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**ASSESSMENT OF THE REPRODUCTIVE
PERFORMANCE IN MARES USING
DIAGNOSTIC ULTRASOUND**
(With 2 Tables and 18 Figures)

By

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**تقييم الكفاءة التناسلية للأفراس باستخدام جهاز الموجات
فوق الصوتية التشخيصي**

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أجريت هذه الدراسة على عدد ١٤٠ فرسه عربية في الإسطبلات الملكية بالمملكة الأردنية الهاشمية وكانت أعمارها تتراوح بين ٦-٢٢ سنة . وكانت نسبة حدوث الحمل عند اليوم ٣٨ بعد التتويض ٧٦,٥% وكانت نسبة حدوث الحمل بالنسبة لدورات الشبق ٧٥% ، وكانت نسبة دورات الشبق بالنسبة للإخصاب ٢ بمتوسط قدره ٢,٢٨ تلقح لكل إخصاب ، وكانت نسبة موت الجنين مبكرا ٨,٥% . كذلك لوحظت الحالات المرضية الموجودة، حيث كانت نسبة حويصلات جدار الرحم ، طول فترة ما بعد الشبق ، عدم الشباج السلوكي ، أورام المبيض ، أورام الرحم ، تقح الرحم (البيومترا) ٢,٧١ ، ٦,٦٧ ، ٤,١٧ ، ١,٢٥ ، ١,٢٥ ، ٣,٤٥% على التوالي. وعند الفحص بالموجات فوق الصوتية كانت أحجام حويصلات المبيض ٢٢,٢ ، ٣٢,٥ ، ٤٠,٢ ، ٤١ مم في اليوم الأول والثاني والثالث والرابع من بداية ظهور الشبق وكان متوسط حويصلات المبيض قبل التتويض ٤٥,٢ مم. كذلك تم تشخيص الحمل المبكر وكذلك تشخيص بعض الأمراض التي تصيب الجهاز التناسلي. استنتج من هذه الدراسة أن جهاز الموجات فوق الصوتية هو جهاز يمكنه الحكم على الكفاءة التناسلية للأفراس ويمكن استخدامه بأمان.

SUMMARY

Mares were subjected to frequent examinations by diagnostic ultrasound and data were collected over two breeding seasons on 140 Arabian

mares (6-22 years old). The cumulative pregnancy rate at 38 day postovulation was 76.5% and the pregnancy rate per cycle was 75%. The average number of cycles per conception was 2 with an average of 2.28 insemination per conceived cycle. The incidence of early embryonic death was 8.5%. The incidence of endometrial cysts; prolonged diestrus; behavioural anestrus, ovarian tumors, uterine tumors and pyometra were 2.71, 6.67, 4.17, 1.25, 1.25 and 3.45% respectively. Ultrasound scanning of normal ovaries and uterus were done. The follicular diameters were 22.2 ± 0.06 , 32.5 ± 0.07 , 40.2 ± 0.02 and 41 ± 0.01 mm at the 1st, 2nd, 3rd and 4th days of estrus respectively. The average size of the follicles prior to ovulation was 45.2 ± 0.03 mm. Early pregnancy diagnoses as well as diagnosis of certain reproductive disorders were done using diagnostic ultrasound. It was concluded that, ultrasound is a good tool for judgement the reproductive performance in mares and its use is safety and did not impair the reproductive efficiency.

Key words: The Reproductive Performance in Mares.

INTRODUCTION

Ultrasonography of the reproductive tract of the mare has proven to be a very useful tool for diagnosing the reproductive status by breeding farm managers (Ginther, 1986). The ability to visualize structures of the tract has not only improved timing of insemination and pregnancy detection, but it has also allowed understanding of follicular status, embryonic characteristics, uterine pathology, monitoring the postpartum mare and detection of ovulation (Mc Kinnon *et al.*, 1987 and Mc Kinnon and Carnevale, 1993).

Problems of equine reproduction needs more investigations to reach an accurate diagnosis for reproductive alterations (Vamer, 1987). Infertility problems in mares were recorded mainly due to pathological alterations in the uterus as endometrial cysts, embryonic death, fetal death and endometritis. Anovulatory luteinized follicles, follicular and ovarian haematomae, ovarian cysts and tumors are the most causes of pathological alterations of the ovary (Ginther, 1986).

As with any new technological procedure, there exists the possibility that deleterious effect from the use or over use of ultrasonography on the reproductive tissues. As yet, there have been no reported incidences of lowered fertility or fetal abnormality as a result of

ultrasound examination in mares (Ginther, 1986 and Newcomb, 1996). The purpose of this study is to present reproductive efficiency of mares subjected to routine ultrasound examination of the ovaries and uterus during periods of follicular growth, early pregnancy diagnosis and to explore the major reproductive problems in mares.

MATERIAL and METHODS

Mares were examined per rectum over two breeding seasons with a 5- MHZ, high resolution, linear array transducer, approximately 7cm in width. Real-time was on a 7- in diagonal display using 120 lines of real ultrasound data with a 10cm depth field and a dynamic range of 16 gray shades (Equi scan II, Model 8100 from Ami, Alliance Medical Inc, Canada).

The present work was carried out at Royal Stables for Arabian Horses in Amman (Hashimet kingdom of Jordan). Over two breeding seasons, a number of 140 mares aged from 6-22 years were observed clinically and examined by ultrasound for determination of reproductive status. During estrus, ultrasound scanning as well as ovarian palpation was performed on each mare on alternate days to monitor follicular development and to detect ovaluation. Mares were inseminated with fresh, extended semen during estrus and, after ovulation, they were subjected to examination by ultrasound at 17, 25 and 38 days for early pregnancy diagnosis. For mares in which conception was not evident at 17 day post ovulation, ultrasound was performed at day 25 to attempt detection of the embryonic vesicle, unless mare returned to estrus. In this case, mares were again subjected to diagnostic ultrasound to monitor follicular development for aid in determining time for insemination and time of ovulation. Also diagnostic ultrasound was used to judge the healthy status of the genital tract.

RESULTS

Reproductive performance of mares is shown in Table 1. The obtained data are belonged to mares that were presented at Royal Stables for two breeding seasons. It is shown that 76.3 and 76.7% of mares became pregnant during the consequent breeding seasons respectively, with an overall mean of 76.5% represented all examined mares at 17 to 38 days of pregnancy, regardless the number of times a mare became

pregnant or aborted and then reestablished a pregnancy. Table (1) further shows that pregnancy rate per cycle were 71.0 and 79% respectively, with an over all mean of 75%. The mean number of insemination per cycle were 2.06 and 2.51, respectively, yielding an over all mean of 2.28 insemination per cycle for the two breeding seasons.

Occurrence of early embryonic death was established when a confirmed pregnancy was reabsorbed or did not increase in size in accordance with age. Irregular shape of the embryo and poorly defined margin is a good indicator of early embryonic death (Fig. 1).

Rate of occurrence of early embryonic death was calculated by adding the number of early embryonic death to the total number of pregnant mares and then dividing the number of early embryonic deaths by this sum. As shown in table 1, the rate of early embryonic death was 8.0 and 9.0 % respectively.

Endometrial cysts are ultrasonically visible in older mares. The incidence of mares with endometrial cysts are 3.75 and 1.67% respectively (Table 1). The endometrial cysts appeared as immobile, usually compartmentalized non echogenic structures with well- defined borders (Fig. 2 and 3). Mares with a large number and or size of cysts tend to have a reduced pregnancy rate. It was treated by curreting the endometrium and infusion of iodine preparation 0.5%.

As shown in Table 1, the incidence of behavioral anestrus was 5 and 3.33% respectively. It is commonly observed in miniature mares.

In prolonged dioestrus mares, the corpus luteum remains clearly visible as a defined hypoechoic structure (Fig. 4). It is commonly detected for several weeks. The incidence of mares with prolonged diestrus were 5 and 8.33% respectively, yielding an over all mean of 6.67% for the two seasons (Table 1). All mares with prolonged diestrus were treated by 0.55 mg / kg cloprostenol sodium (Estrumate: Miles, Inc., Agricultural Division, Animal Health products, Shawne, Kans.). The commonly observed side effect was sweating and cramping.

The incidence of mares with ovarian tumors was 2.5%. The ovary appears ultrasonically as a highly echogenic structure (Fig..5). Rectal palpation revealed a hard mass. The uterine tumors also detected ultrasonically as a highly echogenic mass within the uterine lumen (Fig.. 6). The incidence of uterine tumors was 2.5% (Table 1).

The incidence of mares with pyometra were 3.75 and 3.33 % for the two seasons respectively (Table1). The pus appears as a hyperechogenic fluid inside the uterus (Fig. 7). All mares were treated

after sensitivity test with a specific antibiotic and then ultrasonically examined to detect the grade of echogenicity and response of treatment (Fig. 8).

Concerning the ultrasonic of the normal ovaries and uterus, scanning of these structures was performed routinely to achieve the most efficient reproductive performance. Table (2) demonstrates the use of diagnostic ultrasound on mares during various parts of the estrous cycle. Ultrasound images of follicles of various sizes and the changing during estrous cycle (Fig. 9,10, 11 and 12) are shown. The follicular diameters were 22.2 ± 0.06 ; 32.5 ± 0.07 ; 40.2 ± 0.02 and $41. \pm 0.01$ mm during 1st, 2nd, 3rd and 4th days of estrus respectively. Before ovulation the preovulatory follicles grows at an average 2 mm per day. The average size of the follicles prior ovulation are 45.2 ± 0.03 mm and the follicles are soften (Fig. 13). At the beginning of the formation of the corpus luteum after ovulation, it could be recognized by a central non echogenic area representative a blood clot (Fig. 14).

By using ultrasound to detect early pregnancy, the uterine echo texture is similar to that of dioestrus until approximately day 15 to 17, after which an increase in endometrial folding and the equine embryonic vesicle could be detected and the conceptus was highly mobile within the uterine lumen. Identification by the visualization of two artifactual, hyperchogenic reflections located at the dorsal and ventral aspects of the early vesicle (Fig. 15). It maintains its spherical shape until approximately day 18 when it begins to become irregular in out line at days 26 and 38 of pregnancy and the embryo proper appears clearly (Fig.16 and 17). With the advancement of pregnancy the fetal eye socket, cranium, ribs and trunk appeared clearly (Fig. 18).

DISCUSSION

Although a comparison of the current data with that of other facilities is difficult, it does appear that regular, conscientious use of ultrasonography did not have a deleterious effect on pregnancy rates. It is shown that 76.3 and 76.7% of mares became pregnant. Pregnancy rates at other studies have yielded an average of 80% (Merkt and Gumzel, 1979) and 95.6 (Vogelsang *et al.*, 1989) for light horse mares. Pregnancy rate per cycle was 75% and the over all mean number of insemination per cycle was 2.28. These means are within the range of those reported else where (Fontijne and Hennis, 1989).

The rate of early embryonic death was 8.0 and 9.0% respectively, which was lower than the rates reported by Vogelsang *et al.* (1989). Irregular shape of the embryo and poorly defined margin is a good indicator of early embryonic death. This observations came in accordance with that reported by Merkt and Gunzel (1979).

The incidence of mares with endometrial cysts in the 25 seasons are 3.75 and 1.67% respectively. The endometrial cyst appeared as immobile, non echogenic structures with well defined borders. A nearly similar observation was detected by Ginther (1986); Adams *et al.* (1987) and Griffin and Ginther (1991).

The incidence of behavioral anestrus were 5 and 3.33% respectively. It is commonly observed in miniature mares due to the tremendous emotional attachment by mares to their foals (Robert, 1994). For this reason it is recommended that miniature foals normally be weaned at 3 months of age. If the foal is allowed to nurse longer, the weaning process is much more stressful for both mare and foal, and anestrus lasts longer.

Mares with prolonged diestrus were treated by 0.55 mg /kg cloprostenol sodium. Although cloprostenol is not approved for mares at this time, its use has been reported (Vamer, 1987).

The ovarian and uterine tumors were detected ultrasonically as a highly echogenic structures. A similar observations were reported by Kenny and Ganjam, (1975), Ginther (1984) and Ginther and Pierson (1984).

In mares with pyometra the pus appears as a hyperechogenic fluid inside the uterus. The fluid echogenicity is apparently dependant upon the amount of inflammatory cells and debris within the fluid (Mckinnon *et al.*, 1988 a). A system for grading echogenicity (grades I to IV, hyperechogenic to non echogenic; (Mckinnon *et al.*, 1988 b) is helpful in documenting the severity of an inflammatory condition, as well as a means for monitoring the response to therapy.

The follicular diameters of mares, fortunately are excellent subjects for ultrasonic imaging because they are large, filled with fluid, and readily accessible by transrectal route. The follicles, like other fluid - filled structures, appear on the ultrasound images as black (non echogenic) areas (Ginther, 1986). In the present study the follicular diameters were 22.2, 32.5, 40.2 and 41 mm at 1st, 2nd, 3rd and 4th days of estrus respectively. These measurements were nearly similar to those obtained by Parker (1971) and Pierson and Ginther (1985). The follicles

prior ovulation are soften. Various characteristics could be used to predict time of ovulation. Softening of the follicular wall occurred 24hr before ovulation in about 70% of the mares (Parker, 1971). This was frequently associated with a change in follicular shape from spherical to an irregular shape (Pierson and Ginther, 1985). This might be due to disruption of ovarian stroma as the follicle protruded towards the ovulation fossa in preparation of oocyte release (Bergin and Shipley 1968; Ginther 1979 and Morioka 1989). At the beginning of the formation of the corpus luteum, it could be recognized by a central non echogenic area representative a blood clot. A similar observations were reported by Carnevale *et al.* (1988) and Newcombe (1996).

By using ultrasound to detect early pregnancy at day 17, the equine embryonic vesicle is identified by the visualization of two artifactual, hyperechogenic reflections located at the dorsal and ventral aspects of the early Ginther (1986). It maintain its spherical shape until day 18 when it begins to become irregular in out line at day 26 and 38 of pregnancy and the embryo proper appears clearly. A similar observation was reported by Ginther (1986). With advancement of pregnancy the fetal eye socket, cranium, ribs and trunk appeared clearly. A similar observations was recorded by Kähn and leidl (1987). Our results suggest that the use of diagnostic ultrasound did not impair reproductive efficiency of mares to cause increase in the rate of early embryonic death.

It was concluded from this study, that ultrasound is a good tool for judgement the reproductive performance in mares and its use is safety and did not impair the reproductive efficiency.

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Table (1): Reproductive performance of mares over two breeding seasons

No. of Mares	No. of pregnant mares	Preg. Rate %	Preg. Rate per cycle %	Cycle per conception (x)	Insemination per conception (x)	Early* embryonic death %	Endometrial cysts %	Behavioural anestrus %	Prolonged diestrus %	Ovarian tumors %	Uterine tumors %	Pyometra %
Season 1	80	61	76.35	71	1.51	2.06	8.0	3.75	5	2.5	-	3.75
Season 2	60	46	76.70	79	1.42	2.51	9.0	1.67	8.33	-	2.5	3.33
Over all mean:	-	-	76.5	75	2	2.28	8.5	2.71	6.67	1.25	1.25	3.45

* Calculated by dividing the number of early embryonic death by the total number of pregnant mares plus the number of early embryonic deaths
 Table (2): Follicular diameters (M ± SE) for estrus phases in Mares.

Follicular diameter (mm)	1 st day of estrus	2 nd day of estrus	3 rd day of estrus	4 th day of estrus	Prior ovulation
	22.2 ± 0.06 ^d	32.5 ± 0.07 ^e	40.0 ± 0.02 ^b	41.2 ± 0.01 ^{ab}	45.2 ± 0.03 ^a

Means with different alphabetical superscripts are significantly different from each other at level (p<0.05).







