A Case of Equine Pregnancy Confirmation, Monitoring and Measurement of Some Fetal Parameters Using 2D Ultrasound in 22 Mares

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ABSTRACT

Although there are advanced and improved diagnostic techniques in the understanding of equine reproduction which have resulted in increased pregnancy rates in mares, however, it is imperative to continue to monitor fetal well-being along the gestational growth stages in order to assess fetal well being through measurement of heart rate, fetal movement/tone, position, presentation and posture. This case report delved into these indices using a 2D ultrasound scan of 22 pregnant mares in their three different gestational stages. Expected date of delivery (EDD) and fetal heart rates were obtained for first trimester (192 ± 9), second trimester (113 ± 9), and third trimester (91 ± 9) mares. The prominent fetal features discernable in the three stages of gestation (3 Trimesters) included gestational sac, the allantois and amniotic fluid (positive confirmation of pregnancy, first trimester); fetal stomach rugae, abdominal organs-kidneys, bladder and viscera (second trimester), and the fully formed fetus with advanced skeletal development, skull, femur, clavicle assuming an anterior presentation (third trimester), which were all monitored using 2D ultrasonography.

Key words: Fetal components, Mares, Trimesters, Ultrasound

INTRODUCTION

Non-invasive imaging methods, particularly ultrasound, which is often used in clinical practice, have proven to be an indispensable tool in obtaining gestational indices, such as for pregnancy diagnosis, studies of prenatal life, especially of the fetal period, (Bucca *et al.*, 2005 and Murase *et al.*, 2014) and also a reliable method for the estimation of gestational age (GA), pregnancy management, monitoring and interpretation of fetal growth assessments (Ioannou *et al.*, 2012). These indices are important for appropriate scheduling of dams antenatal care and informed gestational management interventions/decisions geared towards a successful gestation and delivery, and at the long run a reduced neonatal/maternal death or incidences of congenital abnormalities. Improved diagnostic techniques and advances in the understanding of equine reproductive physiology and pathology have resulted in increased pregnancy success rates in the mare (Mats, 2007). Some conditions causing high risk pregnancies in horses have been categorised as maternal conditions (Colic, endotoxemia, abdominal tunic rupture, prepubic tendon rupture, dystocia, uterine inadequacy, uterine torsion, hyperlipemia, e.t.c.), fetal conditions (twins, dystocia, congential defects, hydrops) and placental conditions (placentitis, twisted umbilical cord, and fescue toxicity).

Therefore, some indications that may necessitate evaluation and examination of the fetus include early lactation, vaginal discharge, maternal systemic illness, larger than normal abdominal size, suspected twinning, overdue pregnancy and a previous poor outcome of parturition (McGladdery, 1991 and Reef, 1998).

In spite of recent advances in equine reproduction, many stages of embryonic and fetal development remain poorly understood. A study by Barone and Laplace, in 1965 was the first to describe a donkey embryo 1.25 cm long, with an approximate age of 30 days. Descriptions of the development of specific systems have been published, including cardiogenesis between Days 21 and 49 (Vitums, 1981). In addition, macroscopic and microscopic morphological descriptions of the equine embryo between Days 17 and 40 have been published (Acker *et al.,* 2001); similarly, sonographic descriptions of the equine embryo have been reported (Franciollia *et al.,* 2011).

Gestation in the mares ranges from 320-370 days, average 340 days (Anon). A foal born before 315 days is considered premature; prior to 300 days it is considered too young to survive. Pregnancy diagnoses in the mare by the veterinarian can be achieved via rectal palpation as early as day 20-30 of gestation (Lucia, 2024 and AAEP, 2018). Mare's gestation cycle can be grouped into three (3) trimesters stages: first trimester is from day 0 to 110; second trimester from day 114 to 220; and third trimester is from day 226 to 340 (Lavoie and Hinchcliff, 2010).

In the mare, the embryo proper is visualized as an echogenic spot in the ventral aspect of the vesicle at around day 20. Additionally, development of allantoic sac, embryonic heartbeat, yolk sac regression and posterior umbilical cord formation can also be visualized from days 20 to 40 (Meira *et al.,* 2012). Between days 55 and 60 of pregnancy the conceptus occupies the whole gravid horn and the uterine body, while the whole interior of the uterus is filled by days 80 to 85. By day 60, the fetus shows a horse-like appearance and it lies in the ventral region of the uterus (Ginther, 1998).

Case Report and History

Client and Patient description: 22 horses of different age and breed including Arewa, Sudanese, Tallon, Argentine and Thoroughbreed belonging to SD Stables, Bida, Niger State.

On the 16th of April, 2024, the services of a team of radiologist was requested by the management of SD stables to carry out pregnancy confirmation, monitoring and fetal evaluation to a group of 22 mares bred intermittently, between July 2023 and March, 2024. Medical records revealed that the mares were initially stimulated into oestrous by premedication with equine chorionic gonadotrophin (eCG) IM and GnRH IM, to synchronize the mares. Thereafter, the mares showing signs of oestrous and receptivity were bred via natural mating method by 2 Thoroughbreed stallions purchased from South Africa. The horses are been fed on green pastures (grass), wheat bran, concentrate, grain supplements (millet). They are been housed in individual paddocks.

Physical field examination:

This was carried out in the individual paddock. In general, the body condition score (BSC) of the mares was assessed to be within 5-7; vital parameters of all the examined mares were within normal ranges. General clinical examination revealed average parameters within 38.2℃ ± 0.5 of body temperature, 44-46 of heart beats and 24-30/min of respiratory rates.

Management Plan:

On the stated date, pre-mated mares were presented to the Chute section of the SD stables for ultrasonographic pregnancy examination. All mares were restraint physically and mildly with the use of chute, and supportive restraint was by psychology via feeding with stalks of guinea corn.

Pre-procedure preparations:

The examination area was swept and cleaned; this was maintained all through the procedure. We ensure adequate water availability and sanitary measures were maintained. For each mare, pre-evacuation of fecal content was carried out by the technologist prior to trans-rectal ultrasonographic examination. All clinician and technologist were appropriately kitted in laboratory coats and disposable arm gloves worn. The ultrasound machine, a Edan colour ultrasound scanner; Brand YSENMED (YSB-L5PRO) was assembled and mounted on the trolley and then connected to a light/power source. For the trans-rectal approach, a linear transducer set at 8.0 MHz was used; and for the trans-abdominal approach, a curvilinear transducer run on frequency 5-7 Hz, dept 20mm, under equine obstetric examination was employed. For each mare, at the beginning of examination, the individual data was logged in and all results of procedure digitally captured and stored on the ultrasound system. Prior to trans-abdominal ultrasound, hair from the ventral abdominal midline was clipped using an electronic clipper, from the xiphoid sternum to the mammary glands.

Procedure:

All the mares, except those in the most advanced stage (only trans-abdominal), underwent two (2) ultrasound examination procedures, viz (i) trans-rectal with the linear probe, and (ii) trans-abdominal with the rectilinear (curvilinear) probe. At the end of each examination, the mare is properly cleaned of the aquasonic gel and fecal stains before being returned back to the paddock. The clinicians, operators and technologist also ensure adequate cleaning after completion of every examination.

RESULTS

Of the twenty-one (22) mares that underwent the ultrasonographic examinations, twelve (12) mares showed clear evidences of pregnancy with uterine foetal material seen (see table 1 and 2), whereas, two (2) mares were not showing definitive evidences of pregnancy (requiring future scanning). Seven mares were clear to be negative for pregnancy as at the time of the examination.

Table 1: EDD of the mares obtained after confirmation of pregnancy

Date on which Mare was bred	No. of mares crossed	No. of mares showing pregnancy signs	EDD/Due date upon ultrasonography
17-30/07/2023	6	4	03-18/06/2024
07-21/10/2023	6	3	19-31/09/2024
03-18/01/2024	6	3	19-28/12/2024
19-27/03/2024	4	2	13-23/02/2025

Table 2: Fetal features discernable at the three categorized stages of gestation in the maress

No. of mares	Gestation Period (month)	Foetal Features seen	Remarks
5	1-3 (Day 0 - 114) (1st Trimester)	Presence of embryo (gestational sac), the allantoic and amniotic fluid chambers clearly demarcated by the amniotic membrane, presence of fetal/umbilical material, filling the uterus, presence of some fetal organs and fetal cardiac activities was detected	See figure 2
3	4-7 (Day 115 – 226) (2nd Trimester)	There is significant fetal growth, presence of stomach, stomach rugae, kidneys, bladder, other viscera are also discernable. So also, ribs, sternum, lungs, trachea, aorta were also discernable	See figure 3 and 4
4	8-11 (Day 228-340) (3rd Trimester)	Presence of fully developed foetus, thoracic organs, fetal skeleton, posture, position and presentation can be fully discerned	See figure 4

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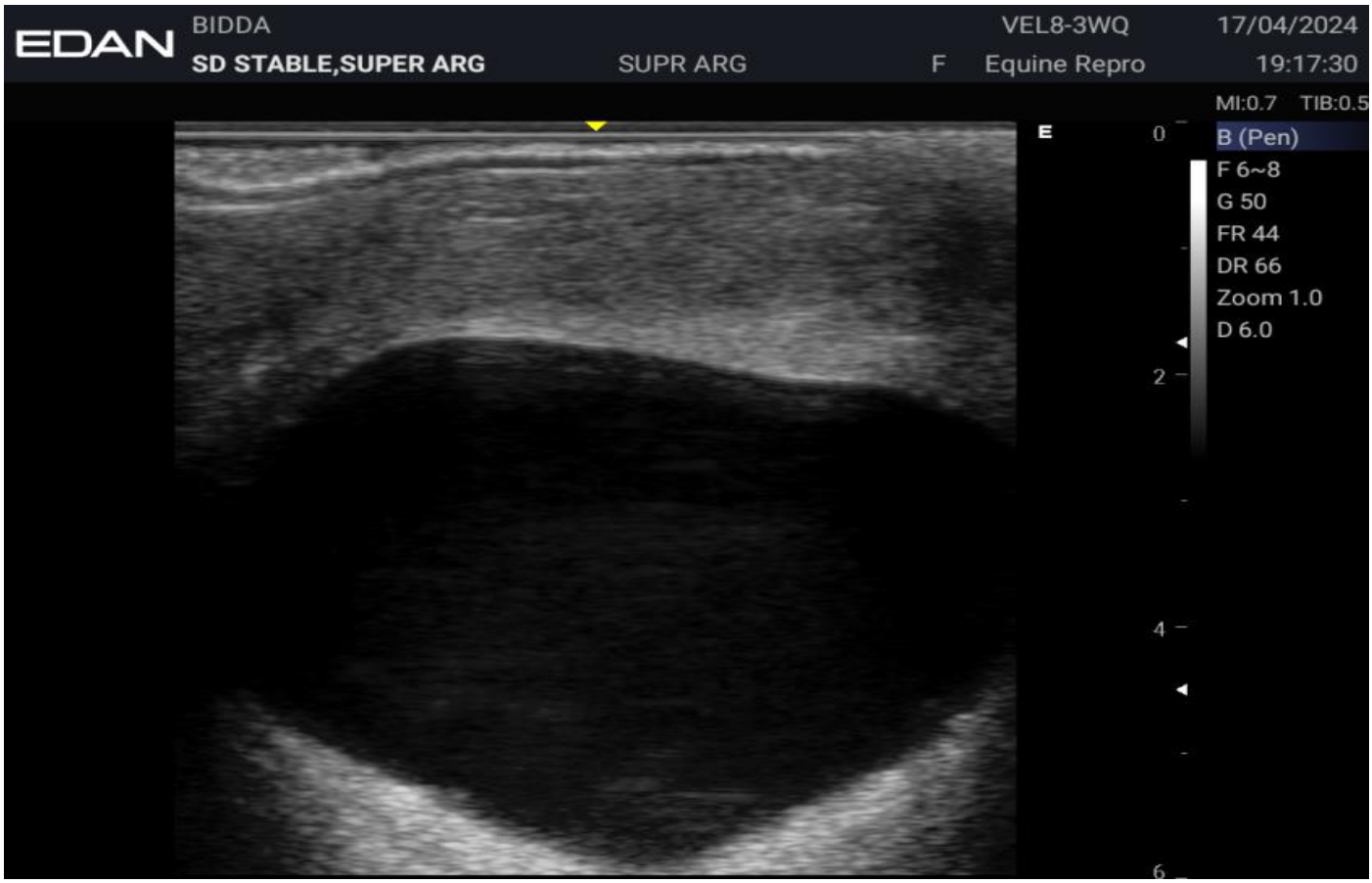

Figure 1: A trans-rectal linear sonogram showing an empty uterine cavity with a fluid filled anechoic bladder in one of the pregnancy negative mares.

Figure 2: Sonogram of a pregnant mare in her first trimester of gestation: A- the developing embryo attached to the uterine wall (pink arrow); B-Trans-abdominal convex sonogram depicting maternal abdominal wall (a), Utero-placental unit/umbilical material (u), fetus (f)

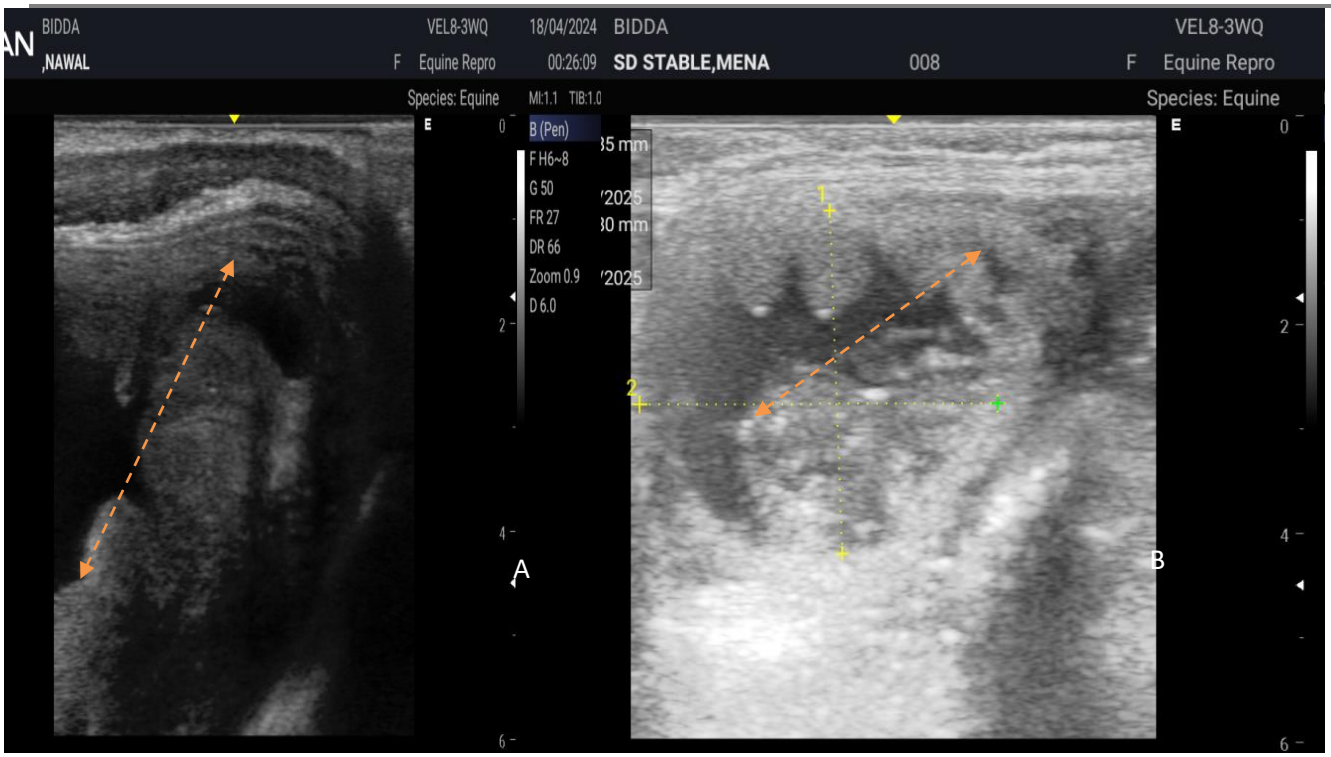

Figure 3: Side view of trans-rectal sonograms of a pregnant mare in its second trimester showing fetuses on ventro-sacral position (pink dotted arrow)

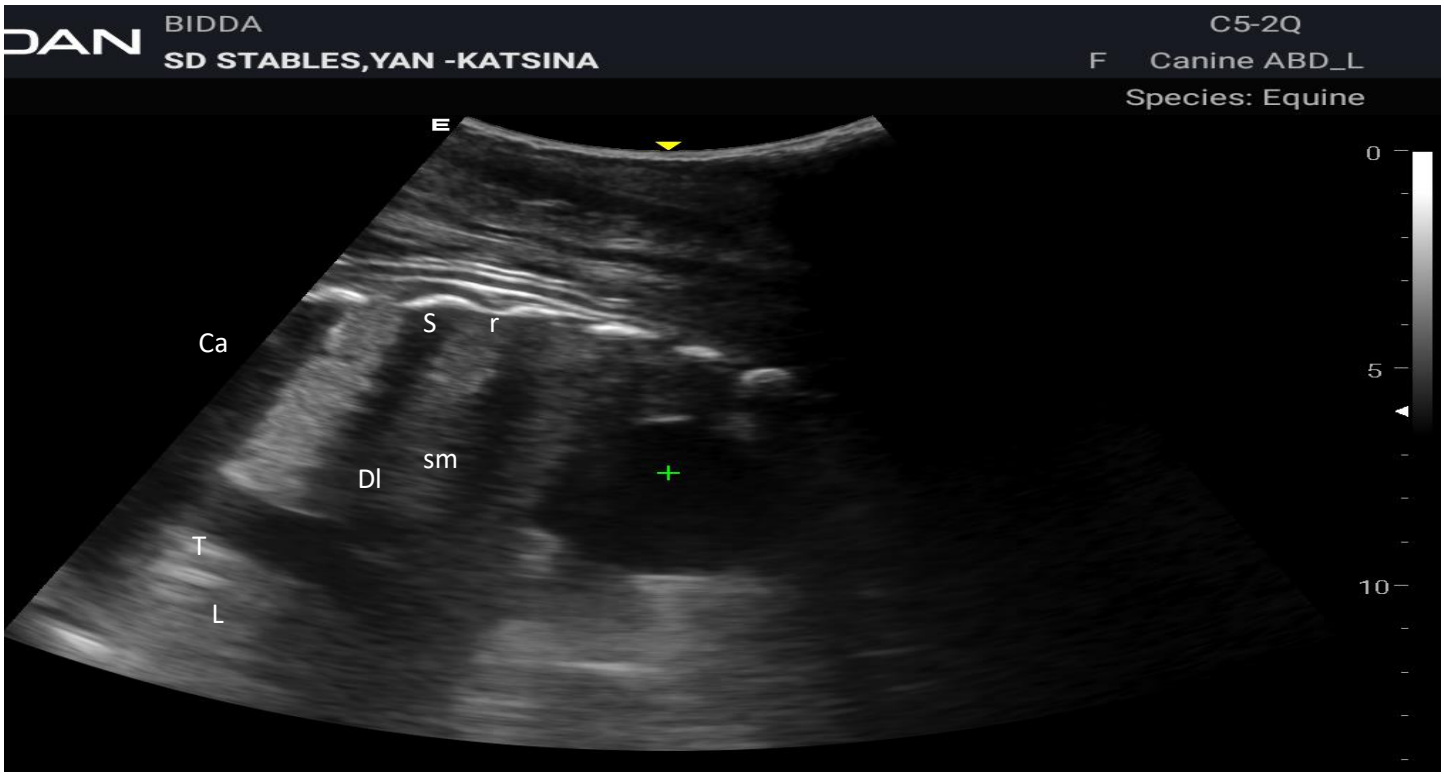

Figure 4: Trans-abdominal sonogram of a mare in her third trimester showing the fetal thoracic cavity and some structures: cardiac area (Ca), sternum (s), rib (r), stomach (sm), diaphragmatic line (Dl), trachea (T), Lung (L)

DISCUSSION

In mares, the presence of a spherical shape and large dimensions of the fluid-filled embryonic vesicle when compared to other species makes it possible for early diagnosis of pregnancy. As early as day 9 of pregnancy,

the conceptus is ultrasonically visualized as a spherical shape structure enclosed by an echogenic capsule, 1 to 2 mm in diameter, termed embryonic vesicle (Ginther, 1983a). Eventually, the conceptus loses its spherical shape and there is a thickening of the dorsal portion of the uterus noticed on ultrasound. This was evident in this case report as depicted in figure 2 (A and B). At day 24 of pregnancy, an echogenic line is detected indicating opposed walls of the allantoic and yolk sacs that are located, respectively, in the ventral and dorsal regions of the vesicle with the embryo seen as a hyperechogenic structure in the echogenic line. This was observed in some of the pregnant mares we scanned during the procedure. The long length of the umbilical cord allows considerable movement to the fetus into the allantoic fluid and, sometimes, the torsion of the umbilical cord is a frequent cause of late abortion (Allen and Wilsher, 2009). The embryo proper can be visualized at day 20 of gestation, seen as an echogenic spot, 4 mm in diameter, in the ventral aspect of the vesicle, whereas by day 23 the embryonic heartbeat can be detected (Ginther, 1983b). The fetal heart rate has been suggested to be used as an indicator of fetal well-being (Curran and Ginther, 1995). In the current case, we detected embryonic heartbeat at late stages of the first trimester, and all through the second and third trimesters (table 2). Upon observing the fetal heart beat, we obtained the fetal heart rate by using the Doppler mode. Fetal heart rate recorded where averaged at 192 ± 9 bpm; 113 ± 9 bpm, and 91 ± 9 bpm in first, second and third trimester respectively. This pattern and figure is in line with documented results reported by Curran and Ginther in 1995 and also by Reef *et al.*, in 1996 where they discovered that heart rate of the fetus peaks at 3 months of gestation to a mean of 196 beats per minute and then gradually decrease throughout pregnancy. The average fetal heart rate in a fetus greater than 300 days gestation is 75 ± 7 bpm (Nagel*et al.*, 2010), and it slows by approximately 10 bpm at greater than 330 days gestation (Curran and Ginther, 1995). The decrease in the fetal heart rate has been attributed to increasing parasympathetic tone to the heart (McGladdery, 1996). Also, the fetal heart rates may generally vary based on activity level of the mare or fetus, because consistently low or high fetal heart rates have been associated with fetal stress prompting serial fetal examinations in order to verify fetal well-being or distress, and intervention decision such as induction of parturition (Mats, 2007).

Sonographic examinations of the mares in their second trimester revealed fetal organs such as the heart, foetal stomach and some skeletal features (figure 3). In reported works by Kahn *et al.*, in 2004 and Prestes and Landim-Alvarenga, in 2006; they showed that by day 60 of gestation, fetal development can be monitored via ultrasound observations of fetal organs, and fetometry measuring of the length from the neck to the rump (crown-rump), the extension of radios and tibia and the diameter of the orbital orifice; and they also showed that these fetal parameters can be used to estimate gestational age and fetal health. However, modern ultrasound machines, like the one in use, have inherent algorithmic ability to estimate fetal age by extrapolating from the gestational sac diameter, height and volume. In the current case we are reporting, the fetus is in dorsal recumbency with the vertebrae closest to the ventral abdominal wall (ventro-sacral position; figure 2). We also observed fetal skeletal structures including the femur, skull and thorax.

Ultrasonography of the pregnant mares in their third trimester was principally achieved via trans-abdominal approach, we resisted trans-rectal in order to avoid unnecessary stress to the mare as she is close to term. Sonography revealed fetal thoracic cavity (recognizable by its striped pattern) and its contents such as the heart and its chambers, heart beat was clearly evident, stomach rugae (diffused mix echogeneicity), bowel and intestinal segments (uniform echogenicity) with peristalsis and skeletal structures (femur, clavicle, skull, hoof) were conveniently discernable.

CONCLUSION

This present case elucidates the common sonographic features of a foals' fetal growth stage in the first, second and third trimester of gestation, using trans-rectal and trans-abdominal approaches. It also outlines some of the discernable features in the ultrasound of a pregnant mare using either or both trans-rectal and trans-abdominal approaches with a linear or curvilinear convex transducers respectively. It showed that the fetal components such as the embryo, placental materials, amniotic and allontoic fluids can be discerned in the earliest stages of gestation; the growing fetus, the eye orbit, heart rates, e.t.c. can be discerned in the mid gestation stage; and also the fetal stomach, bowel components as well as skeletal components can be conveniently discerned at late pregnancy. Therefore, by extension, the entire growth of the fetus can be monitored and fetal

parameters/indices such as heart rate, fetal orbital diameter, and femoral length can be obtained and thus used to assess normal fetal growth in the pregnant mares.

Declaration:

Authors' contributions:

Audu Hassan Abdullahi (MSc) was responsible for the study conception, design and drafting of the manuscript. Sonographic data acquisition and reporting was by all authors. AUDU Hassan Abdullahi (MSc), AJEIGBE Olawale Sherif (MSc), AZEEZ Idris Ayodeji (PhD), TAUHEED Abubakar Muazu (MSc) and KILANI Muhyideen Adio were responsible for designing the study, acquiring the sonoraphs and drafting the manuscript. Maruf Lawal (PhD) was responsible for supervision of study design, analysis and interpretation, manuscript preparation, and general supervision of the case. All authors read and approved the final manuscript.

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Conflicts of interest:

There are no conflicts of interest.

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