after week 18 in both species (Elmetwally et al., 2016). In contrast to studies in cattle (Krueger et al., 2009; Heppelmann et al., 2013) and women (Tekay and Jouppila, 1993; Nakai et al., 1997; Guedes-Martins et al., 2015a), Doppler research on changes in uterine artery blood flow during the postpartum period in small ruminants has not been reported. Therefore, this is the first report of results from a study to evaluate changes in uterine blood flow during the first 4 weeks after parturition in sheep and goats.

2. Materials and methods

2.1. Animals

This study was conducted in accordance with German legislation on animal rights and welfare at the Institute for Reproductive Biology, University of Veterinary Medicine, Hannover, Germany, in March and April 2011/2012 during the lambing/kidding season. Five German Merino ewes and 5 Boer x German Improved Fawn goats with a normal parturition and birth of a single lamb/kid were used in this study. All experimental sheep and goats were pluriparous (3–8 years old).

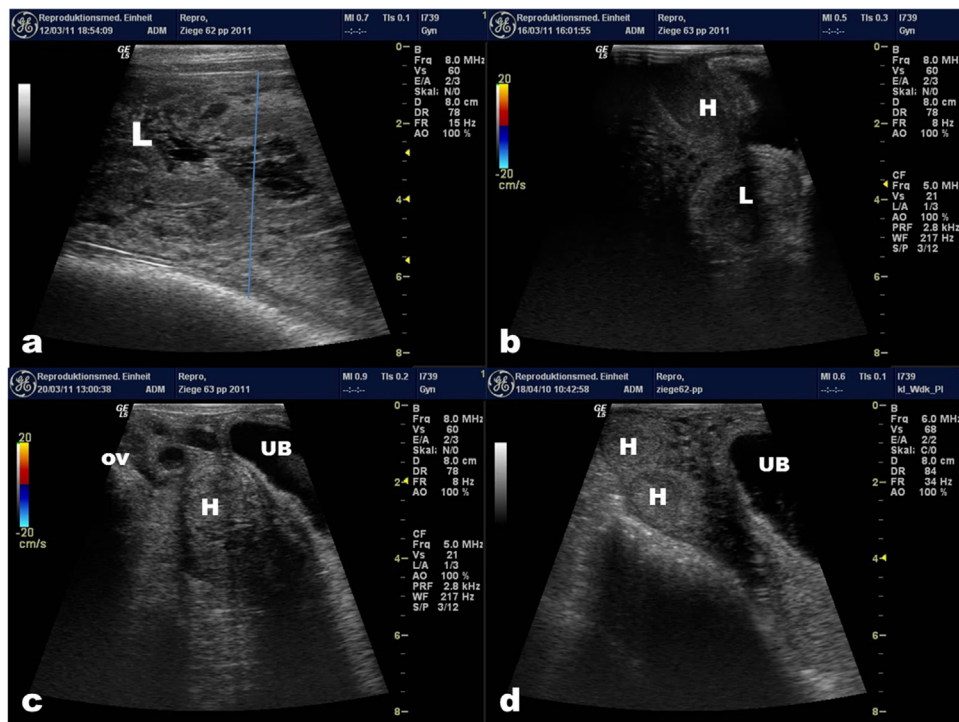


Fig. 1. Uterine horn in goats at day of parturition (a); 9 days (b); 15 days (c) and 27 days (d) after parturition. L: lochia; H: uterine horn; ov: ovary and UB: urinary bladder.

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