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Effects of Removing Cows from Chronic Oxytocin use During Lactation

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Abstract

The objectives of this study were to investigate the effect of discontinuation of chronic oxytocin supplementation on lactating dairy cows and to determine if there was a difference between methods of discontinuation. The study was conducted on a commercial dairy in central New York milking over 1,200 cows, with more than 80 cows being supplemented with oxytocin prior to the start of the study. Seventy-seven cows receiving supplemental oxytocin were enrolled in the study and randomly assigned to one of four treatment groups: 1) abrupt discontinuation; 2) abrupt discontinuation with a needle stick at the normal time of oxytocin injection; 3) graduated decrease in oxytocin dose; and 4) a control group that was only monitored. Total milk weight, milk in the first two minutes, total milking time, and bimodality of milk flow were measured at every milking for 12 milkings before and after the initiation of the treatment protocol. Non-parametric paired analysis was used within treatment group before and after initiation of treatment, and non-paired analysis was used to analyze differences between treatment groups.

Other than the control group, all experimental groups showed a significant decrease in milk production per milking ($P<0.005$), ranging from 2.8-7.4 lb (1.3-3.4 kg) per milking per cow. None of the cows ceased lactating. There were no significant differences in milk produced in the first two minutes, total milking time, or the number of bimodal milk flows in any of the groups ($P>0.09$). No significant differences ($P>0.11$) in the change in milk production per milking or milk produced in the first two minutes were found between the group that underwent graduated discontinuation of oxytocin and the group abruptly removed from oxytocin supplementation without sham injection. These results show that dairy producers can stop supplementing cows with exogenous oxytocin in the parlor by either abrupt discontinuation or a weaning protocol with a loss of milk similar to that gained from oxytocin supplementation, and cows will not cease to lactate.

Key words: dairy, oxytocin, milk, withdrawal

Résumé

Les objectifs de cette étude étaient d'examiner l'effet de l'arrêt de la supplémentation chronique d'ocytocine chez les vaches laitières en lactation et de déterminer s'il existait des différences entre les méthodes d'arrêt. Cette étude a été menée dans une ferme laitière commerciale de 1200 vaches en traite du centre de New York où plus de 80 vaches recevaient une supplémentation d'ocytocine avant le début de l'étude. On a alloué au hasard 77 vaches recevant l'apport supplémentaire dans l'un des quatre traitements suivants: arrêt soudain, arrêt soudain avec piqûre d'aiguille au moment habituel de l'injection d'ocytocine, arrêt progressif de la dose d'ocytocine, et un groupe témoin seulement sous surveillance. On a mesuré le poids total du lait, la production de lait dans les deux premières minutes, la durée totale de la traite et la bimodalité du flux laitier à chaque traite lors de 12 traites avant et de 12 traites après le début du traitement. Une analyse non-paramétrique appariée a été utilisée pour examiner l'effet du temps dans chaque traitement et une analyse non-appariée a été utilisée pour analyser les différences entre traitements.

Il y avait une baisse significative de production de lait par traite ($P<0.005$), s'étalant de 2.8 à 7.4 lb (1.3-3.4 kg)/traite/vache, dans tous les groupes expérimentaux à l'exception du groupe témoin. Aucune des vaches n'a cessé de produire. Il n'y avait pas de différence significative au niveau de la production de lait lors des deux premières minutes, de la production totale de lait et de la fréquence des courbes bimodales du flux laitier entre les groupes ($P>0.09$). Il n'y avait pas de différence au niveau de la production de lait par traite ou de la production de lait lors des deux premières minutes entre le groupe qui bénéficiait d'un arrêt progressif d'ocytocine et le groupe avec arrêt soudain de la supplémentation sans piqûre. Les résultats de cette étude démontrent que les producteurs de lait peuvent arrêter la supplémentation d'ocytocine des vaches dans la salle de traite soit abruptement ou soit

progressivement avec une perte de lait proportionnelle au gain encouru par la supplémentation d'ocytocine. De plus, les vaches ne vont pas arrêter de produire du lait.

Introduction

Prior to teat end stimulation, less than 20% of milk is stored in the cistern where it is immediately available for removal from the udder.[2,11] Oxytocin, released from the neurohypophysis, is necessary for ejection of milk from the alveoli. Stimulation of the teat end causes afferent nerve impulses to travel from the teats, through the central nervous system to the paraventricular nuclei of the hypothalamus, which in turn stimulates release of oxytocin from the neurohypophysis into the circulatory system.[2,3,11] Upon reaching the mammary gland, oxytocin acts on myoepithelial cells causing them to contract and expel milk from the alveoli into the cisternal system.[11]

It is a relatively common practice on modern American dairy farms to administer oxytocin intramuscularly (IM) at the time of milking to cows that have poor or delayed milk let-down. This practice is sometimes perpetuated throughout a cow's lactation due to fear of a precipitous decrease in milk production or failing to let-down when exogenous oxytocin supplementation is discontinued. Oxytocin is approved by the US Food and Drug Administration to aid milk let-down, but not labeled for use to increase production.[6] If cows are administered oxytocin for poor let-down but the practice is continued for fear of production loss, this could be construed as extra-label use for production purposes, which is illegal.[7]

Fears that cows will drop precipitously in milk production or fail to let-down after discontinuation of chronic oxytocin supplementation may be unfounded. A drop in milk production would likely be expected, but overall milk loss should equate to the approximate 11.6% increase in total milk yield that oxytocin provides.[5] It has also been shown that removal of milk from the udder will drop somewhat after discontinuing chronic oxytocin treatment, but results were variable.[4] This effect was thought to result from reduced contractibility of myoepithelial cells at physiological oxytocin levels.[4] A similar study reported that cows will recover from removal of exogenous oxytocin, but results were not provided for this statement.[1]

Objectives of this study were to investigate the effect of discontinuation of chronic exogenous oxytocin supplementation on lactating dairy cows, and to determine whether there was a difference between methods of discontinuation.

Materials and Methods

Study farm

The study was conducted on a commercial dairy in central New York milking over 1,200 cows. More than 99% of the cows were Holsteins, and averaged approximately 90 lb (41 kg) of milk per cow per day. The parlor was a double 28 herringbone, and the cows were milked three times daily. Cows were prepared for milking in groups of five; they were first dipped with a commercial iodine dip using a foaming applicator, stripped, and then wiped with cloth towels before claw attachment. At the time of the study, over 80 cows were receiving 40 IU of exogenous oxytocin by IM injection in the parlor at each milking.

Treatment groups

There were four treatment groups: Group 1 - oxytocin supplementation (a commercially available suspension of 20 IU/ml) was abruptly discontinued at the start of the treatment period; Group 2 - supplementation was abruptly discontinued, but a sham injection (stuck with a needle) was given in the parlor; Group 3 - oxytocin was gradually withdrawn as follows: at the start of the treatment period the dose of oxytocin was reduced from 40 IU to 20 IU for four milkings, then further reduced to 10 IU for four milkings, and then supplementation was discontinued for the last four milkings; Group 4 - cows were administered oxytocin as per farm protocol (controls). Throughout the trial period, all oxytocin was administered by study personnel, and injections were given in the parlor shortly before claw attachment. Cows were identified by radio frequency identification collars which were read and displayed by parlor machinery. All other procedures in the parlor and the milking routine were kept constant and performed by the usual farm workers.

Enrollment

Based on availability, 77 of the cows already receiving exogenous oxytocin were chosen for the study. Cows were blocked by parity, days-in-milk, treatment, and randomly assigned to one of four treatment groups using a random number generator. There were 12 cows in Group 1, 16 cows in Group 2, 29 cows in Group 3, and 20 cows in Group 4. A disproportionate number of cows were enrolled in Group 3 because the herdsman would not allow any more cows into treatment groups where oxytocin usage was abruptly discontinued.

Data collection and record keeping

Cows were monitored for a total of 24 milkings, including 12 milkings before the treatment period and 12 milkings after initiation of treatment protocols. There was a milk-pump failure at the beginning of what would have been the eleventh pre-treatment milking, causing several hours of lost time. To allow milkers to compensate for data collection lost time, two milkings were skipped, and then two more pre-treatment milkings were recorded before initiating the treatment protocols.

Milk weight, milk in the first two minutes, total milking time, and bimodality were measured for each cow at each milking using a LactoCorder®.[a] These are cow-side continuous mass flow meters, the accuracy of which has been approved by the International Committee for Animal Recording.[8] After each milking, data was downloaded by study personnel into a commercially available spreadsheet.[b]

Statistical analysis

Each cow served as her own control; the 12 milkings recorded before the start of treatments were compared to the 12 milkings after treatments. Milk weight, milk in the first two minutes, and total milking time were analyzed within treatment groups by use of the Wilcoxon signed rank test, which was chosen because the data did not have normal distributions. Occurrence of bimodal milk flows within treatment groups was analyzed using McNemar's test. Total milk weight per milking and milk produced in the first two minutes of milking was compared between treatment groups using the Wilcoxon rank sum test.[9]

Results

Nine cows were removed from the study due either to culling, antibiotic treatment, or loss to followup. Of the lost cows, three were from Group 1, three from Group 2, two from Group 3, and one from Group 4. Of 1,605 total milking records, 292 were omitted because the LactoCorder® was set in wash mode, a problem attributed to operator error.

Cows in Groups 1-3 had a significant decrease ($P<0.005$) in milk production per milking after oxytocin treatment was discontinued, while cows in Group 4, the control group, did not. Milk production dropped by an average of 7.4, 2.8, and 3.5 lb (3.4, 1.3, and 1.6 kg) per milking per cow in Groups 1 through 3, respectively. Milk production for Group 4 only dropped by 0.5 lb (0.23 kg) per milking per cow ($P=0.47$; Table 1).

No significant differences ($P>0.08$) were found in the amount of milk produced in the first two minutes of milking between any of the treatment groups (Table 2). In addition, no significant differences in total milking time or number of bimodal milk flows were found for any group ($P>0.05$).

Treatment Groups 1 through 4 lost an average of 7.4, 2.8, 3.5, and 0.5 lb (3.4, 1.3, 1.6, and 0.2 kg) per milking per cow, respectively. When these losses were compared between groups, no differences were found between any of the treatment groups, but there was a significant difference ($P<0.05$) between treatment groups 1-3 and the control group (Table 3).

The average change in amount of milk produced in the first two minutes of milking for Groups 1 through 4 was -0.44, -0.90, 0.06, and -0.51 lb (-0.20, -0.41, 0.03, and -0.23 kg) per cow per milking, respectively. When compared between groups, the only significant difference

Table 1. Average change in total milk weight by milking and the results of the Wilcoxan Rank Sign Test by treatment group.

Treatment group	Average change/milking (lb)	*P*-value
1. Abrupt discontinuation of oxytocin supplementation	-7.4	0.004
2. Abrupt discontinuation with needle prick	-2.8	0.005
3. Graduated discontinuation	-3.5	<0.001
4. Control	-0.5	0.47

Table 2. Average change in milk produced in the first two minutes and the results of the Wilcoxan Rank Sign Test by treatment group.

Treatment group	Average change/milking (lb)	*P*-value
1. Abrupt discontinuation of oxytocin supplementation	-0.44	0.57
2. Abrupt discontinuation with needle prick	-0.90	0.13
3. Graduated discontinuation	0.06	0.46
4. Control	-0.51	0.08

($P<0.05$) was between Group 2, the cows which were abruptly removed from oxytocin supplementation but pricked with a needle, and Group 4 (control) (Table 4).

Discussion

In this study, the only detrimental effect of removing cows from exogenous oxytocin supplementation was decreased milk production. Milk produced in the first two minutes of milking, total milking time, and bimodal milk flow did not differ ($P>0.05$) between treatment groups. The decrease in production was similar to the increase in milk production (approximately 11.6%) resulting from chronic exogenous oxytocin supplementation.[5] The average decrease in milk production for cows in Group 1, the group where oxytocin supplementation was abruptly discontinued, was slightly greater than the amount of milk production typically gained from chronic exogenous oxytocin supplementation. This is likely the result of several cows that lost considerable milk production for the first three milkings after oxytocin usage was discontinued; these cows returned to more normal milk production after three milkings. If milk production in these cows had been followed for a longer period of time, we speculate that the average decrease in milk production would correlate more with the gain associated with oxytocin supplementation.

At first it may seem counterintuitive that discontinuing exogenous oxytocin supplementation would not cause a significant difference in milk produced in the first two minutes, total milking time, or cause an increase in the number of bimodal milk flows. We believe the reason for these results is related to the timing of the oxytocin injections. The injections were given on this farm immediately before or shortly before claw attachment. Intramuscular injections of oxytocin take a minute or more to increase blood concentration of oxytocin to the upper physiological level, where it will then stay for up to 25 minutes.[4] Normal endogenous oxytocin reaches its peak at around 1.5 minutes after first stimulation, with adequate levels reached at approximately one minute.[10] In this study, the lag times between exogenous and endogenous oxytocin affecting the mammary gland were likely similar. This could explain why there were no differences between groups for milking time, milk in the first two minutes, or bimodal milk flows.

The protocols for gradual or abrupt discontinuation of oxytocin supplementation in this study produced similar results. Thus, one could choose either method for discontinuation of oxytocin supplementation and expect a similar response.

Conclusions

Oxytocin is approved to aid milk let-down and is a good tool when used in this manner. However, it is not labeled for use to increase milk production and is thus illegal when used in this manner. Some dairy producers

Table 3. Results of the Wilcoxan rank sum test (P-values) for the comparison of the change in total milk produced per milking between groups.

Treatment group	1	2	3	4
1. Abrupt discontinuation of oxytocin supplementation	-	0.11	0.16	0.002
2. Abrupt discontinuation with needle prick	0.11	-	0.63	0.034
3. Graduated discontinuation	0.16	0.63	-	0.01
4. Control	0.002	0.034	0.01	-

Table 4. Results of the Wilcoxan rank sum test (P-values) for the comparison of the change in milk produced in the first two minutes between groups.

Treatment group	1	2	3	4
1. Abrupt discontinuation of oxytocin supplementation	-	0.39	0.45	0.23
2. Abrupt discontinuation with needle prick	0.39	-	0.06	0.015
3. Graduated discontinuation	0.45	0.06	-	0.59
4. Control	0.23	0.015	0.59	-

continue use of oxytocin beyond indications on the label because of fear that cows will cease to lactate. Results of this study demonstrated that abrupt discontinuation of oxytocin supplementation decreased milk production in a magnitude similar to the increase in milk production resulting from supplemental oxytocin, and cows did not cease lactating completely. The change in milk production did not differ between groups where oxytocin usage was abruptly halted. As a result, it is feasible to discontinue chronic oxytocin supplementation either abruptly, or using the graduated discontinuation protocol described in this paper.

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Endnotes

[a]LactoCorder®, WMB AG, Balgach, Switzerland

[b]Microsoft® Office Excel, Microsoft Corporation, Redmond, WA

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