

COMPARATIVE STUDY ON HIGH-RISK AND NORMAL PREGNANCY IN THOROUGHBRED MARES IN AN ORGANIZED FARM

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ABSTRACT

The equine industry has shown a very rapid growth since last decade worldwide. The breeding is one of the important aspects for the same and heavy economical losses could be faced because of loss of high pedigree foals. In present study, twelve mares were divided into two groups i.e., mares with high-risk pregnancies and normal pregnancies. All the mares were analysed for combined thickness of uterus and placenta (CTUP), gestation length, foal birth weight and placenta weight and postpartum conception rate. The results suggested no significant difference in CTUP during 9th and 10th month of gestation between both the groups, however in 11th month of gestation between both the groups the mean CTUP was recorded to be significantly different. The mean gestation length and foal birth weight in group I was recorded to be lesser in comparison to group II mares. No significant difference was observed in placental weights between the groups. The cervical tone during foal heat was totally relaxed to slightly relaxed and the uterus was extremely flaccid to moderately tonic in both groups on 10th and 12th day post-partum/post-abortion. Group-I mares showed considerably lower conception rate than mares from group-II. A conclusion can thereby be drawn that in case of mares exhibiting symptoms of high-risk pregnancy (acute abdominal enlargement, premature udder development), rigorous monitoring in pre-partum as well as post-partum/post-abortion stages is imperative to optimise future fertility.

Keywords: Combined thickness of utero-placental unit, Equine, High risk pregnancy

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Since few decades, there has been a very rapid growth in the equine breeding industry worldwide. In recent years, sports like show jumping, polo and horse racing have gained a lot of attention and appreciation. In the equine breeding industry, economic motivation influence breeders to maintain a foaling interval of 12 months or less. There are various techniques to identify mares at high-risk of an abnormal pregnancy i.e., endocrine monitoring of placenta (progesterone, oestrogen, relaxin), thereby allowing closer supervision, during the periparturient period and earlier detection, treatment and possible prevention of foal loss (Bucca *et al.*, 2005).

The pregnancy losses during late gestation can be seen because of foetal and maternal illness and placental dysfunction. As per previous references the incidence of pregnancy loss in mares was found to be 15% to 20% (Ginther *et al.*, 1985; Ball, 1988). Early detection of placental failure in the mare has been considered essential for the successful management and treatment of mares affected with placentitis. Placentitis can be diagnosed using trans-rectal and/or trans-abdominal ultrasonography by measuring the combined thickness of the utero-placental unit (CTUP) and evidence of placental separation with accumulation of hyperechoic fluid (Waldrige and Pugh, 2001).

The present study was, therefore aimed at monitoring

of CTUP during advanced gestation in high-risk pregnancies and in normal pregnancies using ultrasonography and monitoring of foal birth weight and conception rate in post-partum/post-abortion mares.

MATERIALS AND METHODS

The present study was conducted at Commercial Stud Farm, Pune and Department of Animal Reproduction, Gynaecology and Obstetrics, Mumbai Veterinary College, Mumbai.

Animals: A total of twelve thoroughbred broodmares in an ideal body condition score of 4 to 5 on a scale of 1 to 9 (Henneke *et al.*, 1983) were selected for the study, of which six mares exhibited symptoms of high-risk pregnancies (acute abdominal enlargement, premature udder development) and so were placed in group-I. Six mares carried normal pregnancies and were placed in group-II as control. The mares were restrained in a travis for the pre- and post-partum examination and were examined as per experimental design.

Ultrasonographic examination: A real-time B-mode ultrasonography machine with a 5-7.5 MHz multi-frequency linear array trans-rectal transducer was used to scan the reproductive tract. The probe was introduced into the rectum with its scanning window directed ventrally while it was being slide cranially along the rectal floor.

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Placental study: All the mares included in the study were scanned using ultrasonography from the end of 9th month of gestation onwards at monthly intervals. The combined thickness of the uteroplacental unit (CTUP) was measured (Fig. 1).

Treatment of mares suspected for high-risk pregnancies: The mares showing signs of impending abortion were treated according to the established treatment protocol on the farm. That included hormonal, anti-inflammatory, anti-microbial and tocolytic therapy. Hormonal therapy included Altrenogest (synthetic progestin) @ 0.044 to 0.088 mg/kg, BID, PO (Bailey *et al.*, 2010). Anti-microbial therapy constituted a combination therapy of Sulphameth-oxazole and Trimethoprim orally @ 24 mg/ kg, BID, PO for a term of 10 days (Britt and Byars, 1997). Pentoxifylline was used as the anti-inflammatory agent @ 7.5 to 8.5 mg/ kg BID, PO (Bailey *et al.*, 2010).

Gestational length: The date of confirmation of ovulation or last date of cover (LDC) and the date of foaling was noted and the gestational length was calculated as the interval between the two (Kamble, 2004).

Foal weight and placenta weight: Upon expulsion, the placenta was weighed and then spread out and observed for their intactness. Also, foals were weighed immediately after birth.

Monitoring post-partum cervical and uterine tone: The mares were examined per-rectally on the 10th day post foaling or abortion to determine the cervical and uterine tone. The cervix and uterus were graded based on the length, width and tone of the cervix and uterine tone on a scale of 0 to 2 (Table 1) (Walawalkar, 2008).

Monitoring of subsequent oestrus and conception rate: Mares from both the groups were teased daily from 7th day post-partum/post-abortion. Pregnancy was confirmed by ultrasonography on 14th day from the day of covering by the visualization of an embryonic vesicle in either of the uterine horns. Conception rate for each group was calculated as the number of mares that were diagnosed pregnant divided by the total number of mares covered, in each group.

Statistical analysis: The quantitative results were compared using t-test as per standard statistical procedure (Snedecor and Cochran, 1994).

RESULTS AND DISCUSSION

Combined thickness of uterus and placenta (CTUP): The mares were scanned trans-rectally at monthly intervals starting from 9th month of gestation and continuing up till 11th month of gestation. Three mares (Mare no. 3, 5 and 6) foaled and one mare (Mare no. 4) aborted in the 11th month (Table 2).

The average CTUP finding for the 9th month of gestation in the present study were 07.34±0.56 mm and

07.70±0.96 mm for group-I and II, respectively (Table 2). These results corroborated with those of Barnes *et al.* (2005), Bucca *et al.* (2005) and Morris *et al.* (2007). Troedsson (2007) however quoted an upper limit of CTUP as low as 07.00 mm for 9th month of gestation to which, findings from both groups of the present study contrast (10.00 mm for group I and 09.33 mm for group II). This could be attributed to individual variation.

Observations in the 10th month of pregnancy revealed an average CTUP of 08.93±0.51 mm and 09.18±0.10 mm for group-I and II, respectively. Barnes *et al.* (2005) quoted an average CTUP in the 10th month of pregnancy to be 8.4±0.5 mm and Troedsson (2007) reported the upper limit of CTUP value for 10th month of gestation to be less than 8 mm. Though, the values observed in the present study were supported by those observed by Bucca *et al.* (2005). Walawalkar (2008), reported an average value of CTUP for the 10th month to be lesser than those in the present study.

In the 11th month of gestation, the average values of CTUP in group I and II were 12.10±0.007 and 09.71±0.74 mm, respectively. Only two out of four mares from group-I could be examined in the 11th month of pregnancy because out of the two remaining mares one had aborted and one had foaled. The results of group-II disagree with those of Troedsson (2007) but concurrently, the observations of group-I are in corroboration with those of above stated authors. However, Bucca *et al.* (2005) have quoted CTUP values of 15.70±5.6 mm which are higher than those obtained in both the groups of the current study. Morris *et al.* (2007) have quoted CTUP value of 11.00±0.1.60 mm at 345 days of gestation in normally pregnant mares, which is slightly higher than the mean CTUP at 11 months of gestation in group II of the present study. Walawalkar (2008) found CTUP from the 11th month to be 08.13±0.1.31 mm which is lower than those in the present study. These could be attributable to breed and individual variation.

Treatment of mares suspected for high-risk pregnancy: Treatment was administered to six mares showing signs of high-risk pregnancy. Altrenogest was administered @ 0.044 to 0.088 mg/kg, BID, PO depending on the response to the therapy (Bailey *et al.*, 2010). Anti-microbial therapy constituted a combination therapy of Sulphamethoxazole and Trimethoprim orally @ 24 mg/ kg, BID, PO for a term of 10 days (Britt and Byars, 1997). Sulpha/Trimethoprim is known to reach therapeutic endometrial concentrations in a very short time (Waldrige and Pugh, 2001). Pentoxifylline was used as the anti-inflammatory agent @ 7.5 to 8.5 mg/ kg BID, PO (Britt and Byars, 1997; Wolfsdorf *et al.*, 2000; Bailey *et al.*, 2010).

Gestational length: One mare from group-I, was excluded while calculating the average gestational length as she aborted (Table 3). From the table, it is seen that the

mean gestational period was of 330±09.27 and 344±19.16 days for group-I and group-II, respectively. The findings for group-I corroborate with those of Barr (2005). The mean gestational length for group-II was consistent with findings of Youngquist (1997), Kamble (2004) and Rangnekar *et al.* (2009). It can be stated that the foals born out of mares from group-I were carried for a significantly lesser time than those from group-II.

Foal birth weight and placenta weight: The results for birth weights of foals and placental weights in group-I and II were recorded (Table 4). The mean foal birth weight in group-I and II were 40±5.35 kg and 45±2.36 kg, respectively. The findings of the present study are in accordance with those of Singhvi (1987). The observations of Rangnekar (2006) are much lower than the observation of the present study. This could be attributed to breed and individual variation.

The mean placental weights for group-I and II were 4.62±1.24 kg and 4.41±0.66 kg (Table 4). The results of the present study corroborated with the findings of Wilsher *et al.* (2003). But the values are higher than those quoted by Rangnekar *et al.* (2009). No significant difference between mean placental weights between group-I and II was found.

Monitoring post-partum cervical and uterine tone:

Cervical Tone: The details pertaining to the cervical tone during the course of involution and foal heat in group-I and II were recorded (Table 5). On the 10th day post-partum/post-abortion, 66.67% (4/6) of the mares from group-I had a cervical tone of grade 0 whereas, 33.34% (2/6) had a cervical tone of grade-1. In group-II, 33.34% (2/6) had a cervical tone of grade 0 and 66.67% (4/6) mares showed a cervical tone grade-1. This implies that 66.67% mares from group-I and 33.34% mares in group-II had a totally relaxed, wide and short cervix on the 10th day post-partum/post-abortion. All the remaining mares had a slightly relaxed wide and short cervix. Four mares from group-I and five from group-II were re-examined on the 12th day post-partum/post-abortion. In group-I, 100% (4/4) mares and in group-II 40.00% (2/5) mares had a cervix with grade 1 tonicity. The remainder of 0% from group-I and 60.00% from group-II showed the cervical tonicity of grade 0. It is evident from the above illustration that all mares had a relaxed, wide and open cervix during foal heat. These findings are supported by those of Knottenbelt *et al.* (2003) and Walawalkar (2008).

Uterine tone: The uterine tone in mares from group-I and II were recorded (Table 5). On 10th day post-partum/post-abortion, four out of six mares in group-I i.e., 66.67% showed uterine tone of grade 0 upon rectal palpation. The remaining two mares (33.33%) showed a uterine tonicity of grade-1. However, in group-II, 50.00% (3/6) mares had a uterine tonicity of grade 0 and the remaining 50.00% (3/6) scored grade-1.

Table 1. Cervical grading and uterine grading

| | Grade | Interpretation |
|------------------|-------|----------------------------------|
| Cervical grading | 0 | Totally relaxed, wide and short |
| | 1 | Slightly relaxed, wide and short |
| | 2 | Tonic, narrow and long |
| Uterine grading | 0 | Extremely flaccid |
| | 1 | Reasonably flaccid |
| | 2 | Moderately tonic |

Table 2. Combined thickness of uterus and placenta (CTUP) in mm from 9th to 11th month of gestation (Group-I and II)

| Group | Mare No. | Day of Symptoms | Month of Gestation | | |
|----------|-----------|-----------------|-------------------------|-------------------------|---------------------------|
| | | | 9 th | 10 th | 11 th |
| Group I | 1 | 192d | 07.27 | 09.22 | 12.10 |
| | 2 | 251d | 07.19 | 08.21 | 12.11 |
| | 3 | 298d | 07.06 | 09.15 | F |
| | 4 | 311d* | 08.47 | 09.59 | Ab |
| | 5 | 305d | 07.05 | 08.46 | F |
| | 6 | 310d | 7.00 | 9.00 | F |
| | Mean ± SD | | 7.34 ^a ±0.56 | 8.93 ^b ±0.51 | 12.10 ^c ±0.007 |
| Group II | | | Month of Gestation | | |
| | | | 9 th | 10 th | 11 th |
| | | 7 | 06.43 | 07.19 | 09.20 |
| | | 8 | 07.48 | 09.12 | 09.20 |
| | | 9 | 07.22 | 09.37 | 10.12 |
| | | 10 | 09.31 | 10.26 | 09.79 |
| | | 11 | 8.05 | 10.16 | 10.98 |
| | | 12 | 7.75 | 9.00 | 9.00 |
| | | Mean ± SD | 7.70 ^a ±0.96 | 9.18 ^b ±1.10 | 9.71 ^b ±0.74 |

* = Aborted on the same day; Ab=Aborted; F=Foaled; Mean values bearing different superscripts (a, b, c) within groups differ significantly (p<0.05)

Table 3. Gestational length in days (Group-I and II)

| Group | Mare No. | Last date of cover (LDC) | Date of Foaling | Gestational Length |
|----------|----------|--------------------------|-----------------|---------------------|
| Group I | 1 | 14/04/2020 | 15/03/2021 | 335 |
| | 2 | 22/02/2020 | 26/01/2021 | 338 |
| | 3 | 25/04/2020 | 06/03/2021 | 317 |
| | 4 | 19/06/2020 | 21/04/2021* | 310* |
| | 5 | 16/06/2020 | 26/04/2021 | 314 |
| | 6 | 17/04/2020 | 29/02/2021 | 319 |
| | | Mean ± SD | | 324.6±9.89 |
| Group II | 7 | 27/02/2020 | 08/01/2021 | 318 |
| | 8 | 14/04/2020 | 12/04/2021 | 364 |
| | 9 | 25/05/2020 | 04/05/2021 | 345 |
| | 10 | 06/06/2020 | 21/05/2021 | 349 |
| | 11 | 19/03/2020 | 17/03/2021 | 364 |
| | 12 | 24/02/2020 | 02/02/2021 | 340 |
| | | Mean ± SD | | 346.66±17.17 |

*= Date and Day of Abortion (Excluded from calculation); Mean values bearing different superscripts (A, B) between groups differ significantly (p<0.05)

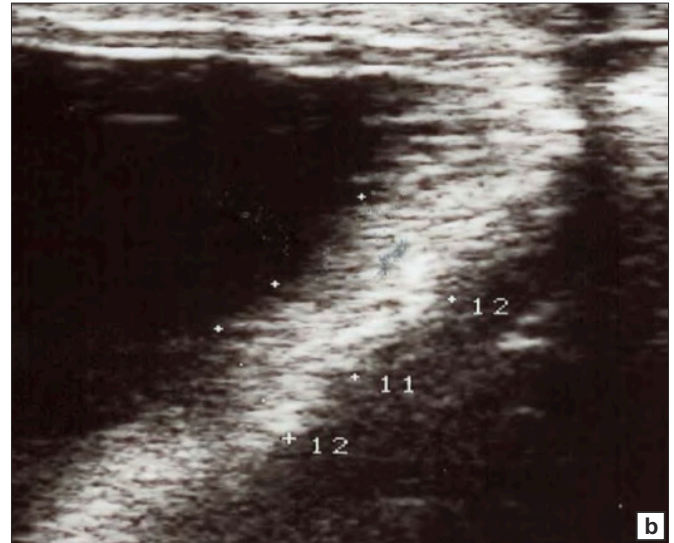
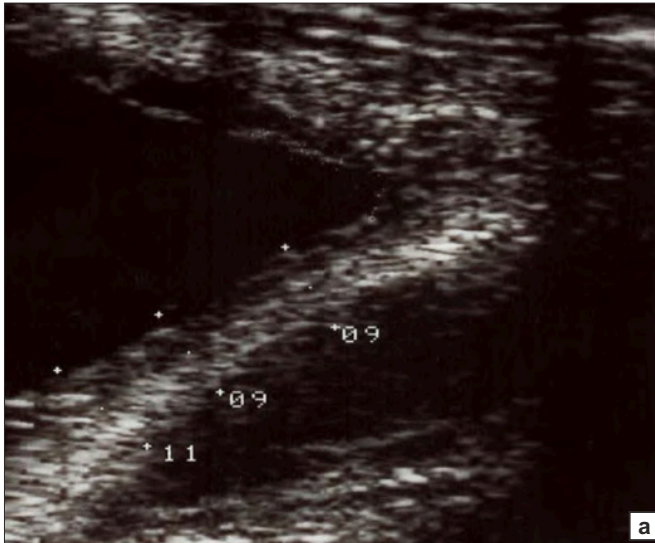


Fig. 1. Measurement of Combined Thickness of Uterus and Placenta (CTUP) in healthy mare (a) and high-risk pregnant mare (b)

Table 4. Foal birth weights and placental weights (Group-I and II)

| Group | Mare No. | Birth Weight of Foal (kg) | Weight of Placenta (kg) |
|----------|-----------|---------------------------|-------------------------|
| Group I | 1 | 46.00 | 04.00 |
| | 2 | 41.00 | 03.00 |
| | 3 | 33.00 | 06.00 |
| | 4 | Ab | Ab |
| | 5 | 36.00 | 05.00 |
| | 6 | 35.00 | 05.00 |
| | Mean ± SD | 40 ± 5.35 | 4.62 ± 1.24 |
| Group II | 7 | 42.00 | 04.00 |
| | 8 | 43.00 | 03.50 |
| | 9 | 47.00 | 05.00 |
| | 10 | 44.00 | 05.00 |
| | 11 | 46.00 | 04.00 |
| | 12 | 48.00 | 05.00 |
| | Mean ± SD | 45.00 ± 2.36 | 4.41 ± 0.66 |

Ab = Aborted; Mean values bearing different superscripts (A, B) between groups differ significantly ($p < 0.05$)

This made it evident that on the 10th day post-partum/post-abortion, 66.67% of group-I mares and 50.00% of the group-II mares had an extremely flaccid uterus. Remaining mares had a reasonably flaccid uterus. On the 12th day post-partum/post-abortion, out of four mares from group-I which were re-examined, one mare (25%) had a very flaccid uterus of the grade 0, three mares (75%) mares showed a grade-1 uterus. Of the five mares re-examined in group-II, two mares (40%) showed a uterine tone of 0, one mare (20%) showed a uterine tone of 1 and the remainder two mares (40%) scored a 2.

From the above observations, it can be seen that maximum mares had an extreme to reasonably flaccid uterus on 10th and extremely flaccid to moderately tonic on 12th day post-partum/post-abortion. The findings of the present study are in agreement with those of Knottenbelt *et*

Table 5. Cervical and uterine tone during involution/foal heat (Group-I and II)

| Group | Mare No. | Days Post-partum/ post-abortion | |
|----------------------|----------|---------------------------------|-----------------|
| | | 10 ^a | 12 ^a |
| Cervical Tone | | | |
| Group I | 1 | 0 | 1 |
| | 2 | 0 | 1 |
| | 3 | 0 | NE |
| | 4 | 1 | NE |
| | 5 | 0 | 1 |
| | 6 | 1 | 1 |
| Group II | 7 | 0 | NE |
| | 8 | 1 | 0 |
| | 9 | 1 | 0 |
| | 10 | 1 | 1 |
| | 11 | 0 | 0 |
| | 12 | 1 | 1 |
| Uterine Tone | | | |
| Group I | 1 | 0 | 1 |
| | 2 | 0 | 0 |
| | 3 | 1 | NE |
| | 4 | 1 | NE |
| | 5 | 0 | 1 |
| | 6 | 0 | 1 |
| Group II | 7 | 0 | NE |
| | 8 | 1 | 0 |
| | 9 | 0 | 0 |
| | 10 | 1 | 2 |
| | 11 | 0 | 1 |
| | 12 | 1 | 2 |

NE = Not Examined

al. (2003), Walawalkar (2008) and Noakes *et al.* (2019) who stated that the uterus is relaxed to slightly tonic during oestrus. Thus, it can be said that the cervical tone during foal heat was totally relaxed to slightly relaxed and the uterus extremely flaccid to moderately tonic in post-

Table 6. Conception rate (Group-I and II)

| Group | Mare No. | Oestrus Subsequent to Foal Heat | Next Oestrus |
|----------|----------|---------------------------------|--------------|
| Group I | 1 | Pregnant | - |
| | 2 | Pregnant | - |
| | 3 | Non-pregnant | Non-pregnant |
| | 4 | Non-pregnant | Non-pregnant |
| | 5 | Non-pregnant | Non-pregnant |
| | 6 | Non-pregnant | Non-pregnant |
| Group II | 7 | Pregnant | - |
| | 8 | Pregnant | - |
| | 9 | Pregnant | - |
| | 10 | Not Covered | Pregnant |
| | 11 | Pregnant | - |
| | 12 | Pregnant | - |

partum/post-abortion/foal heat mares with normal as well as compromised previous pregnancies on 10th and 12th day post-partum/post-abortion.

Conception rate: Observations on conception rate in group-I and II were recorded (Table 6). In Group-I, 33.34% (2/6) mares conceived at the oestrus subsequent to foal heat i.e., at first cover. The mares which did not conceive at first cover were covered again on the next oestrus, but none of the remaining mares conceived at the second cover as well. However, in group-II 83.34% (5/6) mares conceived at the oestrus subsequent to foal heat i.e., at first cover. Mare number 10 was not covered at the oestrus subsequent to foal heat because of abrupt ovulation on the 1st day of oestrus. The mare was covered at the next oestrus and conceived.

From above observations, it can be seen that mares from group-I who had exhibited symptoms of high-risk pregnancy in the previous gestation showed considerably lower conception rate than mares from group-II with a normal previous gestation.

CONCLUSION

Mares that exhibited signs of impending abortion had substantially higher CTUP by the end of gestation when compared with control mares. The gestation length and foal birth weight of group-I mares were significantly lesser than group-II mares. The mares with a compromised previous pregnancy had a substantially lower conception rate in comparison to the control mares. A conclusion can thereby be drawn that in case of mares exhibiting symptoms of high-risk pregnancy, rigorous monitoring in pre-partum as well as post-partum/post-abortion stages is imperative to optimise future fertility.

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