Research Article

Ultrasonographical and Hormonal Study on Some Causes of Infertility in Iraqi Goats (Capra hircus)

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Abstract: The study was designed to investigate the causes of infertility in Iraqi goats (Capra hircus) during the breeding season in Al-Muthanna province from June to November 2021. Twenty-eight infertile goats (study group) and six fertile goats (control group). All animals were examined for causes of infertility by visual inspection of the external genitalia and using transabdominal and transrectal ultrasonography. Results obtained that the most important causes diagnosed by ultrasonography were; higher percent (46.43%) of endometritis, inactive ovaries (21.42%), moderate percent (14.29%) of pyometra, (10.72%) of luteal ovarian cysts, and lower percent (7.14%) without clear diagnostic causes. Hormonally; there is a significant increase ($p<0.05$) in the serum progesterone level (l34.69±11.71) in the case of luteal cysts and pyometra compared with the control group(0.93±0.28), and a significant decrease ($p<0.05$) in the serum estradiol level in all causes of infertility compared with the control group. In contrast, cortisol evaluation revealed a significant ($p<0.05$) higher level of cortisol in the case of ovarian inactivity (67.12±11.20) and luteal ovarian cysts (62.50±9.27) compared with the other cases and compared with the control group (28.79± 4.42). This study concluded that endometritis, pyometra, and hormonal disturbances (inactive ovaries and luteal ovarian cysts) form the most important causes leading to infertility in Iraqi goats (Capra hircus).

Keywords: Infertility, Goats, Ultrasonography, Hormones.

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1. Introduction

The reproductive problems in goats play an essential role in decreasing their reproductive ability and minimizing the chance of pregnancy. Several causes contribute to inducing infertility in goats during the reproductive season, including managemental, nutritional, hormonal, and infectious causes [1,2]. One study in Iraq [3], showed that 16% of non-pregnant doe have one or more lesions that lead to temporary or permanent infertility. Early detection of the causes of infertility in small ruminants and choosing the drug of choice is essential for enhancing reproductive efficiency and increasing the pregnancy rate [2]. The diagnosis of female infertility in goats has a great challenge and difficulties compared to large animals because of the inability to palpate the ovaries and uterus, as well as the seasonal pattern of breeding limiting the time available for medical treatment [4]. Ultrasonography is one of the most critical diagnostic techniques for evaluating and diagnosing pathological cases in different animal species [5–7].
Seasonal anestrus, inactive ovaries, ovarian cysts, silent estrus, and persistent corpus luteum are regarded as the most critical causes of infertility, which can easily be diagnosed through hormonal detection for estradiol, progesterone, and cortisol [5,8]. Metritis is often associated with retention of fetal membranes or trauma to the uterus during dystocia, and it may lead to infertility in some goats, but in ewes, metritis is often associated with a dead fetus, assisted delivery of multiple lambs without proper hygiene, and uterine prolapse [9].

Metritis is inflammation of the uterus with white watery discharge from an external orifice of the vagina and a systemic sign of illness commonly after parturition [10]. Reduced milk yield, high rate of culling, and high therapeutic cost are involved with metritis resulting in substantial economic loss [11]. Recent literature indicates E. coli, Arcanobacterium pyogenes, Fusobacterium necrophorum, Prevotella spp., and Bacteroides spp. are the most prevalent bacteria isolated from the uterine lumen of metritis cases [12]. However, there are few reports of concurrent infection of metritis and mastitis in small ruminants. The present paper records metritis along with mastitis and its successful clinical management in a goat.

Reproductive failure can result when hormones are not produced in the correct amount or the right pattern or if no ovum is produced and released from the ovary. Ovaries can become cystic (both follicular and luteal, so either before or after ovulation). In does with follicular cysts, which are rare, the follicle with the ova grows but there is failure of ovulation or release of the ova. This type of cyst usually results in females that are always in heat. This may be related to problems with the hormone that causes ovulation known as the luteinizing hormone [13].

Luteal cysts can occur when the corpus luteum (CL) fails to regress (go away) and becomes filled with fluid such that hormone secretion is altered. Poor uterine health resulting in low prostaglandin secretion could cause this problem. Luteal CL cysts can lead to pregnancy loss, a dead, mummified fetus, infection, and even pseudopregnancy (fake pregnancy). Reproductive failure can also occur if external factors cause anestrus (no estrus/heat). These factors include season, low nutrition, lactation, and disease. However, proper management or care can be used to overcome or lessen the impact of these types of reproductive failure [23].

It is also important to understand that females might undergo silent estrus, which is ovulation without visible signs of estrus. The incidence of a silent estrus occurring is high during transition periods in goats, such as the onset of puberty and transition into and out of the breeding season. In addition, reproductive failure can occur from females having shorter cycles, which has been associated with lower fertility. Females with longer cycles appear to be as fertile as females with normal cycle lengths [13]. This study was designed to investigate the causes of infertility in Iraqi goats (Capra hircus) during the breeding season.

2. Materials and Method

Animals:

The study included 28 infertile matured goats and 6 fertile goats as the control group, all animals were aged (1.5-3 years), The breeding system (shelter and grazing, followed), and the type of mating was natural mating. Animals were subjected to ultrasonographical and hormonal examinations. Infertility in study animals was diagnosed through case history and then perform the ultrasonography examination.

Examinations and ultrasonography

All animals (n = 34) were examined for causes of infertility by visual inspection of the external genitalia and using ultrasound through the abdomen and rectum. Transabdominal and transrectal ultrasonography (Eickemeyer - Mindray, Hamburg, Germany) was used for inspection of the ovarian and uterine structures and contents. Transabdominal ultrasonography was performed by placing the curve linear probe with (5-6.5 MHz) on the right inguinal region of the goat. A contact gel was smeared at the area of examination to afford good contact with the skin. If required, the hair was clipped. A transrectal examination was carried out with the female standing position. After emptying the rectum, the probe was inserted near contact with the pelvic content. The urinary bladder was found first, while the uterus was located dorsal and cranial to the bladder. When the bladder surpassed, the probe had to be replaced laterally for both sides to explore the uterine horns and both ovaries [14].

Hormonal analysis

The blood sample was drawn from all goats (from fertile and infertile goats) using a sterile syringe (after controlling the animal) from the jugular vein (5 ml) and transferred directly to the test tube. Then, the blood samples were centrifuged at (3000 rpm) for 10 minutes to isolate serum and then collected in a tube and stored at -20 C for laboratory analysis. Hormonal analysis for progesterone, estradiol, and cortisol was estimated by the Enzyme-Linked Immune Sorbent Assay (ELISA) technique using a specific sheep kit (Yingxin Laboratory, China), according to the manufacturer's instructions.

Statistical analysis

SPSS version 25 was used to conduct the statistical analysis. A one-way ANOVA model was used to analyze the results of the hormonal study. Differences were compared by Tukey multiple comparison post hoc test. All data were represented as mean ± SEM, and the differences were considered significant at $p<0.05$.

3. Results

As the results; the ultrasonographical diagnosis revealed 21.42% of study animals have inactive ovaries, which showed ray iso-echoic small ovaries (0.9-1.1 cm) without structures and with a high echoic border (Figure 1), and the uterus became more echogenic (Figure 2). Moreover, 10.72% of study animals revealed luteal ovarian cysts, which showed dense theca tissue larger and more echoic than ovarian follicles (Figure 3). The results were confirmed in (Table 1).

Table 1. Infertility causes in infertile goats and features according to the ultrasonographical scanning

Infertility causes	No. (%)	Features
Endometritis	13 (46.43)	Dense and hyperechoic inflammatory fluid, with thick uterine lining
Inactive ovaries	6 (21.42)	Smooth gray iso-echoic small ovaries (0.9-1.1 cm), without structures with a high echoic border
Pyometra	4 (14.29)	Hypoechoic inflammatory fluid, the lining of the uterus was taking 0.3 cm
Luteal ovarian cyst	3 (10.72)	Follicle-like structure (1cm-1.1cm) that appears hyperechogenic with dense theca tissue more echoic than ovary
Other cases	2 (7.14)	without clear diagnostic causes
Total	28 (100)	

Figure 1. Sonogram of inactive ovaries: smooth gray iso echoic structure with a high echoic border due to the absence of follicles (5-6.5 MHz) curve linear transducer

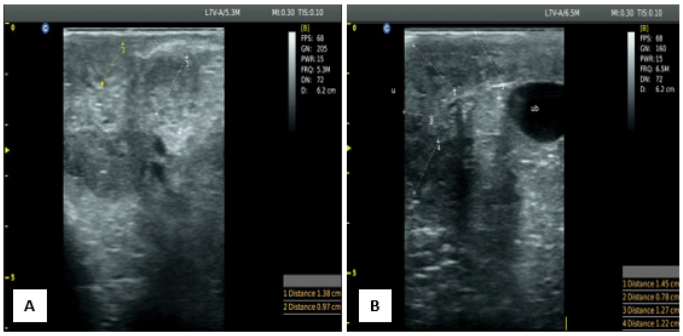

Figure 2. Sonogram of the uterus (A): uterine horns more echogenic than normal due to ovarian inactivity (B): uterus in a normal fertile goat with gray iso echoic and a high echoic border in the front urinary bladder (5-6.5) MHz curve linear transducer

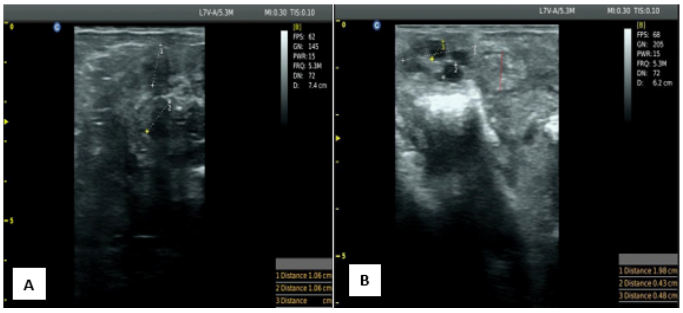

Figure 3. Sonogram of ovaries (A): luteal ovarian cystic with dense theca tissue (B): normal follicles in fertile goat with hypoechoic follicles (5-6.5 MHz) curve linear transducer

The ultrasonographical examination for infertile goats revealed that endometritis formed 46.43% of the total cases of infertility and appeared as a thickness in the uterine wall with inflammatory fluids that appeared higher echoic (Figure 4). In this study; pyometra reached 14.29% of the total infertile goats with an accumulation of hyperechoic purulent fluid and thickness in the uterine lining (Figure 5). Only two cases (7.14%) didn't show a clear lesion during ultrasonography examination.

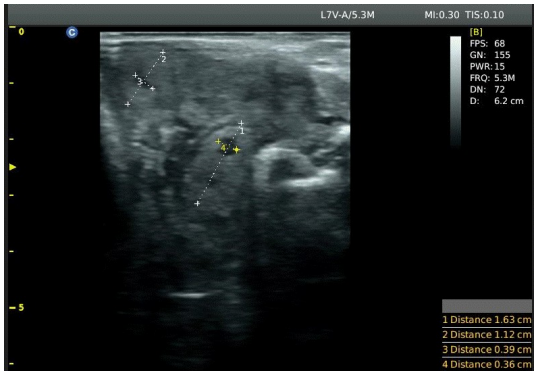

Figure 4. Sonogram of uterine horns in an infertile goat with endometritis shows uterine inflammatory turbid echogenic fluid that appears higher echoic than normal with uterine wall thickness (5-6.5 MHz) curve linear transducer

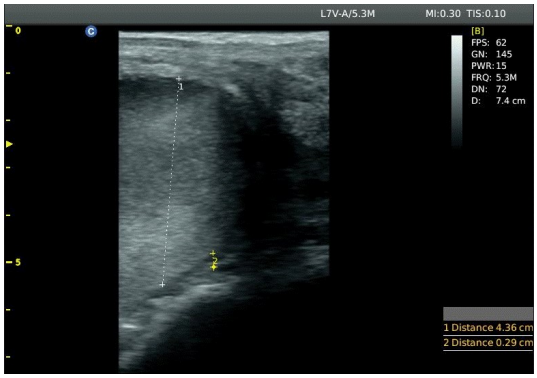

Figure 5. Sonogram of infertile goat uterus with turbid echogenic uterine inflammatory fluid, and uterine wall thickness (5-6.5MHz) curve linear transducer

Results of Hormonal analysis for infertile goats revealed a significant decrease in the estradiol levels at ($p<0.05$) in all cases of infertility compared to the control group, a significant increase in the progesterone level in case of luteal ovarian cysts (34.69±11.71 a), and a significant ($p<0.05$) increase in the levels of cortisol in all cases of infertility compared with the control group (Table 2).

Table 2. Hormones level for estrogen (pg/ml) progesterone (ng/ml), and cortisol (pg/ml) in infertile goats according to infertility causes

Infertility causes	No.	Progesterone	Estradiol	cortisol
Inactive ovaries	6	0.84±0.12 a	21.89±6.50 a	67.12±11.20 a
Lutea ovarian cyst	3	34.69±11.71 a	2.46±0.72 b	62.50±9.27 a
Endometritis	13	0.61±0.48 a	31.84±9.79 a	31.22±7.37 b
Pyometra	4	1.92±0.35 b	24.57±7.44 a	33.74±6.85 b
Normal features	2	0.87±0.38 a	61.72±10.52 b	33.84±4.40 b
Control	6	0.93±0.28 a	58.69±8.41 b	28.79± 4.42 b
Total	34			

Data are presented as (mean ± SEM), Different letters within each column indicate significant differences ($p<0.05$) among groups

4. Discussion

According to the current data, inactive ovaries refer to a condition where the ovaries are not functioning optimally, leading to anestrous [15]. Inactive ovaries may result from various factors, including hormonal imbalances, age-related changes, nutritional deficiencies, or certain diseases such as metritis, endometritis, and pyometra [5,15,18].

On the other hand, the ultrasound diagnosed luteal ovarian cysts in infertile goats, which seems as dense theca tissue on the ovary and appear more echoic than normal follicle. Luteal ovarian cysts are fluid-filled structures that form on the ovaries and can disrupt normal ovarian function. They are a common reproductive disorder in goats that causes anovulation, prolonged luteal phase, and subsequent estrus [16,17] and leads to irregular estrous cycles, anestrous, and infertility [17]. The combination of inactive ovaries and luteal ovarian cysts can severely impact goats' fertility, lead to absent estrous cycles, and reduce the frequency of opportunities for successful mating and conception [18].

In this study, the hormonal analysis confirmed the results of the ultrasound, which discovered a significant decrease in estradiol concentration in the case of inactive ovaries and a significant increase in progesterone levels in the case of luteal ovarian cyst which proves the efficiency of ultrasound in the diagnosis of infertility causes which came in agreement with many studies of different species [5,17,18].

One of the essential causes of infertility in animals is endometritis [16], the present study motionless the efficiency of ultrasonography for detecting endometritis in infertile goats that agreed with. The inflamed endometrium can create an unfavorable environment for embryo development and implantation and can lead to an imbalance in uterine secretions and a decrease in the ability of the uterus to support early pregnancy [19]. Endometritis can disrupt the goat's estrus cycle, leading to irregular estrous cycles or prolonged anestrus and delayed or missed opportunities for conception [20].

In addition to uterine inflammation, the ultrasonographical evaluation revealed 14.29% of pyometra from the causes of infertility and its efficiency for diagnosis of these cases, which is agreed with [21]. Pyometra typically occurs in non-pregnant females but can also be observed in goats after kidding. The accumulation of pus in the uterus creates an inhospitable environment for embryo implantation and pregnancy maintenance, leading to reduced fertility and reproductive losses [22].

Genital infections and hormonal disorders that affect the reproductive system, especially the uterus and ovaries can disrupt normal reproductive processes, making fertilization challenging [21,22]. Chronic pyometra can cause damage to the uterine tissues, leading to scarring and adhesions within the uterus, and may be accompanied by persistent corpus luteum in ewes. Hormonal analysis showed a significant increase in progesterone in the case of pyometra, which is usually accompanied by persistent corpus luteum and elevation of progesterone concentration like in cows and ewes [8].

The current study revealed that two cases of infertile goats (7.14%) showed no lesions by ultrasound and no significant differences in hormonal assay for progesterone, estradiol, and cortisol compared to the control group. These cases may be related to male infertility and didn't inseminate with fertile males during the

breeding season.

5. Conclusion

According to the data of these results, the reproductive system of goats is susceptible to infection and hormonal disorders that ultimately lead to infertility and lack of production. The study concluded that endometritis, pyometra, and hormonal disturbances (inactive ovaries and luteal ovarian cysts) form the most important causes leading to infertility in Iraqi goats (Capra hircus). The study recommended the necessity of following the correct systems in managing and raising goats and conducting periodic examinations using various modern diagnostic methods to identify problems, diseases, and hormonal disorders that cause infertility to determine treatment and progress appropriate solutions early to avoid worsening the condition and not responding to treatment.

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