Association of immediate postpartum plasma Ca concentration with early-lactation clinical diseases, culling, reproduction, and milk production

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Introduction

▪ Subclinical hypocalcemia (SCH) is a prevalent disorder associated with detrimental health- and productive-outcomes
▪ Despite recent research, no large-scale epidemiological study has been done to fully evaluate the associations of Ca concentration collected in the immediate postpartum with lactational responses

Objectives

Determine the association of plasma total Ca (tCa) concentration collected within 12 h of parturition with:

1) Health outcomes (RP, metritis, DA, and clinical mastitis)
2) Culling risk within 60 DIM
3) Pregnancy to first service
4) Milk production across the first 9 Dairy Herd Improvement Association (DHIA) tests

Materials & Methods

▪ Prospective cohort study in 5 dairy herds in NY State (Feb. to Nov. 2015)
▪ Inclusion criteria: primiparous and multiparous cows with a blood sample collected within 12 h of parturition
▪ Exclusion criteria: gestation length <260 d (n=37), animals that died or were sold within the first 2 DIM (n=5). **1,412 animals remained for the final analyses**
▪ Statistical analyses using SAS v. 9.4. Mixed modeling (herd as a random effect) Primiparous and multiparous (2nd, 3rd, and $\geq 4^{th}$) cows were stratified and modeled separately as a first approach for all outcomes. Primiparous and multiparous were modeled jointly if plasma tCa was found not to be associated with the outcomes of interest
  - Multivariable Poisson regression for binary outcomes
  - Repeated measures modeling for milk production
  - ROC analyses performed if plasma tCa was meaningful at P ≤0.05 in the final models, and dichotomized based on largest AUC

Conclusions

▪ For primiparous cows, tCa was not associated with any of the outcomes measured
▪ Multiparous cows with tCa ≤1.85 mmol/L had increased risk of DA
▪ Multiparous cows with tCa ≤1.95 mmol/L produced on average, 1.08 kg more milk per test day
▪ Multiparous cows with higher plasma tCa tended to have a higher culling risk

▪ **We caution researchers about attempts to classify SCH based on a single sample collected within 12 h of parturition, as lower plasma tCa was associated with higher milk production**

Results

Table 1. Plasma mean tCa concentration by farm and parity group, and average prepartum DCAD-levels during the study enrollment-period

	Primiparous		Multiparous		
Farm	n	Total Ca Mean (mmol/L)	n	Total Ca Mean (mmol/L)	Prepartum DCAD (mEq/100g DM)
A	57	2.27	140	2.08	-6.9
B	61	2.22	154	2.01	-2.8
C	100	2.29	240	2.02	-5.5
D	71	2.24	187	1.93	7.3; 14.1*
E	60	2.25	342	1.95	-2.8

*Herd D had a moderate diet modification during the study

Table 2. Outcome frequencies by parity group for the parameters of interest in the cohort of cows under study

Item	% Primiparous	% Multiparous
Retained placenta	6.0	9.2
Metritis	13.5	8.9
Displaced abomasum	0.3	3.7
Clinical mastitis	3.8	10.0
Culling	2.3	4.9
Pregnancy to 1st service	44.5	37.3

Table 3. Final Poisson regression model evaluating the association of plasma tCa concentration at parturition with the risk of multiparous cows being diagnosed with DA

Parameter	Estimate	SE	P-value	RR	95% CI
Parity (2nd, 3rd, or 4th and greater)	–	–	0.32	–	–
Uterine disease					
Healthy	Ref				
RP, metritis or both	0.92	0.34	0.008	2.51	1.29 to 4.94
[tCa] within 12 h of parturition					
>1.85 mmol/L	Ref				
≤1.85 mmol/L	1.04	0.37	0.006	2.82	1.35 to 5.87

Table 4. Final Poisson regression model evaluating the association of plasma tCa concentration at parturition with the risk of multiparous cows being culled within 60 DIM

Parameter	Estimate	SE	P-value
Clinical mastitis	1.27	0.3	<0.001
Parity group*			
3	0.98	0.42	0.02
≥4	1.42	0.42	<0.001
[tCa] within 12 h of parturition	1.21	0.65	0.06

*Reference category - Parity 2

Figure 1. Milk production for multiparous cows based on plasma tCa at parturition. Cows with tCa ≤1.95 mmol/L produced on average, 1.08 kg more milk per test day for the first 9 DHIA tests, compared to cows with tCa >1.95 mmol/L (P = 0.002). Variable categorization based on ROC analyses
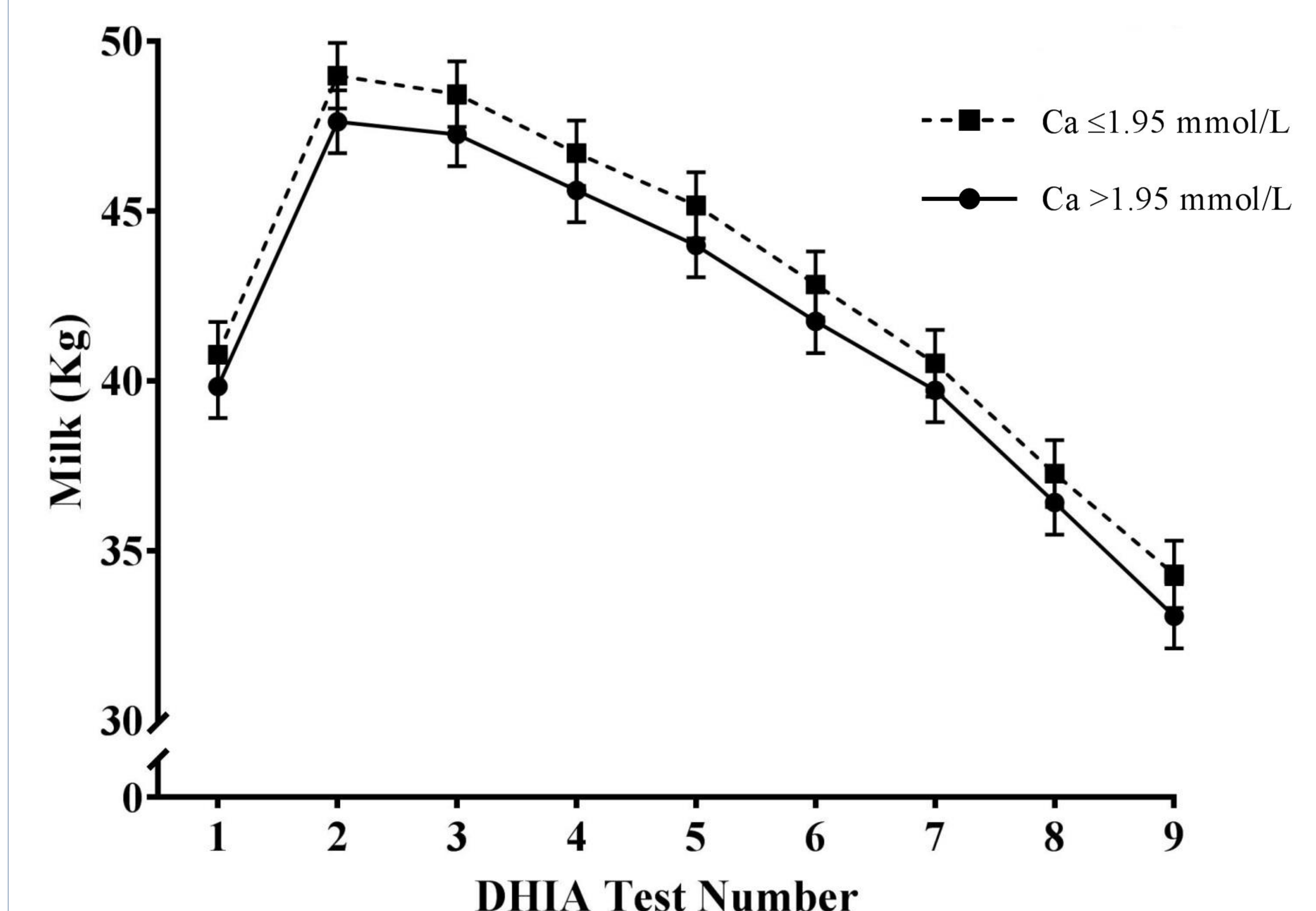
▪ **No association of immediate postpartum plasma tCa with:**
RP (P = 0.52) | metritis (P = 0.21) | clinical mastitis (P = 0.61)
Pregnancy to 1st service (P = 0.88)
▪ **No association of immediate postpartum plasma tCa in primiparous cows with:**
Culling risk (P = 0.45)
Milk production over 9 DHIA tests (P = 0.46)