

## Case report: successful foaling in a Warmblood mare with uterus unicornis

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### Summary

Uterus unicornis is a rare congenital condition in the horse. There are limited cases documented in horses and little data on the outcome of pregnancy. This report describes the birth of a small filly foal (35kg) at 360 days gestation. Postpartum examination of the mare and placenta confirmed absence of the right uterine horn.

**Keywords:** Mare, uterus, unicornis, pregnancy, placenta

### Case description

#### History

A 6 year old maiden Warmblood mare was admitted to the Cornell University Equine Park, at 306 days after ovulation for supervised foaling. She had been bred with cooled shipped semen and ovulation date and pregnancy diagnosis were confirmed by trans-rectal palpation and ultrasound by the referring veterinarian.

#### Clinical findings

Upon arrival the mare was bright, alert and responsive. Her vital parameters were within normal limits. She had no udder development and was in good body condition. Her pregnancy status was confirmed using transrectal palpation and ultrasound and the fetus was confirmed to be alive and in anterior presentation. The combined thickness of uterus and placenta (CTUP) was nine mm and so within normal range for this stage of gestation (306 days from ovulation).<sup>1</sup>

The mare's pregnancy status was confirmed regularly, and the placental thickness and fetal heart rate remained consistently within normal limits. A foal alarm system was used for monitoring the mare (Foalert, Abfohlssystem, Germany). Mares at the center for supervised foaling were also under continuous video surveillance and were visually monitored by a student foal watch crew who covered overnight periods. The mare was slow to develop pre-partum mammary tissue, which is not unusual for maiden mares. She was also reluctant to allow any mammary secretions to be milked from her udder to check electrolyte values for prediction of readiness for birth. Eventually, her pelvic ligaments started showing signs of relaxation in the week preceding parturition.

#### Outcome

The mare foaled spontaneously at 360 days of gestation. The foaling was supervised and uncomplicated with stage two labor lasting around 15 minutes, and stage three was complete at 30 minutes after delivery of the 35kg filly foal. Routine examination of the placenta revealed that it had only occupied one uterine horn, otherwise it was normal in consistency and villous coverage. The mare's colostrum was checked with a brix refractometer and deemed to be of good quality (26%).

It soon became evident that the foal was impaired and most likely dysmature. The filly foal was small in stature and thin with curling of its ears and a silk-like texture to its hair coat. The foal had a suckle reflex but was weak and unable to stand or nurse by three hours of age. Vital parameters were within normal limits and there was no evidence of any deformities. The foal had poor maternal recognition and environmental awareness. Colostrum (200mls) was stripped from the mare and fed to the foal by means of a nasogastric tube. As the foal was unable to stand unsupported and had not managed to make any successful suckling attempts from the mare, an indwelling nasogastric tube was sutured in place. The foal was supplemented with mare's milk at regular intervals and observed for evidence of postprandial colic. Attempts were made to assist the foal to stand and try to nurse directly from the mare. From 12 hours of age the foal was able to periodically nurse from the mare if assistance was given with

standing. If the foal was not witnessed to suckle then she was given additional milk. The foal was small in size for its breed and weighed approximately 35kg (foal was weighed on scales with person holding it) at 24 hours of age. At nine hours of age the foal's IgG concentration was assessed using a SNAP test assay and it had a serum IgG concentration of greater than 800 mg/dL, indicating adequate transfer of passive immunity. Over the next 24 hours the foal required less assistance to stand and suckle, but required help to lie down as it would fall asleep standing. The nasogastric tube was removed at 48 hours and the foal became progressively stronger and was able to stand, nurse and lie down unaided. The foal's initial depression and weakness were attributed to in-utero growth retardation (IUGR) owing to placental insufficiency. The placenta occupied only one uterine horn (Fig. 1). In effect, the foal had the same disadvantage as an equine twin, with less than complete uterine surface available for placentation.

No postpartum abnormalities were noted on physical examination of the mare and there were no signs of trauma within the vaginal vault. Two days after foaling, trans-rectal palpation revealed that the uterus was involuting well with good tone. The uterine body, left uterine horn and both ovaries could be palpated. The right uterine horn was not palpable and instead a membranous band of tissue was identified, at the approximate location where the missing right horn would be expected, along the cranial edge of the broad ligament, and slightly thicker than the broad ligament. This band of membranous tissue originated from the base of the left horn and coursed to and apparently attached to the mesovarium of the right ovary. Trans-rectal ultrasonographic imaging using a 10 - 5.0 MHz linear array transducer revealed follicular activity on both ovaries (Fig. 2). The uterine body and left uterine horn had mild endometrial edema (Fig. 3; consistent in size and echotexture with two days postpartum). The thin band of membranous tissue that was identified in place of the right uterine horn was imaged as a small linear structure and color doppler revealed prominent vasculature (Fig. 4). On palpation there was an obvious difference in size, shape and texture between the mesometrium on the right hand side and the existing left uterine horn. An additional trans-rectal palpation and ultrasound examination of the uterus at seven days postpartum confirmed that the uterus was involuting appropriately and there was no evidence of a right uterine horn. Three different clinicians all reached the same conclusion.

## Discussion

Uterus unicornis is a rare congenital condition in which there is absence of one uterine horn. The condition has been reported in many domestic species including mares, cows, ewes, bitches and queens.<sup>2-7</sup> Pregnancies in mares, cows and ewes with uterus unicornis are reported and reproductive inefficiency caused by ovulation ipsilateral to the missing uterine horn have also been observed.<sup>3-5</sup> It has also been suggested that fetal growth or litter size is restricted in uterus unicornis due to limitations in the uterine surface area available for placentation.<sup>4,5</sup>

In one case report, uterine unicornis was diagnosed as occurring on the right side in two mares.<sup>5</sup> One of the mares previously had a mule foal that the owner had described as "small" at the time of birth. Both of these mares failed to conceive during the breeding season that was documented. Newcombe et al, described two cases involving aplasia of the left uterine horn; one mare also had a missing left ovary.<sup>3</sup> Both of these mares managed to conceive but there are no data on the gestation length and the weight of foals produced was reported.

Uterus unicornis is recognized as the most common congenital abnormality of the ovine uterus, with one survey reporting 20 cases among 30,000 abattoir specimens examined.<sup>4</sup> A large multicenter study describing the characteristics and frequency of gross uterine anomalies in cats and dogs undergoing elective ovariohysterectomy, uterine anomalies were more than twice as common in cats (approx. 10/10,000 cats) than in dogs (approx. 5/10,000 dogs). More than half of cats and dogs with uterine anomalies also had ipsilateral renal agenesis, but both ovaries were identified in most affected animals, although the ipsilateral ovary was sometimes malpositioned.<sup>6</sup>

Concurrent uterine and renal anomalies can arise as a result of the interdependence between the tracts during embryological development.<sup>8</sup> Both tracts are derived from a common embryonic intermediate mesoderm. The embryonic mesonephric urinary system develops first, followed by the definitive kidney and reproductive tract. The Müllerian (paramesonephric) duct system gives rise to the

uterine tubes, uterus, and vagina. It is believed that the mesonephric ducts induce Müllerian duct formation and guide the ducts in their growth caudally.<sup>9-11</sup> Damage to the mesonephric duct may affect the development of the associated Müllerian duct.<sup>9</sup> In the case described in this report it may have been informative to assess the urinary tract and visualise if the right kidney was indeed intact.

The horse has a diffuse epitheliochorial placenta that attaches to the entire endometrium. The size of the uterus is governed by the size of the mare and this, in turn, will directly control the available area for placentation and, hence, fetal growth.<sup>12</sup> In the studies by Allen et al, transfer of equine embryos between breeds led to either restricted Thoroughbred-in-pony (Tb-in-P) or enhanced pony-in-Thoroughbred (P-in-Tb) growth of the foal, which was directly determined by the growth of the allantochorion. The mean birth weight of the Tb-in-P foals was significantly lower than that of the Tb-in-Tb controls. The growth retardation and dysmaturity of the Tb-in-P foals and the overgrowth of the P-in-Tb foals may be a good model for comparison of mares with developmental conditions such as unicornuate uteri versus the normal bicornuate structure.

Twinning is another example in which the allantochorions of the two foals compete for the limited surface area of endometrium. Occasionally, in the case of bicornuate twins, each allantochorion achieves attachment to roughly half the uterus and live, but smaller than normal, foals are born.<sup>13</sup> Twin foals which do survive to term are usually of small size and body weight, emaciated and have a very high rate of mortality compared to singleton foals.<sup>14</sup> Twin placentae are divided into three morphological groups according to the disposition of the chorionic sacs within the uterus. In type A, one fetus occupies one horn and most of the body (a mean 68 % of the total functional surface area),<sup>14</sup> this may be comparable to the total placental area engaged with unicornuate pregnancy. It has been shown in another study that placental weights (which also include amnion and umbilical cord) up to 6.5kg are rate-limiting for foal birthweight.<sup>15</sup> Clearly in the case of uterus unicornis placental weight and also surface area would be reduced.

The average gestation length of mares is approximately 340 days, and the range of normal gestations is considered to be 320 to 360 days.<sup>16</sup> A gestation length of <320 days may be associated with delivery of a premature foal. A gestation of >360 days is considered prolonged. In the case described, the gestation length was on the cusp of prolonged at 360 days.

The clinical examination of the case described confirmed uterus unicornis given the findings of trans-rectal palpation and ultrasonography of the mare's reproductive tract and the passage of a placenta lacking one horn. A considerable palpable difference in size, shape and texture between the right mesometrium and existing left uterine horn could be appreciated. Further diagnostic investigation could have been performed in the case presented. This may have included hysteroscopy of the uterus, fluid distention of the uterus combined with trans-rectal palpation and ultrasonography or laparoscopic imaging of the reproductive tract.

The mare described in this case study had a breeding soundness examination performed prior to purchase and had been examined by trans-rectal palpation and ultrasound multiple times prior to foaling. If the absence of one uterine horn is suspected, the diagnosis should be confirmed by serial examinations or backed up by a second experienced clinician, especially if the mare is in anestrus. Mating should then be delayed until ovulation is anticipated from the ovary contralateral to the absent horn. Other forms of treatment which might be considered would include ovariectomy of the ipsilateral ovary. Assisted reproductive technology, such as embryo transfer would be a valid recommendation for mares with uterus unicornis.

### Learning points

- Uterus unicornis is an important condition requiring accurate diagnosis so that appropriate advice can be given to mare owners regarding potential reproductive inefficiency
- The diagnosis of uterus unicornis in mares may be challenging depending upon the phase of the estrous cycle. If there are any doubts, serial examinations would be encouraged and also having a second experienced clinician involved would be beneficial

- Birthweight of the foal is determined by the size of the mare's uterus which it inhabits during gestation. One would therefore expect that mares with uterus unicornis would deliver smaller foals than bicornuate mares carrying fetuses with similar genetic potential. In this case the foal weighed only 35kg and an average Warmblood foal would be 50-60kg
- Developmental uterine anomalies are uncommon. However, when anomalies are present in the small animals and humans, they were commonly associated with renal anomalies. Therefore, the finding of unicornuate uterus should trigger an assessment of both kidneys because associated ipsilateral renal agenesis may require specific management practices for future health of the mare

### Conflicts of interests

No conflicts of interest to declare

### Sources of funding

None

### References

1. Renaudin CD, Troedsson MHT, Gillis CL, et al: Ultrasonographic evaluation of the equine placenta by transrectal and transabdominal approach in the normal pregnant mare. *Theriogenology* 1997;47:559-573.
2. Thursby-Pelham RH: Uterus unicornis in mares. *Vet Rec* 1997;141:132.
3. Newcombe JR: Uterus unicornis in two mares. *Vet Rec* 1997;141:21.
4. Smith KC, Long SE, Parkinson TJ: Abattoir survey of congenital reproductive abnormalities in ewes. *Vet Rec* 1998;143:679-685.
5. Brown JA, Hodder ADJ, Benak J, et al: Uterus unicornis in two mares. *Aust Vet J* 2007;85:371-374.
6. McIntyre RL, Levy JK, Roberts JF, et al: Developmental uterine anomalies in cats and dogs undergoing elective ovariohysterectomy. *J Am Vet Med Assoc* 2010;237:542-546.
7. Rousset N, Abbondati E, Posch B, et al: Unilateral hydronephrosis and hydroureter secondary to ureteric atresia, and uterus unicornis in a young terrier. *J Small Anim Pract* 2011;52:440-443.
8. Taylor E, Gomel V: The uterus and fertility. *Fertil Steril* 2008;89:1-16.
9. Li SY, Qayyum A, Coakley FV, et al: Association of renal agenesis and mullerian duct anomalies. *J Comput Assist Tomogr* 2000;24:829-834
10. Romagnoli S, Schlafer DH: Disorders of sexual differentiation in puppies and kittens: a diagnostic and clinical approach. *Vet Clin North Am Small Anim Pract* 2006;36:573.
11. Christensen BW: Disorders of sexual development in dogs and cats. *Vet Clin North Am Small Anim Pract* 2012;42:515-526.
12. Allen WR, Wilsher S, Turnbull C, et al: Influence of maternal size on placental, fetal and postnatal growth in the horse. I. Development in utero. *Reproduction* 2002;123,445-453.
13. Allen WR, Stewart F: Equine placentation. *Reprod Fertil Dev* 2001;13:623-634.
14. Jeffcott LB, Whitwell KE: Twinning as a cause of fetal and neonatal loss in thoroughbred mare. *J Comp Pathol* 1973;83:91-106.
15. Elliott C, Morton J, Chopin J: Factors affecting foal birth weight in Thoroughbred horses. *Theriogenology* 2009;71:683-689.
16. Rossdale, PD: Clinical view of disturbances in equine foetal maturation. *Equine Vet J* 1993;14,3-7.

Fig. 1. (A) Placenta with allantoic surface imaged, this demonstrates only the uterine body and one uterine horn attachment.

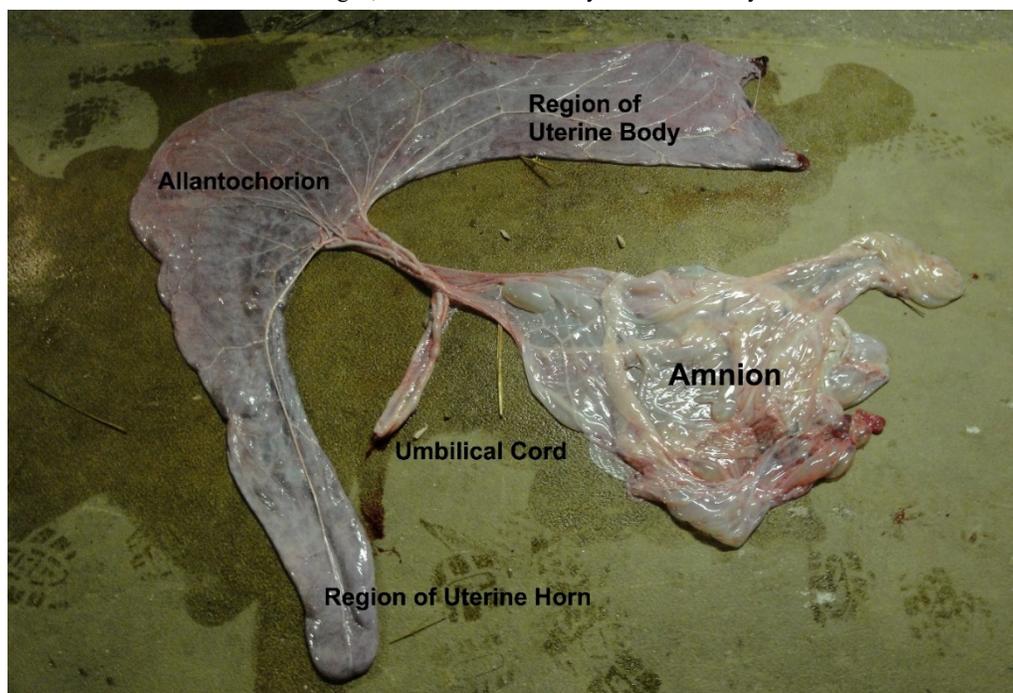


Fig. 1. (B). Placenta with chorionic surface photographed. This demonstrates only contact with one uterine horn and uterine body. There is no evidence of a twin membrane.



Fig. 2. The left and right ovaries with follicular activity.

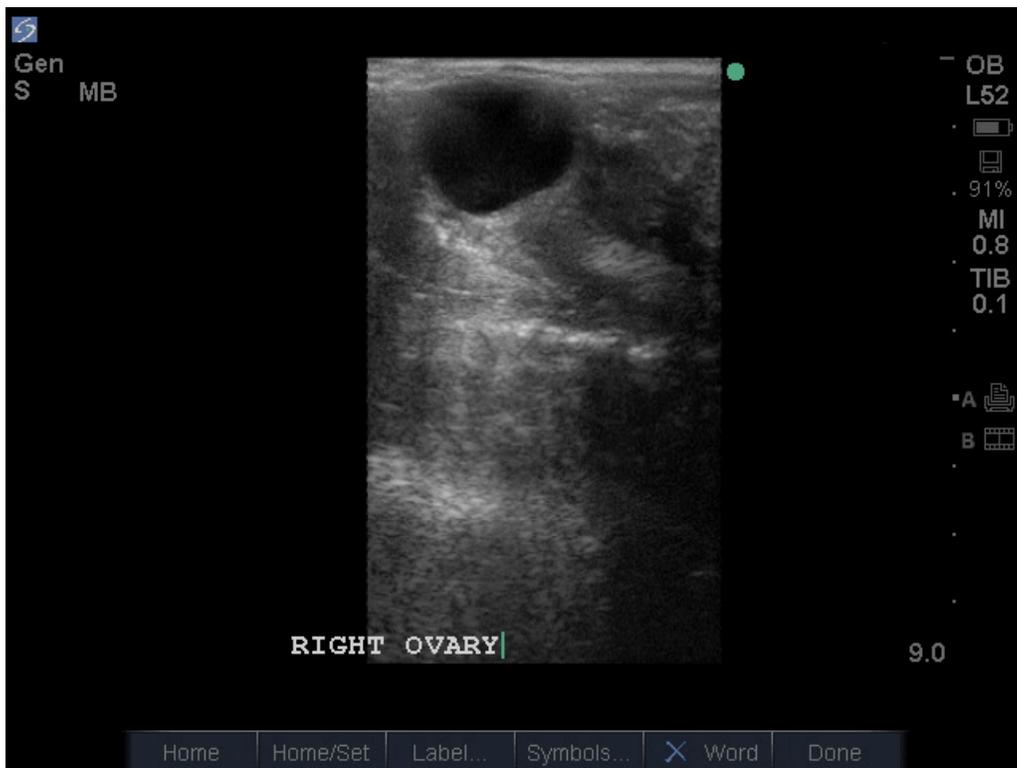
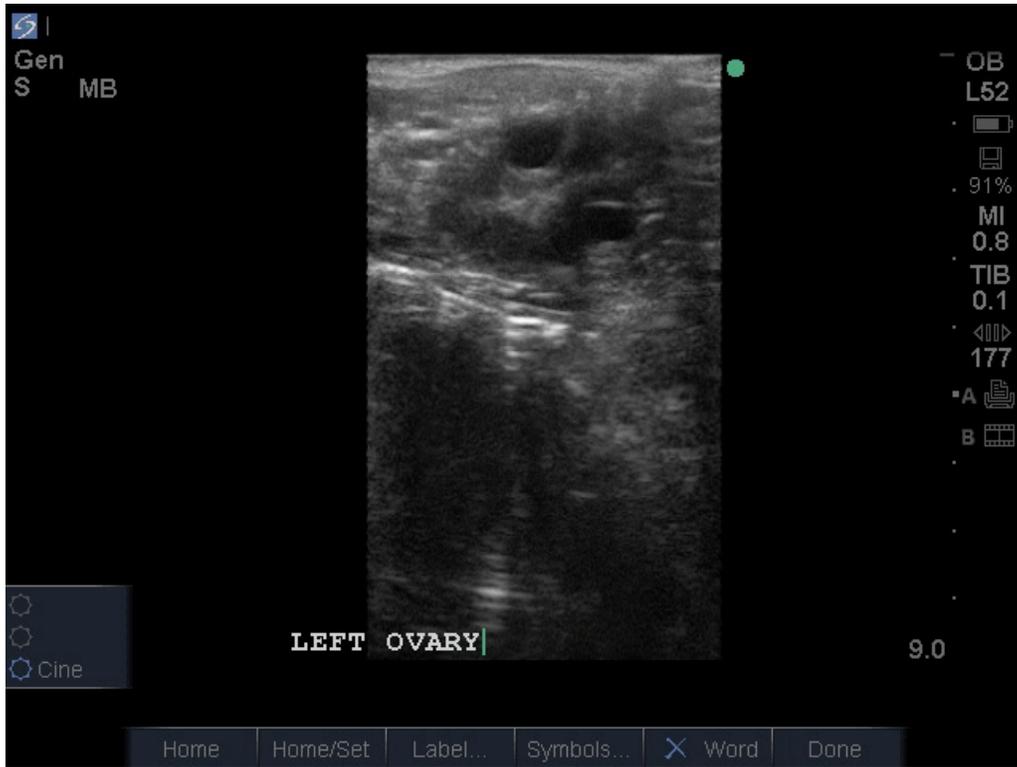


Fig. 3. The left uterine horn and uterine body showing mild endometrial edema

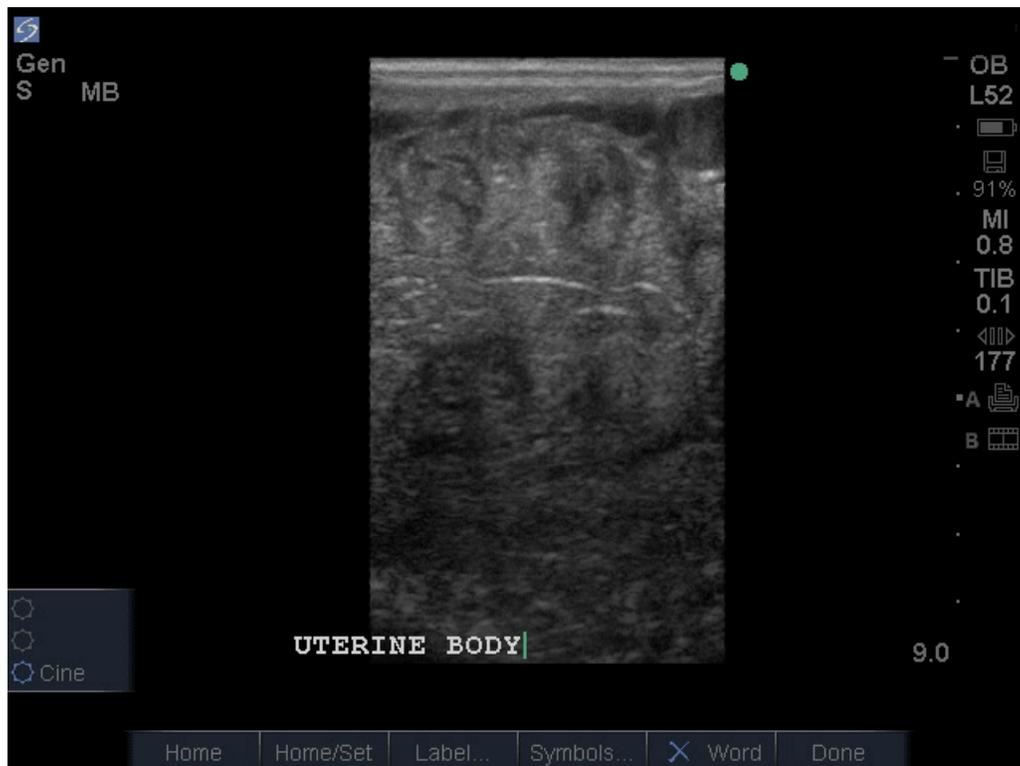
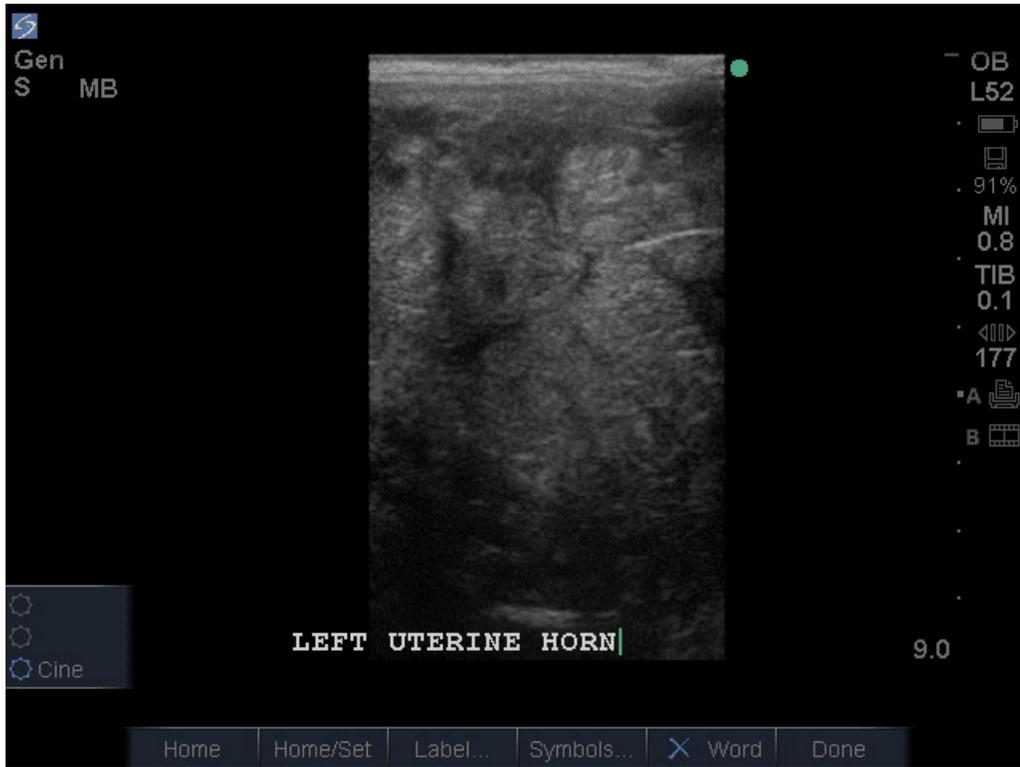
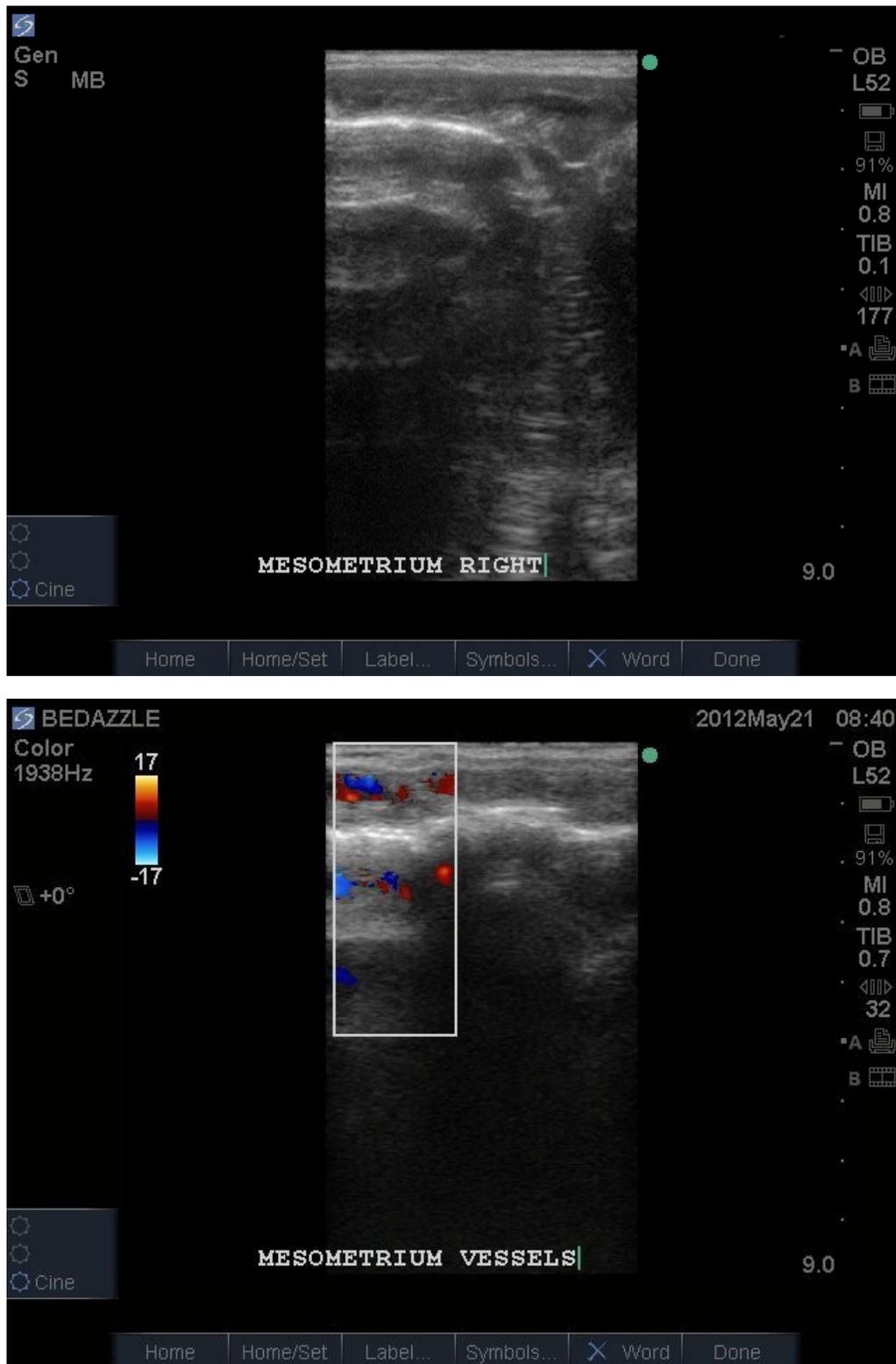


Fig. 4. Ultrasound and color Doppler imaging displaying mesometrial vessels on the right side and no evidence of a right uterine horn.



(Editor's note: Photographs in this manuscript are available in color in the online edition of Clinical Theriogenology.)