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Hormonal Levels Associated with Dystocia Due to Failure of Cervical Dilation in Sheep and Goats

Hussein A. Khamees[1], Sulake F.Al-Zubaidi[2] and Khawla A. Hussain [3*]

[1] Department of Surgery and Theriogenology - College of Veterinary Medicine-University of Al-Muthanna, Al-Muthanna. Iraq.
[2] Surgery and Obstetrics Department, College of Veterinary Medicine, Al-Qasim Green University, Babylon 51013, Iraq.
[3] Department of Surgery and Obstetrics - College of Veterinary Medicine-University of Baghdad, Baghdad, Iraq.

Abstract

THE STUDY was designed to identify hormonal levels associated with dystocia due to cervical failure dilation in sheep and goats. Animals were divided into 4 groups: ewes: group 1 (study): 6 ewes suffering dystocia (failure cervical dilation), group 2 (control): 6 ewes with normal parturition. Goats: group 1 (study): 6 goats suffering dystocia (failure dilation), Group 2 (control): 6 goats with normal parturition in AL-Muthanna Governorate in 2023. Blood samples at two times: 1st time during the last period of pregnancy, 2nd time during the 1st stage of parturition. The study showed a decrease in the progesterone level (0.5±126 ng/ml) in ewes, (1.7±0.16 ng/ml) in goats (at $p < 0.5$) of the control groups in the 1st stage of labor, compared with the study groups (no decrease) in the progesterone level (2.11±117 ng/ml) in ewes, (2.13±0.10 ng/ml) in goats (at $p < 0.5$), during the 1st stage of labor. The study showed a rise in the estrogen level (15.00±1.84 pg/ml) in ewes, (26.18±3.8 pg/ml) in goats (at $p < 0.5$) of control group in the 1st stage of labor, compared with the study group (no rise) in the estrogen level (3.95±0.32 pg/ml) in ewes, (7.81±1.00 pg/ml) in goats (at $p < 0.5$) during the 1st stage of labor. The study concluded that the concentration of progesterone and estrogen during the last days of pregnancy and 1st stage of labor plays a major role in cervix dilation and parturition in sheep and goats, so any defect causes a failure in the dilation and lead to dystocia.

Keywords: Estrogen, Progesterone, Cervical dilation, Parturition, Sheep, Goats.

Introduction

The parturition is the delivery of completely grown fetus, and it occurs when the gestation period normally reaches its end. During the parturition, the uterus begins to contract, and the cervix relaxed in a soft manner. Hence, the cervix would allow the fetus to pass along the uterus through the birth canal. As a result the labor process occurs. The latter is specified by a prominent change in the myometrial activity/contractility. In other words, myometrial contractility alters from long and weak contractures to short and strong contractions. Thus, the uterine cervix effaces and dilates [1].

From above, it is clear that parturition and the early lactation stages represent a stressful and susceptible periods through the life-cycle of the dams. Such susceptibility emerges from the intense depletion of nutrients from the body due to the fetus, colostrum, and milk production. Where the need for energy and minerals for milk synthesis are increased [2]. These major symptoms varies from one animal to another as well as from one parturition to the next in the same animal. Therefore, such symptoms do not predicts the accurate parturition time of the animal, rather they indicate the expected parturition time. Because of this delicate parturition situation, it is advisable

*Corresponding author: Hussein A. Khamees, E-mail: hussinabbaskhamees@mu.edu.iq , Tel.: 0096407800031124
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that the clinicians must avoid the prediction of the parturition exact time [3]

The hormonal concentrations such as progesterone and estrogen during gestation and parturition in small ruminants have been reported [4]. The regulation of uterine activity during pregnancy including activation of inhibitors to the uterus, which remained in a hyphenating functional state during the activity of a number of putative inhibitors, namely relaxin, adrenomedullin, progesterone, etc. Although, the fetus dominates the gestation length, the mother restrictedly affects the birth time [5]. Moreover, progesterone levels reach a high concentration during pregnancy, while they decrease at the last month of gestation [6] The fetal pituitary adrenal axis is known to initiate the prepartum events by which signals to the placenta trigger the maternal hormonal changes that allow normal labor to proceed at least in the ruminants [7]. However, such role of the fetal and its indicatives for maternal changes are still ambiguous in dogs [8]. The uterus remains quiesurecent during pregnancy in most domestic animals by a combined action of luteal and/or placental progesterone and molecules like relaxin, nitric oxide, and prostacyclin [9]. This is transformed into an oscillatory organ with cervical relaxation near parturition. Many biochemical, hormonal, and molecular changes precede parturition. The universality of the fetal glucocorticoid surge [sudden rise in levels] before normal labor at term suggests that it may represent a fundamental signal common to all species [1].

Progesterone synthesis proceeded from pregnenolone in sheep placental preparations, but the adrenal contribution of precursors for placental progesterone production has not been reported [10,11]. According to the concept of the fetoplacental unit, placental estrogen synthesis in ewes results from placental hydrolysis and aromatization of androgen sulfates originating from the fetus [12]. Dehydro-epi-androsterone sulfate originating from the maternal adrenal gland also contributed significantly to placental estradiol and estrone production [13,14]. Lutein gestation, the ovarian contribution to the maternal plasma progesterone levels has been reported to be small in sheep [15,16].

Material and Methods

Animals

The study models are 24 animals [12 ewes and 12 goats] in AL-Muthanna Governorate in 2023, all the animals at the last period of gestation, and then parturition. The study animals were divided into 4 groups according to the species:

Ewes:

Group 1 [study]: 6 ewes suffering dystocia due to failure dilation of the cervix.

Group 2 [control]: 6 ewes with normal parturition [normal dilation of the cervix].

Goats:

Group 1[study]: 6 goats suffering dystocia due to failure dilation of the cervix.

Group 2 [control]: 6 goats with normal parturition [normal dilation of the cervix].

Samples collecting

Blood samples were collected from all the study animals using 2 periods [during the last period of gestation [135-145 days], and at the 1st stage of parturition]. Each blood sample was 5 ml, and it was obtained from the jugular venipuncture. Then, the blood was kept in tubes that inclose clot activator with separating gel. Next, we put the tubes in the centrifuge at 3000 rpm for 5 minutes. After that, we labeled and kept the resulted serum samples at -20° C. We accomplished the blood collection and separation Al-Mortada Laboratory for Medical Analysis and Hormones.

Laboratory analysis

Serum progesterone and estrogen concentrations were investigated using an Enzyme-Linked Immunosorbent assay [ELISA Reader Dona 3200] [USA].

Statistical analysis

We analyzed the data statistically using SPSS software, the version of 2018. We adopted the probability value of 0.05 to indicate the significance of the results. Finally, our results were illustrated as mean ± standard deviation.

Results

Our laboratory analysis of the control groups [1,3] showed that the progesterone [P_4] levels steadily increased to reach 2.6 ng/ml in ewes, and 2.4 *ng/ml* in goats at the last months of gestation. However, the progesterone [P4] levels descended to 0.6 ng/ml in ewes, and 1.9 ng/ml in goats at the first stage of parturition. Also, the study showed that estrogen [E_2] levels in ewes increased significantly to a maximum of 2.7 *pg/ml* during the last months of gestation, and reached 13.5 *pg/ml* during parturition. While in the goat's estrogen, level increased significantly and steadily to 6.23 *pg*/ml during the last month of gestation, and reached 28.5 *pg/ml* during parturition [**Table 1**]. The study also illustrated that groups 2 and 4 exhibited significant difference in concentration of the progesterone [P_4] in the serum concentration during the first stage of labor in the study groups compared with the control groups. The results showed a decrease in the serum progesterone level [0.5±126 *ng/ml*] in ewes, [1.7±0.16 *ng/ml*] in goats [at $p < 0.5$] of the control group in the first stage of labor [the birth was normal and a normal expansion of the cervix], compared with the animals of the treatment group, which showed no decrease in the level of progesterone [2.11±117 *ng/ml*] in ewes, [2.13±0.10 *ng/ml*] in goats [at $p < 0.5$], during the first stage of labor, which led to cervical dilatation failed in these animals.

Further, our research found a significant difference in estrogen [E_2] levels during the first stage of labor between the control group and the study group. Where the results showed that there was a rise in the level of estrogen [15.00±1.84 *pg/ml*] in ewes, [26.18±3.8 *pg/ml*] in goats [at $p < 0.5$] of the control group in the first stage of labour [the birth was normal and a normal expansion of the cervix], compared with the animals of the treatment group, which showed no rise in the level of estrogen [3.95±0.32 *pg/ml*] in ewes, [7.81±1.00 *pg/ml*] in goats [at $p < 0.5$] during the first stage of labor, which led to cervical dilatation failed in these animals [Table 2], [figure 1], [figure 2].

Discussion

According to the results of this study that is showed the concentration of the hormones progesterone and estrogen during the last days of pregnancy and in the first stage of labor plays a major role in the process of dilating the cervix and completing parturition in sheep and goats agree with [17]. Al-Watar and Hussein [18] illustrated a significant increment of the estrogen level from the 1st week to the 4th week over the postpartum period for all groups. The exogenous oxytocin has also exhibited a significant influence on the E2 concentrations. So, the results showed the serum progesterone levels steadily increased in ewes and goats at the last months of gestation and declined at the 1st stage of parturition, and the serum estrogen level in ewes and goats increased during the last months of gestation and parturition, agree with [19]. Liotta et al. [20] illustrated that estradiol concentrations in goats progressively enhance throughout the pregnancy, also agreement with [17] who indicated the significant decadence of P4 levels from week 1 to week 4 throughout the postpartum period. Also, level E2 reaches its maximum values at parturition, and consistently decreases on the following day [21].

Fodder provided to animals, especially during pregnancy, plays an important role in regulating metabolic activities, physiology, and hormonal balance in the animal, which contributes greatly to the completion of the pregnancy stage and the process of parturition naturally agree with [22] who emphasized that the physiological status of the animal is one of the important factors which affects the concentrations of blood indicators that are involved in the development of blood metabolic profiles which are used in assessing nutritional status and animal health, and agree with [21] which underlined that the maintenance of normal health and sustaining efficient production of livestock, it is necessary to ensure adequate dietary intake of essential nutrients.

In sheep, nutrient quality and quantity directly affect the high demand for reproductive functions such as expression of estrus; embryo implantation, parturition, and lactation, as well as, its direct effect on animal health [23]. The study showed that there was a significant difference in progesterone concentration during the first stage of labor between the control group and the study group. The results showed a decrease in the serum progesterone level in ewes and goats in the first stage of labor, compared with the animals of the study group, which showed no decrease in the level of progesterone in ewes and goats during the first stage of labor, which led to cervical dilatation failed in these animals, agree with [24] which show the levels of progesterone hormone increased during 1st and 2nd months in ewes and goats, while the significant increased from 3rd month on.

The study showed that there was a rise in the serum estrogen level in ewes and goats of the control group in the first stage of labor, compared with the animals of the study group, which showed no rise in the level of estrogen in ewes and goats during the first stage of labor, which led to cervical dilatation failed in these animals, agree with [25] who confirmed that the estrogen reaches maximum concentrations during the last month in goats which is higher about 11 times than that of ewes. Placental progesterone production becomes important between 7 and 9 weeks, and the placenta is the dominant source of progesterone thereafter. Estrogen: the placenta is the primary source of estrogen biosynthesis during pregnancy. Estrogens do not themselves cause myometrial contractions, and maternal administration of estradiol for goats from 130 days of gestation does not affect the length of pregnancy [25].

Instead, estrogens act by up-regulating myometrial gap junctions and uterotonic receptors [including L-type calcium channels and oxytocin receptors], thereby enhancing the capacity of the myometrium to generate contractions [26]. The results of this study agreed with [27] that the concentration of estrogen and progesterone increases gradually among the different pregnancy months and is observed as the pregnancy progresses. Progesterone withdrawal, in the absence of any subsequent rise in circulating estrogen concentration, is a sufficient stimulus to induce cervical softening in the ewe. Cervical softening following progesterone withdrawal can be prevented by inhibition of prostaglandin synthesis [28].

This study proved that hormones play an important role in the process of relaxing and opening the cervix during parturition and cause dystocia, in agreement with [26] that showed the failure of the cervix to dilate at parturition may be caused by failure of secretion of the hormones that control labor or of the tissue response to hormonal secretions. Failure of the cervix to dilate also called [Ring-womb] leads to sporadic dystocia in ewes and is associated with a significantly higher lambing percentage. The condition has been reported to be responsible for 15 – 32% of cases of ovine dystocia.

Conclusions

The study concluded that the concentration of the progesterone and estrogen during the last days of pregnancy and in the first stage of labor plays a major role in the process of dilating the cervix and completing parturition in sheep and goats. As the concentration of the progesterone level must decrease, and in return, the level of estrogen increases, any defect in this process causes a failure in the dilation of the cervix, and thus the occurrence of dystocia, which causes great economic losses.

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Funding statement

Self-funding

TABLE 1. Hormones levels during the last gestation period and 1st stage of parturition in ewes and goats, where Group 1 represents the study group with failure cervical dilation and Group 2 stands for the control group with normal dilation.

EWES														
Group 1	**Progesterone level ng/ml**						**R**	**Estrogen level pg/ml**						**R**
Last of gestation	2.7	2.1	2.3	2.8	2.4	2.6	2.4	2.5	3.0	3.1	2.5	2.4	2.3	2.6
At the parturition	2.3	2.0	2.0	2.1	2.2	2.1	2.1	3.4	3.9	4.3	3.8	4.1	4.2	3.9
Group 2														
Last of gestation	2.6	2.7	2.6	2.8	2.5	2.5	2.6	2.7	2.8	2.7	2.9	2.7	2.5	2.8
At the parturition	0.6	0.5	0.4	0.6	0.3	0.6	0.5	14.5	16.1	12.5	17.8	15.3	13.8	15
GOATS														
Group 1	**Progesterone level *ng*/ml**						**R**	**Estrogen level *pg*/ml**						**R**
Last of gestation	2.4	2.6	2.3	2.8	2.1	2.2	2.4	6.1	6.12	6.11	5.9	5.8	7.1	6.1
At the parturition	2.1	2.2	2.0	2.3	2.1	2.1	2.1	6.9	6.9	7.11	6.3	8.1	8.6	7.3
Group 2														
Last of gestation	2.4	2.4	2.5	2.6	2.4	2.4	2.4	6.23	6.2	6.15	5.8	6.1	6.3	6.13
At the parturition	1.9	1.7	1.9	1.9	1.5	1.8	1.7	20.5	23.12	25.5	28.8	30.3	28.9	20.5

TABLE 2. Comparison between the progesterone and estrogen Means ± SD serum levels during the 1st stage of parturition in ewes and goats

	Parameter	Control [N=6]	Study [N=6]	Test value
EWES	**Progesterone**	0.5 ±126	2.11 ±117	22.9912
	Estrogen	15.00 ±1.84	3.95 ±0.32	14.4205
GOATS	**Progesterone**	1.7±0.16	2.13 ±0.10	4.4977
	Estrogen	26.18 ±3.8	7.81 ±1.00	11.3625

A highly significant [HS] difference between the two groups was measured at P-value <0.0001 and degree of freedom [df] equals to 10.

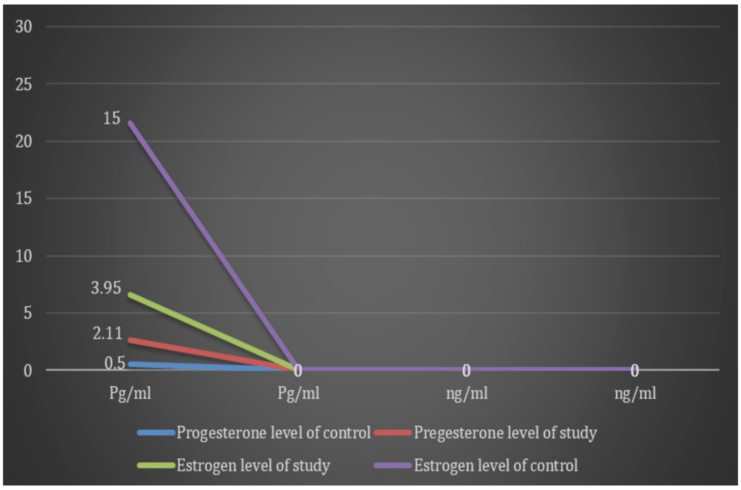

Fig. 1. Progesterone and Estrogen level during the first stage of parturition in ewe [normal and failure cervical dilation

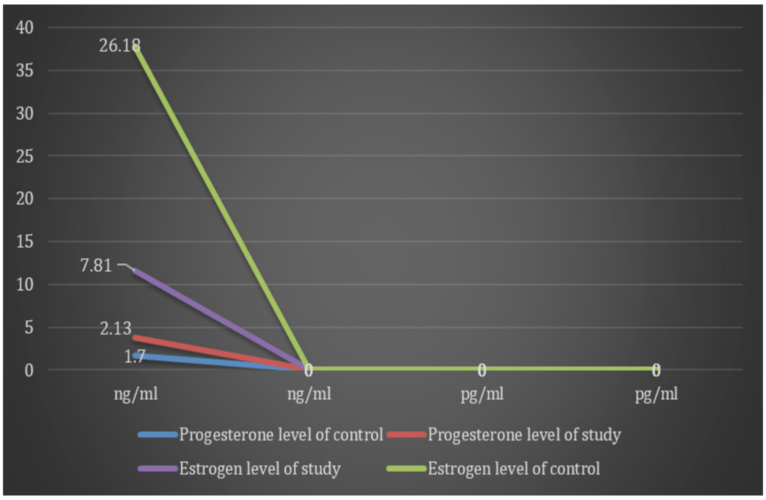

Fig. 2. Progesterone and Estrogen level during the first stage of parturition in goats [normal and failure cervical dilation

Conflict of interest

Authors declare no conflict of interest.

Author contribution

All authors equally contributed to the conception, data discussion and manuscript preparation.

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المستوى الهرموني وعلاقته بعسر الولادة الناتج من فشل توسع عنق الرحم في الأغنام والماعز

حسين عباس خميس*[1]، سليك فاضل عباس[2] و خولة عباس حسين[3]

[1] مدرس: فرع الجراحة والتوليد - كلية الطب البيطري - جامعة المثنى - المثنى - العراق.

[2] أستاذ مساعد فرع الجراحة والتوليد - كلية الطب البيطري - جامعة القاسم الخضراء ٥١٠١٣- بابل- العراق.

[3] أستاذ مساعد - فرع الجراحة والتوليد - كلية الطب البيطري- جامعة بغداد- بغداد - العراق.

الخلاصة

صممت الدراسة للتعرف على المستويات الهرمونية المصاحبة لعسر الولادة الناتج عن فشل اتساع عنق الرحم في الأغنام والماعز. تم تقسيم الحيوانات إلى أربعة مجاميع: النعاج: المجموعة ١ (دراسة): ٦ نعاج تعاني من عسر الولادة بسبب فشل توسع عنق الرحم، المجموعة ٢ (السيطرة): ٦ نعاج ذات ولادة طبيعية. الماعز: المجموعة ١ (دراسة): ٦ ماعز تعاني من عسر الولادة بسبب فشل توسع عنق الرحم، المجموعة ٢ (السيطرة): ٦ ماعز ذات ولادة طبيعية في محافظة المثنى في سنة ٢٠٢٣. جمعت عينات الدم خلال فترتين: الفترة الأولى خلال المرحلة الأخيرة من الحمل، والفترة الثانية خلال المرحلة الأولى من الولادة. أظهرت الدراسة انخفاضاً في مستوى هرمون البروجسترون (126±0.5 نانوجرام/مل) في النعاج، (1.7±0.16 نانوجرام/مل) في الماعز (عند ($p<0.5$) لمجموعات السيطرة في المرحلة الأولى من الولادة، مقارنة مع مجموعة السيطرة. مجموعات الدراسة لم يلاحظ انخفاض في مستوى البروجسترون (٢,١١ ± ١١٧ نانوجرام / مل) في النعاج، (٢,١٣ ± ٠,١٠ نانوجرام / مل) في الماعز (عند $P<0.5$)، خلال المرحلة الأولى من المخاض. أظهرت الدراسة ارتفاع مستوى هرمون الأستروجين (١٥,٠٠±١,٨٤ بيكوغرام/مل) في النعاج، (٢٦,١٨±٣,٨ بيكوغرام/مل) في الماعز (عند $p<0.5$) لمجموعة السيطرة في المرحلة الأولى من الولادة، مقارنة مع حيوانات مجموعة الدراسة. أظهرت الدراسة عدم وجود في مستوى هرمون الأستروجين (٣,٩٥ ± ٠,٣٢ بيكوغرام / مل) في النعاج، (٧,٨١ ± ١,٠٠ بيكوغرام / مل) في الماعز (عند $P<0.5$) خلال المرحلة الأولى من الولادة. وخلصت الدراسة إلى أن تركيز هرموني البروجسترون والأستروجين خلال الأيام الأخيرة من الحمل والمرحلة الأولى من الولادة يلعب دوراً كبيراً في توسع عنق الرحم والولادة في الأغنام والماعز، وأي خلل يؤدي إلى فشل التوسع ويؤدي إلى عسر الولادة.

الكلمات المفتاحية: الاستروجين،البروجسترون، توسع عنق الرحم، الولادة، الأغنام والماعز.