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Multicenter study of uterine tears and other reproductive complications in periparturient goats presented to veterinary teaching hospitals

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Abstract

Background: Goats are increasingly popular as both production animals and pets. The frequency of and factors associated with periparturient reproductive complications in goats are largely unreported.

Objectives: (1) To report the frequency of periparturient reproductive complications in does presented to university veterinary hospitals and (2) to identify factors associated with uterine tears in the study population.

Animals: A total of 198 periparturient does presented to 9 university veterinary hospitals from October 2021 to June 2022.

Methods: Multicenter, cross-sectional study, with data collected from questionnaires completed by attending veterinarians. Logistic regression was used to identify factors associated with diagnosis of uterine tears.

Results: Ninety-three (47%) does had at least 1 periparturient reproductive complication. Periparturient complications included retained fetal membranes (n = 38, 26%),

Abbreviations: BHB, β-hydroxybutyrate concentration; ID, identification; IQR, interquartile range; OR, odds ratio.

vaginal or perineal trauma (n = 33, 19%), uterine tears (n = 32, 18%), metritis (n = 22, 13%), uterine or vaginal hemorrhage (n = 8, 5%), Cesarean section complications (n = 8, 8%), and uterine prolapse (n = 1, 0.5%). A positive interaction effect was found between small breeds (Nigerian Dwarf and Pygmy) and manipulation on the farm by a layperson upon diagnosis of uterine tears (odd ratios [OR], 5.48; 95% confidence interval [CI], 1.41, 21.25; $P = .01$).

Conclusions and Clinical Importance: Periparturient reproductive complications were common. Small breed combined with manipulation on the farm by layperson was associated with diagnosis of uterine tears. Clients should be educated that in the event of dystocia, small breed does are at greater risk of uterine tears and prompt veterinary intervention is critical.

KEYWORDS
caprine, cesarean section, dystocia, theriogenology

1 | INTRODUCTION

Goats are becoming increasingly popular as sources of meat and milk, as well as gaining popularity as pets and show animals.[1] Consequently, there is increased demand for veterinary services, improved veterinary care, and improved survival rates. Because of this increased popularity, as well as a shortage of available ruminant veterinarians, goats often are presented to university veterinary hospitals for the treatment of periparturient conditions, such as pregnancy toxemia and dystocia.[2,3] The incidence of dystocia in small ruminants has been reported to range from 2.5% to 3.1%, although these rates were determined in small numbers of sheep and a recent incidence in goats has not been reported.[4,5] Despite the frequency of presentation of reproductive emergencies to university veterinary hospitals, little information is available regarding the frequency of and risk factors for periparturient reproductive complications in goats. The largest available studies evaluated 25 goats with dystocia and 56 goats with pregnancy toxemia.[6,7] In 1 study of small ruminants receiving Cesarean section to correct dystocia, 60% of the animals developed at least 1 complication, with retained fetal membranes being most common.[7] In that study, 6 animals were diagnosed with uterine tears. In another study of goats with pregnancy toxemia, 37% of does developed reproductive complications consisting of retained fetal membranes, metritis, or both.[6] Although these studies provided valuable information regarding risk factors for dystocia and pregnancy toxemia, the focus was not on development of complications. Larger multicenter prospective studies are required to evaluate the incidence and risk factors of other periparturient conditions in goats.

Dystocia in goats can lead to secondary reproductive complications, such as uterine tears, prolapse, periparturient hemorrhage, retained fetal membranes, and metritis.[8,9] The prevalence of these reproductive complications in goats is unknown. In particular, uterine tears are often a fatal complication of dystocia and minimal information is available regarding risk factors for uterine tears in goats. Identifying risk factors for this condition is an important step toward prevention of a life-threatening complication. Therefore, our primary objective was to describe the admission characteristics of pregnant does presented to university veterinary hospitals and to report the frequency of periparturient reproductive complications (uterine tear, uterine prolapse, periparturient hemorrhage, retained fetal membranes, metritis, and vaginal or perineal trauma). A secondary objective was to identify factors associated with uterine tears in periparturient does.

2 | MATERIALS AND METHODS

2.1 | Study design

The investigation was designed as a multicenter, cross-sectional study. Nine university veterinary hospitals (Auburn University Vaughan Large Animal Teaching Hospital, UC Davis Veterinary Medical Teaching Hospital, University of Florida Large Animal Hospital, Iowa State University Lloyd Veterinary Medical Center, Louisiana State University Veterinary Teaching Hospital, Michigan State University Veterinary Medical Center, University of Pennsylvania New Bolton Center, University of Tennessee Charles and Julie Wharton Large Animal Hospital, and Texas A&M University Veterinary Medical Teaching Hospital) in the United States participated in data collection. Periparturient does that delivered kids in hospital from October 1, 2021 to June 30, 2022 were included; delivery was categorized as dystocia, Cesarean section, fetotomy, or unassisted kidding. Reproductive complication outcomes of interest were retained fetal membranes, uterine tears, vaginal or perineal trauma, metritis, Cesarean section complications, uterine or vaginal hemorrhage, uterine or vaginal prolapse, and perinatal mortality. The study was approved by the University of Florida Institutional Animal Care and Use Committee (IACUC 202111491).

2.2 | Data collection

For each study doe, the following data were collected by an attending hospital veterinarian using a structured questionnaire: Hospital identification (ID; (anonymized to hospital A to I for analysis), animal ID, age (years), body weight (kg), breed, breed of buck, parity (primiparous, multiparous, unknown), history of vaginal manipulation on farm by layperson (yes, no), estimated duration of labor before hospital admission (hours), admission time (daytime, after hours), pregnancy toxemia diagnosis (yes, no), kidding difficulty score (1–4),[10] dystocia (yes, no), reason for dystocia, in-hospital vaginal palpation (yes, no), who performed vaginal palpation (faculty, resident, student), Cesarean section (yes, no), total number of kids (live and dead) delivered, number of live kids delivered, total days of hospitalization, total hospital bill (US dollars). For each variable, only goats for which a response was provided were included in counts for that variable. Questionnaires were provided as hard copy and fillable PDF format. Data was collected until hospital discharge, but no follow-up beyond hospital discharge was performed.

2.3 | Definitions

Pregnancy toxemia was defined as the presence of ketonemia (blood β-hydroxybutyrate concentration [BHB] ≥1.2 mg/dL), ketonuria (presence of ketones in urine), or both in periparturient does.[6,11] Kidding difficulty score was adapted from cattle and was graded on a scale of 1 to 4 (1 = unassisted, 2 = easy pull by 1 person, no mechanical assistance, 3 = difficult pull by ≥2 people, or mechanical assistance [head snare, ropes], 4 = Cesarean section or fetotomy).[10] Dystocia was defined as a kidding difficulty score ≥3, >30 minutes elapsed between kids, no progress after 2 hours in stage II of labor, or some combination of these. Fetal membranes were defined as retained if present >12 hours postpartum. Vaginal hemorrhage, uterine hemorrhage, metritis, uterine prolapse, and vaginal prolapse were diagnosed by the clinician upon presentation or during hospitalization. Uterine tears were diagnosed based on vaginal palpation, at surgery, or at necropsy. Small serosal tears associated with surgical manipulation of the uterus were not designated as uterine tears. Perinatal mortality was defined as death of a full-term kid shortly before, during, or up to 48 hours after birth, including euthanasia.[12] Survival of the doe was defined as survival to hospital discharge. Small breed was defined as Nigerian Dwarf and Pygmy breeds, or mixed breeds containing 1 of these 2 breeds and weighing <30 kg, whereas large breed was defined as Boer, Nubian, and all other breeds.

2.4 | Statistical analysis

Statistical analysis was performed using standard statistical software (Stata 17.0BE, StataCorp, State College, Texas). Descriptive statistics were used to report doe characteristics on admission (age, weight, parity, pregnancy toxemia diagnosis, duration of labor before admission, kidding difficulty score, hospitalization days) and to report the frequency and percentage of reproductive complications (eg, uterine tear, uterine prolapse, periparturient hemorrhage, retained fetal membranes, metritis, and vaginal or perineal trauma). For categorical variables, data were reported as observed frequency and percentage. For continuous variables, data were assessed for normality using the Shapiro-Wilk test and visual inspection of histograms and QQ plots. Descriptive statistics were reported as median (interquartile range). Survival frequencies between does with and without a particular complication were assessed using Chi-squared tests.

Logistic regression was used to identify investigated exposure factors associated with diagnosis of uterine tears in study does. Exposure factors included: admission time (day time, after hours), breed (small, large), buck breed, parity (primiparous, multiparous), layperson manipulation on the farm (yes, no), in-hospital vaginal palpation (yes, no), vaginal palpation by whom (resident, faculty, student), dystocia (yes, no), Cesarean section complication (yes, no), total number of kids delivered (0-1, 2-6), number of live kids delivered (0-1, 2-5), hospital (A to I). Exposure factors retained in final models were examined for confounding by adding each of the variables to the model, and assessing the changes in the odds ratios (OR; ≥20%) of the remaining variables in the model. The observed and expected combined effect of breed size (small, large) and manipulation on the farm by layperson (yes, no) was calculated as follows: observed OR for manipulation on farm by layperson + OR for small breed − 1 (additive model) or observed OR for manipulation on farm by layperson × OR for small breed (multiplicative model).[13] Odds ratios and 95% confidence intervals (CI) were calculated to measure the magnitude of association between investigated exposure factors and a diagnosis of uterine tears. Values of $P < .05$ were considered significant.

3 | RESULTS

3.1 | Animals

One hundred ninety-eight does were included in the study. Median age was 3 years (interquartile range [IQR], 2-5 years). Median body weight was 37 kg (IQR, 26-61 kg). Doe breeds included Nigerian Dwarf (n = 75, 38%), Boer (n = 31, 16%), Pygmy (n = 32, 16%), and other (n = 60, 30%; Table 1). A complete list of doe breeds is included in Table S1. Does were bred to Nigerian Dwarf sires (n = 53, 27%), Boer sires (n = 33, 17%), Pygmy sires (n = 22, 11%), and unknown breed (n = 89, 45%). Twenty-eight does were diagnosed with pregnancy toxemia (median BHB, 4.45 mmol/L; IQR, 2.9-5.4) and 25 of the 28 does with pregnancy toxemia had labor induced. Additional doe characteristics are shown in Table 1.

Eighty-two (41%) does had vaginal manipulation performed on the farm before admission; 71 of these (87%) were manipulated by a layperson on the farm. Before admission, 159/188 (85%) does did not deliver any kids on the farm, 20 (11%) does delivered 1 kid, 7 does delivered 2 kids, 1 doe delivered 3 kids, and 1 doe delivered 4 kids.

TABLE 1 Characteristics of study does by breed.

Variable	All, n = 198	Boer, n = 31	Nigerian Dwarf, n = 75	Pygmy, n = 32	Other, n = 60
Age (years)	3 (2, 5)	4 (2, 4)	3 (2, 5)	2 (1, 3)	3 (2, 5)
Body weight (kg)	37 (26, 61)	68 (57, 84)	34 (22, 40)	23 (18, 31)	60 (42, 78)
Parity					
Primiparous	81 (41)	11 (35)	34 (45)	20 (62)	16 (27)
Multiparous	83 (42)	12 (39)	36 (48)	5 (16)	30 (50)
Unknown	34 (17)	8(26)	5 (7)	7 (22)	14 (23)
Pregnancy toxemia	28 (14)	10 (32)	7 (9)	0	11 (18)
Duration of labor prior to hospital admission	3 (1, 10)	2 (0, 10)	3.5 (1.25, 12)	5 (2, 8)	3 (0, 7)
Kidding difficulty score					
1	7 (4)	4 (13)	1 (1)	0	2 (3)
2	36 (18)	7 (23)	9 (12)	4 (13)	16 (27)
3	31 (16)	4 (13)	15 (20)	2 (6)	10 (17)
4	120 (61)	15 (48)	49 (65)	26 (81)	30 (50)
Hospitalization days	1 (0, 3)	1 (0, 3)	1 (0, 2)	1.5 (1, 2)	2 (0, 3)

Note: Data are reported as median (first, third quartiles) or as observed frequencies N (%).

TABLE 2 Frequency of periparturient reproductive conditions in study goats.

Reproductive complication	Goats examined	Goats affected, *N* (%)	Survival to hospital discharge, *N* (%)
Retained fetal membranes	147	38 (26)	30 (79%)
Vaginal or perineal trauma	178	33 (19)	23 (70%)
Uterine tears	179	32 (18)	13 (41%)
Metritis	170	22 (13)	14 (64%)
C-section complications	100	8 (8)	3 (37%)
Uterine or vaginal hemorrhage	172	8 (5)	3 (37%)
Uterine prolapse	174	1 (< 1%)	1 (100%)
Perinatal mortality of at least 1 kid	183	97 (53)	70 (72%)

Median duration of labor before hospital admission was 3 hours (IQR, 0-10 hours). Of 186 goats with admission time reported, 110 (59%) were admitted during regular hours (6 AM to 6 PM) and 76 (41%) were admitted after hours (6 PM to 6 AM). One-hundred sixty-one of 198 (81%) does were reported to have dystocia based on hospital evaluation. Reasons for dystocia included fetal-maternal mismatch (n = 65, 40%), fetal malpositioning (n = 58, 36%), inadequate cervical dilatation (n = 16, 10%), other (n = 14, 9%), and unspecified (n = 8, 5%).

3.2 | Reproductive complications

Of the 164 (83%) goats that had vaginal palpation performed in the hospital, 69 (42%) resulted in successful vaginal delivery of all kids, 90 (55%) resulted in decision for Cesarean section, 4 does were euthanized, and 1 doe died after vaginal palpation but before Cesarean section could proceed. A Cesarean section was performed in 25 additional does without vaginal palpation performed before surgery because of the doe's unstable clinical condition or because history, initial evaluation, or both indicated that Cesarean section would result in better outcome for the doe, offspring, or both. Therefore, 115 does had Cesarean section performed.

Of the 198 goats, 93 (47%) had at least 1 periparturient reproductive complication: 57 had 1 complication, 27 had 2 complications, and 9 had ≥3 complications. Periparturient complications and survival are presented in Table 2. Uterine tears were diagnosed in 32/179 (18%) does. Reported Cesarean section complications included postoperative uterine rupture and hematoma at site of uterine compromise (n = 2; confirmed at necropsy), postanesthetic pneumonia (n = 1), and unspecified (n = 5).

3.3 | Factors associated with diagnosis of uterine tear

All goats with uterine tears (32) were reported to have dystocia and 30/32 had a kidding difficulty score ≥3 (8 had a score of 3, 22 had a

TABLE 3 Univariate logistic regression for diagnosis of uterine tears and investigated exposure factors in study does.

Variable	Category	Uterine tear, No (N = 147)	Uterine tear, Yes (N = 32)	OR	95% CI	P
Admission time	Day time	75	19	1.00	Referent	NA
	After hours	62	12	0.76	0.34, 1.70	.51
Doe breed	Boer	24	3	1.00	Referent	NA
	Nigerian Dwarf	55	15	2.18	0.58, 8.20	.25
	Pygmy	22	9	3.27	0.79, 13.59	.10
	Other	46	6	0.87	0.19, 3.91	.86
Doe breed size	Large breed	56	7	1.00	Referent	NA
	Small breed	82	24	2.34	0.95, 5.78	.06
Buck breed	Boer	26	3	1.00	Referent	NA
	Nigerian Dwarf	40	8	1.73	0.43, 7.03	.44
	Pygmy	16	5	2.71	0.58, 12.72	.21
	Unknown	65	15	2.00	0.54, 7.36	.30
Buck breed size	Large breed	26	3	1.00	Referent	NA
	Small breed	56	13	2.01	0.53, 7.67	.31
Parity	Primiparous	61	12	1.00	Referent	NA
	Multiparous	58	16	1.40	0.61, 3.22	.42
Manipulation on farm by layperson	No	89	12	1.00	Referent	NA
	Yes	49	17	2.57	1.14, 5.82	.02
Vaginal palpation (in-hospital)	No	22	4	1.00	Referent	NA
	Yes	125	28	1.23	0.39, 3.86	.72
In-hospital palpation: who?	Resident	58	15	1.00	Referent	NA
	Faculty	13	1	0.30	0.04, 2.46	.26
	Student	3	0	ND	ND	ND
	Resident + Faculty	23	3	0.50	0.13, 1.91	.31
	Resident + Student	10	4	1.55	0.43, 5.62	.51
	Faculty + Student	8	4	1.93	0.51, 7.29	.33
	Resident + Fac. + Stu.	8	1	0.48	0.06, 4.17	.51
Dystocia	No	25	0	1.00	Referent	NA
	Yes	122	32	ND	ND	ND
C-section	No	56	12	1.00	Referent	NA
	Yes	91	20	1.03	0.47, 2.26	.95
No. of total kids	0 to 1	66	17	1.00	Referent	NA
	2 to 6	81	14	0.67	0.31, 1.46	.32
No. of live kids	0 to 1	100	26	1.00	Referent	NA
	2 to 5	47	5	0.41	0.15, 1.12	.08
University Hospital	A	21	1	1.00	Referent	NA
	B	21	10	10.00	1.20, 83.57	.03
	C	15	2	2.80	0.24, 33.21	.41
	D	2	0	ND	ND	ND
	E	44	8	3.82	0.46, 31.91	.22
	F	12	1	1.75	0.10, 30.11	.70
	G	4	3	15.75	1.31, 189.24	.03
	H	13	5	8.08	0.86, 75.64	.07
	I	15	2	2.80	0.24, 33.21	.41

TABLE 4 Interaction effect between exposure to vaginal manipulation on farm by layperson in combination with small breed on diagnosis of uterine tears in study does.

Layperson manipulation	Small breed doe	N	Odds ratio	95% confidence interval	*P*
No	No	37	1.00	Referent	NA
No	Yes	66	1.36	0.34, 5.49	.67
Yes	No	32	1.04	0.19, 5.54	.96
Yes	Yes	39	5.48	1.41, 21.25	.01

Note: Area under the curve = 0.68 (0.59, 0.75).

score of 4, 2 were unreported). Median age was not different in does with uterine tears (4 years; IQR, 1-6) or without uterine tears (3 years; IQR, 2-5; $P = .4$). Uterine tears were reported in multiple sites within the uterus (8), the uterine body (6), unspecified region within 1 uterine horn (5), tip of uterine horn (2), and unspecified location (11).

Using logistic regression, in the univariable analysis, the variables manipulation on farm by layperson, breed, number of live kids born and university hospital had values of $P < .2$ (Table 3) and were further examined. The odds of uterine tear were 2.5 times higher in does exposed to manipulation on the farm by layperson, compared to those that were not (OR, 2.57; 95% CI, 1.14-5.82; $P = .02$; Table 3). Breed was correlated with number of live kids born ($P = .03$) and university hospital of delivery ($P < .001$). The frequency of does that had 2-5 live kids was highest in Boer does (14/31, 45%) and lowest in Pygmy does (5/32, 16%). The frequency of Pygmy does was highest in Hospital B (7/19, 37%) and Hospital I (5/15, 33%) and lowest in Hospital A (0/25) and Hospital H (0/20).

In the multivariable analysis, a positive interaction effect was observed between exposure to manipulation on farm by layperson in combination with small breed on diagnosis of uterine tear. The odds of uterine tear were 5.5 times higher in small breed does exposed to manipulation on the farm by a layperson, compared to large breed does that were not exposed to layperson manipulation (OR, 5.48; 95% CI, 1.41-21.25; $P = .01$; Table 4). This observed combined effect (OR, 5.48) was higher than the expected combined effect based on adding (OR, 1.40) or multiplying (OR, 1.41) absolute independent excesses associated with small breed or manipulation on farm by a layperson (ie, OR, $1.36 + 1.04 = 2.40 - 1.00 = 1.40$ or OR, $1.36 \times 1.04 = 1.41$).

3.4 | Outcome

Of the 198 goats, 156 (79%) survived to hospital discharge. Survival of does with each reproductive complication is shown in Table 2. Uterine prolapse and retained fetal membranes had no significant effect on survival ($P > .05$). Does with uterine tears were significantly less likely to survive than does without uterine tears (41% survival vs 87% survival; $P < .001$). Does with uterine or vaginal hemorrhage were significantly less likely to survive than does without hemorrhage (37% survival vs 87% survival; $P < .001$). Does with Cesarean section complications were significantly less likely to survive than does without complications (37% vs 88% survival; $P < .001$). Does with metritis were significantly less likely to survive than does without metritis (64% survival vs 87% survival; $P = .01$).

Based on the severity of uterine tears, 16 does were euthanized upon detection of the tear (9 euthanized intraoperatively, 7 euthanized based on admission vaginal palpation). One goat with a uterine tear died during surgery. Surgical correction of the uterine tear was performed in 10 goats and a subtotal hysterectomy (for a tear at the tip of the gravid horn) was performed in 1 goat. Ten of these goats (9 with surgical correction and 1 with subtotal hysterectomy) survived to hospital discharge. Four additional goats had no information provided regarding attempts at correction: 3 of these 4 survived to hospital discharge.

4 | DISCUSSION

Our multicenter cross-sectional study reports the frequency of various reproductive complications in periparturient does admitted to participating university veterinary hospitals. Periparturient reproductive complications were common in goats, with almost half of goats developing at least 1 complication. Uterine tear was a common complication, and layperson manipulation on the farm was associated with higher risk of uterine tear. In addition, we observed a positive interaction between exposure to manipulation on farm by a layperson in combination with small breed on the diagnosis of uterine tear in does.

In our study, 18% of does were diagnosed with uterine tears. A previous study found uterine tears in 6 of 110 (5%) small ruminants admitted for dystocia, a lower frequency compared to our study.[7] The majority of does in our study presented to university hospitals for dystocia and therefore it is likely the frequency of uterine tears in does without dystocia in the general caprine population is lower. Similarly, because our study included a larger proportion of small breed does, there was likely a higher frequency of uterine tears described than is expected in the general population. The high frequency of dystocia seen in our study likely reflects the biased population seen at university veterinary hospitals and does not reflect the actual incidence of dystocia in goats.

A positive interaction was observed between manipulation on the farm by a layperson with small breed in the diagnosis of uterine tears in study does. These findings could have important implications for clinical practice. This interaction is likely explained by the smaller

pelvic diameter of small breed does relative to kid size and human hand size. Additionally, number of kids born was associated with breed, with Pygmy does tending to have fewer kids than large breed does. It is possible that the combination of small pelvic diameter and larger, singleton kids increases the risk of uterine tear. It is also possible that small breed does might be more commonly kept as pets rather than production animals, and therefore the manipulation might have been performed by less experienced laypersons than might be the case in a production setting. Clients with small breed does may benefit from knowing that, in the event of dystocia, manipulation before veterinary intervention might increase the risk of potentially fatal complications such as uterine tears. The actual mechanism of uterine tears is not known in all cases, and in some cases manipulation before referral could lead to inflammation which might make the uterus friable and more likely to tear with further manipulation or strain. Client training about obstetrical management of small breed does may be warranted. In our study, some goats with uterine tears had no history of layperson manipulation, and some large breed goats also had uterine tears, suggesting that additional factors might be associated with development of uterine tears that were not fully explored in our study. Although uterine tears are more commonly seen after dystocia, and all goats with uterine tears in our study were reported to have dystocia, uterine tears also can occur spontaneously.[14] Finally, although not the focus of our study, vaginal palpation by persons of different experience levels (veterinary student, resident, faculty clinician) was not associated with uterine tears. Our findings emphasize the need for better understanding of treatment and prevention of periparturient reproductive complications in does.

The frequency of Cesarean section complications in goats in our study (8%) was lower compared to a study of Cesarean section in small ruminants, which found complications in 60% of animals.[7] The previous study included retained fetal membranes as a complication, whereas in our study this complication was considered separately. Even when combining the frequency of retained fetal membranes and Cesarean section complications in goats (31%), the frequency of all Cesarean section-related complications appears to be lower in our study than in the previous small ruminant study.[7] In that study, development of complications was associated with antimicrobial administration, with dams that did not receive antimicrobials more likely to develop complications.[7] The majority of animals with complications in our study received antimicrobials and therefore an effect of antimicrobial administration on complications was not evaluated. A recent study found improved kid survival when Cesarean sections were performed under sedation rather than general anesthesia, but having a dead fetus was not associated with development of complications in the doe in another study.[7,15] Parity, surgeon, increased uterine contractility, calf position, and adhesions were associated with complications in a study of cattle undergoing Cesarean sections.[16] Further investigation of factors associated with various complications in periparturient does should be pursued in the future.

Limitations of our study included challenges associated with a multicenter study. Because data was collected from multiple university veterinary hospitals from various regions of the United States, severity of cases and variations in caseload and clinical practice among institutions might have led to inconsistencies in comparisons between outcomes and factors of interest. Because our study involved only university veterinary hospitals, it is likely that it failed to enroll many goats with normal parturition that did not require referral. Therefore, our study does not represent the frequency of complications in the general goat population, but rather the frequency of these complications in goats presented to university veterinary hospitals. Nigerian Dwarf, Boer, and Pygmy goats were overrepresented in our study, and therefore our results should not be extrapolated to other breeds. Additionally, because the design of our study, animals that were discharged but subsequently developed complications could not be assessed, because our study did not collect data beyond hospital discharge. This design might have impacted the lower frequency of certain complications seen in our study. Additionally, although our study design was prospective in nature to attempt to minimize missing data, questionnaires were not always fully completed and therefore missing data contributed to loss of animal numbers for certain variables. However, despite these limitations, our results represent an initial step toward improved understanding of reproductive disorders in periparturient goats.

Our study suggests that client and veterinarian education regarding the increased risk of uterine tears in small breed goats, particularly small breed goats palpated before veterinary intervention, might be warranted. Additional research should be conducted evaluating the effects of these reproductive complications on both doe and kid survival, as well as future fertility and reproductive outcomes. Additionally, research evaluating non-hospitalized goats in a multi-year prospective study might allow improved evaluation of the incidence of complications and survival rates in the general goat population outside of the university hospital setting. Veterinary and client outreach, particularly targeting those who work with small breed goats, should emphasize the need for cautious obstetrical intervention in the event of dystocia to minimize the risk of potentially fatal uterine tears.

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CONFLICT OF INTEREST DECLARATION

Authors declare no conflict of interest.

OFF-LABEL ANTIMICROBIAL DECLARATION

Antimicrobials were administered to goats included in this study, but descriptions of which antimicrobials and how used are not included in this manuscript.

INSTITUTIONAL ANIMAL CARE AND USE COMMITTEE (IACUC) OR OTHER APPROVAL DECLARATION

Approved by the University of Florida IACUC (IACUC 202111491).

HUMAN ETHICS APPROVAL DECLARATION

Authors declare human ethics approval was not needed for this study.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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