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Causes and effects of retained fetal membranes after parturition on some reproductive parameters in Holstein Friesian cows

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Abstract: *The aim of this of this retrospective study was to investigate the causes and effects of retained fetal membranes (RFM) after parturition on postpartum first estrus and Days Open (DO) in subsequent lactation of Holstein Friesian cows. A total of 1731 calving from a research dairy farm were used. All RFM cases were defined as failure to expel fetal membranes within 12 hours after calving. During the period from January 2006 to December 2017 a percent of 93.58% of the calving were with normal placental expulsion, and 6.42%were with RFM. The major causes of RFMs were: parity of the cows, stillbirths at calving, calf sex at calving difficulty and Twinning calving. The associations of this causal factors with RFMs were analyzed by logistic regression. Overall the incidence of RFMs was 6.42%. The odds ratio (OR) for RFM cases was: 2.17 for primiparous cows, 1.79 for cows with male at calving, 6.3 for cows with stillbirths at calving, 6.67 for cows assisted at calving and 20.67 for cows with Twinning calvings. The RFMs influenced some of reproductive performance. Postpartum first estrus was longer with approximately 3 to15 days and DO with 25-33 days. Overall results suggest that appropriate control of causative factors of RFM must be found to reduce occurrence of RFM in a dairy farm*

I. INTRODUCTION

Dairy cows have a cotyledonary placenta, with the dam and fetus connected via many oval-shaped units called placentomes, which consist of the caruncle (maternal side) and the cotyledon (fetal side). The placentomes are covered in a single layer of trophoblastic cells, which is formed, predominantly by mononuclear cells and the presence of giant cells can be observed. Mononuclear cells have irregular shape, with round nucli and big nucleolus, and are projected from distal part of the crypts [1].

There are three stages in the parturition process: dilation of the cervix, delivery of the calf, and delivery of the placenta. Dilation of cervix may take days to complete. During this stage the cervix softens, pelvic ligaments relax and uterine muscular activity is quiet. A thick clear mucus may hang from the vagina.

At the end stage 1 uterine contraction begin, pushing the calf against the cervix, causing further dilation. Appearance of water bag trough the vulva signals the start of stage 2, and the calf should be delivered within 2 to 6 hours of the start of stage 2. Recent research showed that in heifers with normal calf presentation duration of stage 2 was within 1 hour and in cows with normal presentation was 22 minutes of the start of stage 2 [2]. This suggests that normal stage 2 of parturition should be defined as approximately 60 minutes for heifers and 30 minutes for adult cows.

Separation and expulsion of the fetal membranes occur in stage 3 of parturition. Theoretically, all cows that calve have retained fetal membranes (RFM). Greater than three fourths of cows, expel their fetal membranes by 6 hours and very few cows after 12 hours postpartum. In this period (12 hours postpartum) retention of fetal membranes is defined as Physiological Retention [3]. Detrimental effects on reproductive performance, milk production, postpartum disease, and culling rate were detected when duration of retention exceeded 12 hours [3]. In this period (after 12 hours) the retention is defined as Pathological Retention.

Pathological retention of fetal membranes after calving is a frequent complication in dairy cows, and increases the risk of uterine infections and infertility [4, 5].

The incidence of RFM varies in different herds, ranging from 1.3% to 39.2% [6]. Retained fetal membranes correlates with reduced uterine chemotaxis and immunity and potentially affects uterine involution [7].

The pathogenesis of RFM is still unclear, and there are four hypothesis to explain it: deregulation of uterine constructions, dysfunction of the chorionic villi, inflammatory stress, and immune disorders [8, 9, 10].

We hypothesized that parity of cows at calving, calf sex at calvings stillbirths, calving difficulty and twinning calvings are causal factors for RFM in Holstein dairy cows and can effect some reproductive parameters. The aim of this retrospective study was to investigate the causes and the effects of RFM on the postpartum first estrus and Days Open in subsequent lactation of Holstein Friesian cows.

II. Headings

This study was performed on the research dairy farm of Agricultural Research and Development station (ARDS) Șimnic-Craiova, Romania. The research dairy farm is located in the South-West region (182 m above sea level, 44°19’ N, 23°48’ E). The dairy herd was 280 Holstein Friesian cattle that belonged to a long and large genetic improvement program. The initial dairy cattle herd was imported from Denmark (1997, as Danish Black and White cattle). Today the most genes from the original Danish Black and White population have been replace by Holstein-Friesian genes.

The research has good cow and calf data records.

Nutritional and management strategies for dairy cattle are used to prepare the animals for lactation and to minimize the incidence of disease disorders after calving. Forage, a small amount of concentrates and a trace mineral salt constitutes the dry cow ration during dry period. Subsequently a close-up ration is fed which provides additional nutrients. All feed rations were calculated to provide recommended nutrients for dairy cows. All feeds consisting of corn silage, hay lage, chopped alfalfa, fodder beet and grains were produced locally.

All lactating cows were milked two times a day (05:00 AM and 17:00 PM) and were housed free in barns bedded with straw. Cows had ad libitum access to fresh water. At 3 weeks before due date cows were moved into the close-up pen. Where the farm worker and research personnel monitor the calving process.

The data were collected from the records kept by farm manager and veterinary records (past records from January 2006 to December 2017). After parturition all cows (n=1371) were divided into 2 categories: (1) cows with normal placental expulsion and (2) cows with RFMs. Also cows were grouped by number of parity (1st, 2nd, 3rd, and ≥ 4), and parity group (primiparous and multiparous). At calving cows were grouped by sex of newborn calf (female and male). Stillbirths were defined as death of fetus before or during calving of full term (≥ 260 days) or within 24 h after parturition. Calving difficulty score (CDS) was measured on five-point scale (1 easy to 5 extremely difficult), cows after parturition were divided in cows assisted at calving (4 and 5 points CDS) and unassisted (1, 2, 3 points CDS). The twinning calvings were taken into account.

After calving all cows were monitored for first estrus and Days Open.

Statistical analysis

A trend test using FREQ procedure was used to analyze increasing or decreasing trend regarding RFMs cases by parity number or by calving difficulty score. All data were entered into Microsoft excel computer program 2007. Stata version 14 was used to summarize the data. The association of parity group, calf sex, calving difficulty score, stillbirths and twinning calvings with RFMs was analyzed by logistic regression. Means values, standard deviation regarding postpartum first estrus or days open were calculated. The differences between the means were tested with Duncan's multiple rage test (DMRT).

III. Results

A total of 1371 calvings were used for the final analyze, and 93.58% of the calvings were with normal placental expulsion and 6.42 were with retained fetal membranes (RFM). RFM in this study was defined as failure to expel fetal membranes within 12 hours after calving. Normally, expulsion occurred within 6-8 hours after calf delivery. Causative factors of RFM identified in this study are presented in table 1.

An increase trend ($p<0.05$) in the cases of RFM (%) in the period from 2006 to 2017 was detected. A decreasing trend ($p\leq0.01$) of the RFM (%) in the same period was detected as parity increased from first to the ≥ 4th.

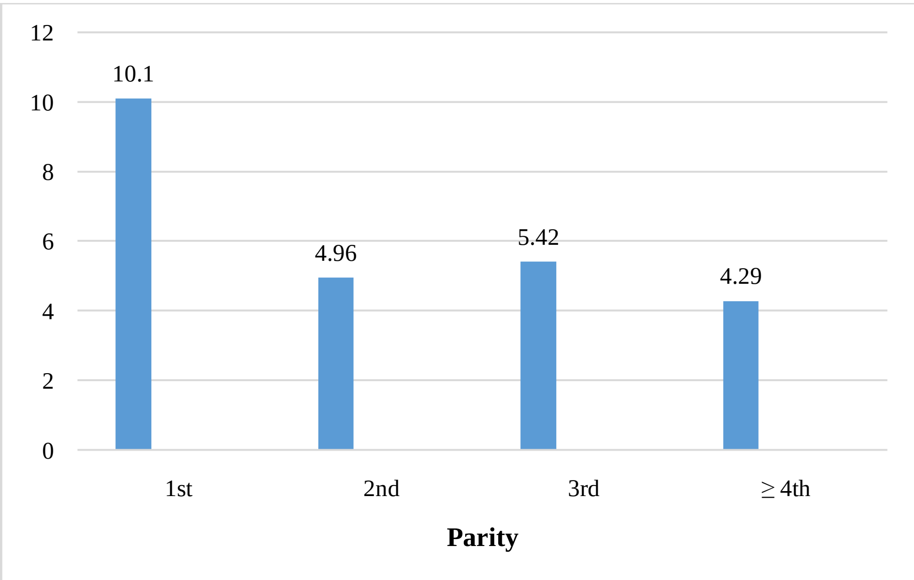

Figure 1. Retained fetal membranes (%) versus parity in Holstein Friesian cows.

The present of RFM cases in first, second, third and ≥ forth parity was 10.10, 4.96, 5.42 and 4.29 respectively (figure 1).

The incidence of RFM in primiparous cows ranged from 9.0 to 12.4%, and in primiparous cows from 3.80% to 12.4%.

A increasing trend ($p<0.01$) of the cases of RFM (%) in years 2006 to 2017 was detected as calving difficult score increased from 1 to ≥ 4 (figure 2). The percent of RFM cases in each calving difficulty score (1, 2, 3, and ≥ 4 was 4.5, 20.5, 25 and 50% respectively).

The percent of RFM cases in primiparous cows was 10.10 and for multiparous cows was 4.92% (table 1, table 2). The odds ratio (OR) for RFM cases was 2.17 times higher ($p<0.001$) for primiparous cows versus multiparous cows (table 2)

Table 1. Causative factor of RFM in Holstein Friesian cows.

	Cows (calvings)		Cows with RFM		Cows without RFM	
Variable:	n	%	**n**	**%**	**n**	**%**
1. Parity:						
first	396	28.9	40	10.10	356	89.90
second	484	35.3	24	4.96	460	95.04
third	258	18.8	14	5.43	244	94.57
forth or greater	233	17	10	4.29	223	95.71
incidence rate	1371	(100%)	88	6.42	1283	93.58
2. Parity group:						
primiparous	396	28.9	40	10.10	356	89.90
multiparous	975	71.1	48	4.92	927	95.08
3. Calf sex:						
female	681	49.67	32	4.70	649	95.30
male	690	50.33	56	8.11	634	91.89
4. Stillbirth:						
yes	68	4.96	18	26.47	50	73.53
no	1303	95.04	70	5.37	1233	94.63
5. Calving difficulty group:						
unassisted	1288	93.95	66	5.13	1222	94.87
assisted	83	6.05	22	26.51	61	73.49
6. Twins						
yes	38	2.08	20	52.63	18	47.37
no	1333	97.92	68	5.10	1265	94.90

RFM = retained fetal membranes

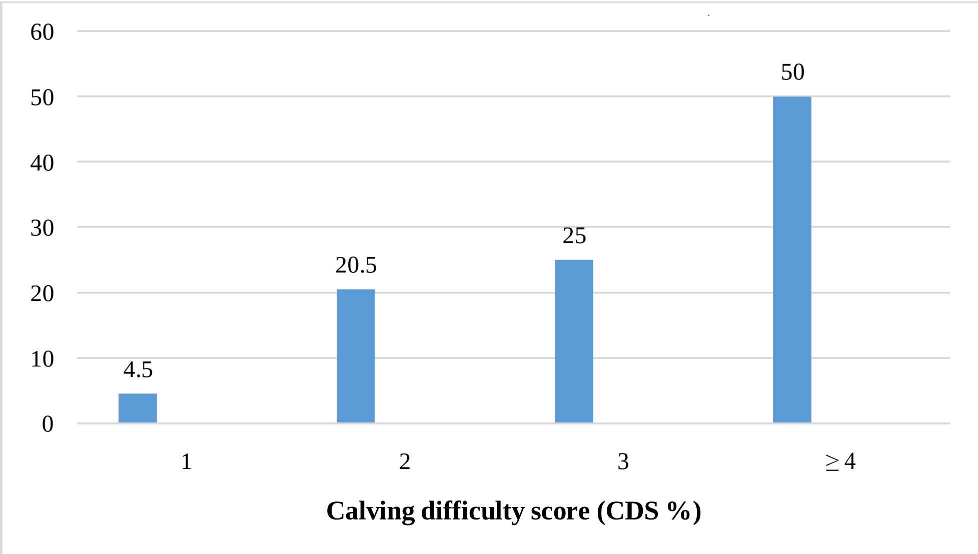

Figure 2. Retained fetal membranes cases (%) versus calving difficulty scores (1 to ≥ 4) in Holstein Friesian cows.

Table 2. Association of RFM cases with parity group, calf sex, stillbirth group, calving difficulty group and twins in Holstein Friesian cows.

Measure	RFM % (n/n)	OR	95% CI	p - value
1. Parity group:				

primiparous	10.10 (40/396)	2.17	1.4 – 3.36	0.000256
multiparous	4.92 (48/975)	1	Referent	
2. Calf sex:				
female	6.17 (32/681)	1	Referent	
male	6.67 (56/690)	1.79	1.145 – 2.804	0.00539
3. Stillbirth group:				
yes	26.47 (18/68)	6.3	3.5 – 11.4	0
no	5.37 (70/1303)	1	Referent	
4. Calving difficulty group:				
unassisted	5.12 (66/1288)	1	Referent	
assisted	26.50 (22/83)	6.67	3.86 – 11.5	0
5. Twinning calvings:				
yes	52.63 (20/38)	20.67	10.45 – 40.87	0
no	5.10 (68/1333)	1	Referent	

RFM = retained fetal membranes; OR = odd ratio; 95% CI = 95% confidence interval.

The OR for RFM cases was 1.79 for cows that give calving a male calf versus cows that give calving a female calf.

The OR for RFM cases was 6.3 for cows that give at calving a stillbirth versus cows that give at calving a live new born calf. This means that the odds of RFM were 85% lower for cows with live new born calf versus cows with stillbirth at calvings.

The OR for RFM cases was 6.67 for cows with assisted calvings versus cows with unassisted calvings, and 20.67 for cows with twinning calving versus single calving (table 2).

For the analysis of the effect of RFM on dam's reproductive performance a total of 1331 cows were enrolled.

Table 3. Effect of RFM on postpartum first estrus in Holstein Friesian cows.

Causative factors of RFM:		RFM (n)	Postpartum first estrus				
			Mean		Means difference		
			Days	±SD	Days	SE	Significant level
1. Parity group of cows:	primiparous	0	45.40	6.28			
		40	66.26	6.88	14.72	1.06	p<0.0001
	multiparous	0	48.26	6.22			
		48	60.12	6.96	11.86	0.93	p<0.0001
2. Calf sex at calving:	female	0	46.40	6.20			
		32	50.20	6.80	3.80	1.13	p = 0.0008
	male	0	47.48	5.08			
		56	55.80	5.21	8.32	0.71	p<0.0001
3. Stillbirth at calving:	yes	0	47.44	6.08			
		18	50.22	6.88	2.78	1.73	p = 0.113
	no	0	46.92	7.08			
		70	50.54	6.94	3.62	0.87	p<0.0001
4. Calving difficulty:	unassisted	0	46.80	6.62			
		66	55.20	6.88	8.40	0.84	p<0.0001
	assisted	0	49.62	7.08			
		22	59.88	7.08	10.26	1.76	p<0.0001
5. Twinning calvings:	yes	0	49.88	7.80			
		20	59.62	7.08	9.74	2.41	p = 0.0003
	no	0	49.06	7.09			

		68	58.96	7.14	9.40	0.88	p<0.0001

RFM = retained fetal membranes
SD = standard deviation
SE = standard error

Table 4. Effect of RFM on days open in Holstein Friesian cows.

Causative factors of RFM:		RFM (n)	Postpartum first estrus				
			Mean		Means difference		
			Days	±SD	Days	SE	Significant level
6. Parity group of cows:	primiparous	0	90.80	8.66			
		40	122.44	9.22	31.64	1.45	p<0.0001
	multiparous	0	88.78	8.86			
		48	120.68	9.08	31.90	1.29	p<0.0001
7. Calf sex at calving:	female	0	91.12	8.88			
		32	124.38	9.10	33.26	1.61	p<0.0001
	male	0	92.28	8.90			
		56	123.42	9.21	31.14	1.24	p<0.0001
8. Stillbirth at calving:	yes	0	88.66	9.10			
		18	118.28	9.33	29.62	2.52	p<0.0001
	no	0	89.20	8.72			
		70	119.38	9.10	30.18	1.26	p<0.0001
9. Calving difficulty:	unassisted	0	90.10	7.98			
		66	115.29	8.20	25.19	1.01	p<0.0001
	assisted	0	92.06	8.27			
		22	124.22	9.08	32.16	2.11	p<0.0001
10. Twinning calvings:	yes	0	92.26	8.38			
		20	119.88	8.88	27.62	2.81	p<0.0001
	no	0	89.78	8.70			
		68	119.26	9.20	29.48	1.09	p<0.0001

RFM = retained fetal membranes; SD = standard deviation; SE = standard error.

The relation of fetal membranes influenced some of the reproductive performance of Holstein Friesian cows (table 1 and 2).

Postpartum first estrus was longer with approximately 3 to 15 days and days open from calving to conception were also longer with 25 to 33 days (table 1 and 2).

IV. Discussion

We present in this study the incidence of RFM, causative factors, and their impact on some reproductive performance.

Number of RFM cases in the research herd of Holstein Friesian dairy cows increased in the period from 2006 to 2017 we consider that this unfavorable trend was as a result of intense use of semen from selected Holstein sires, which increased the proportion of Holstein genes in our cows.

Retained fetal membranes was significantly associated with parity of the cows. In primiparous cows the percent of RFMs was higher (10.10%) compared with multiparous cows (4.92%), and was not in accordance with some previous studies [11, 12, 13], which reported the incidence of RFM to increase with advancing parity. The genotype has significant effect ($p<0.05$) on RFMs. Kashoma and Ngou, 2021 [14] reported the highest premature (13.2%) in pure Friesian cows than in crossbreed cows. Similar trend was reported by Samad et al., 1989; Islam et al., 2013; Sarder et al., 2010, [15, 16, 17] in pure cattle than in Bos Indicus and Bos Taurus crosses.

In our study increased risk for RFMs was correlated with the assisted calvings, male sex at calving, stillbirth and twinning calvings.
All cows with those conditions suffer from circulatory disorders that impair normal fetal detachment, leading to RFMs.
The internal from calving to first estrus and to conception were longer in the cows with RFM than in cows with normal calvings, and this is consistent with other reports [18, 19, and 20].
The incidence of RFMs lead to economic losses and the prevention and treatment are of economic and welfare significance.

V. Conclusion

Based on our results the RFMs cases were higher for primiparous cows compared with multiparous cows.
The incidence of RFMS was highly correlated with twinning calvings, calving difficulty score, stillbirths and first parity in Holstein Friesian cows, and were defined as causative factors for RFMs. They negatively affected postpartum interval to first estrus, and calving to conception interval (days open) in Holstein Friesian cows.
The knowledge attained from this study can help farmers to manage cows at calving time to enhance the chance of having a live calf at calving and a health mother cow in the subsequent lactations..

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