Liner Slip and Mastitis

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Vacuum fluctuations in the milking machine have been associated with mastitis for many years (1, 8, 13). The classic survey of Nyhan and Cowig (2) first documented the relationship of low vacuum reserve and an increase in the bulk tank cell count. Studies by Theil et al (9) at NIRD (National Institute for Research in Dairying) further refined vacuum fluctuations and classified them as cyclic, irregular and fluid flow. The *combination* of cyclic and irregular were found to increase the new infection rate.

O'Callaghan and O'Shea (3, 7) in Ireland tried to repeat the work of NIRD but found, instead, that new infections were associated with liner slip. Studies which duplicate liner slip (5, 6, 11, 14) support the liner slip theory. It is evident that the vacuum fluctuations that occur during the liner slip are massive and at high speeds compared to the normal vacuum fluctuations of milking.

Studies by Thiel and Whittlestone (10, 12) show that endotoxins contained in impact droplets may directly penetrate the streak canal under extreme conditions. Direct penetration by bacteria in impact droplets is possible or existing streak canal infections and/or teat orifice colonies may be aspirated into the teat cistern by the sudden vacuum change.

While on sabbatical leave in Ireland, two experiments were conducted to investigate some of the characteristics of liner slip. In the first experiment, two liner styles from the United States were compared with European style liners, Table 1.

There was a significant difference in milking time between European and U.S. liners with the U.S. style taking longer to milk. The U.S. liners, however, had higher yields. It is not claimed that higher yield would result in a higher lactation yield. The results are summarized in Table 1.

TABLE 1. Liner Performance

Liner Type	Milking[a] Time	Milk[a] Yield	Slips 35-90 1/min	Slips 90 1/min	Fall off	Push ups
Irish	100.0	100.0	44.0	10.8	0.0	0.6
USA #1	107.9	101.9	92.0	62.5	0.0	5.9
USA #2	103.6	103.3	149.0	72.4	0.0	1.9
English	100.9	100.9	31.0	17.6	0.0	0.0
LSD*	3.5	1.78	56.3	39.9	0.0	2.4

(P = 0.05)

[a] Control liner = 100 percent

Claw weight and cluster weights are shown in Table 2, the European style being noticeably heavier.

A second trial was conducted to determine the effect of vacuum reserve on liner slip. The control liner was compared to the U.S. liner that had the greatest tendency to slip in the previous trial.

LSD = Least Significant Difference

The two liners were tested at 120, 360, and 750 liters per minute reserve on the same milking system in a 6 x 2 Latin Square Design, Tables 3 and 4.

There was some effect upon liner slip with respect to reserve on the U.S. liner. There were significantly fewer slips when vacuum reserve was 750 1/min. compared to 120 1/min. at slip volume between 35 and 90 1/min. The major difference, however, was between liners, not reserve. In both trials there were more slips during the AM milkings than PM milkings. Some of this difference may be explained by the 8-16 hour milking interval but the cause of this condition is unknown.

TABLE 2. Claw and Cluster Weight.

Liner Type	Claw Weight (Kg)	Cluster Weight (Kg)
Irish	0.78	3.17
USA #1	0.76	2.16
USA #2	0.62	2.00
English	0.76	2.79

TABLE 3. Liner slips per 100 milkings @ 35-90 1/min slip volume.

Vacuum Reserve and Liner Slips				
Reserve	Irish Liner		U.S. Liner	
	AM	PM	AM	PM
120	5	50	295	165
360	36	12	298	52
750	20	17	168	108
LSD	140.1	105.4	140.1	105.4

TABLE 4. Liner slips per 100 milkings @ 90 1/min slip volume.

Vacuum Reserve and Liner Slips				
Reserve	Irish Liner		U.S. Liner	
	AM	PM	AM	PM
120	2	42.4	188	60.6
360	20	5.5	215	4.5
750	5	14.4	117	49.2
LSD	105.3	63.3	105.3	63.3

Conclusions

Liner slip appears to have an influence in the new infection rate. There are large differences among liners and their slip characteristics. Under the conditions of this trial, liners slipped more during AM milkings than PM milkings and U.S. liners tended to slip more than the European designs.

Recommendations

1. Select liners that have low slip characteristics. The two major design features that are related to liner slip appear to be rigidity of the mouthpiece and bore size. Narrow bore liners tend to slip more than medium bore liners.
2. Dry the cows teats before applying the machine. Wet teats and udders are conducive to increasing liner slip.
3. Pay particular attention to unit position for each individual cow. Good positioning aids in preventing slips. Use radial control arms (hose holders) in milking parlors and hose adjustors in stall barns.

References

1. Braund, D.G. and L.H. Schultz. 1963. Journal Dairy Science 46, 197. 2. Nyhan, J.F. and M.J. Cowig. 1968. Proc. Symposium on Machine Milking, National Institute for Research in Dairying, Shinfield Reading, England. p. 73. 3. O'Callaghan, E., J. O'Shea, W.J. Meany and C. Crowley. 1976. Effect of Milking Machine Vacuum Fluctuations and Liner Slip on Bovine Mastitis Infectivity. Irish J. Agri. Res. 15:401-417. 4. O'Callaghan, E. A Method of Measuring Inflation Slips. Unpublished. 5. O'Shea, J. Machine Milking and Mastitis. May, 1981. Irish Veterinary Journal, Dublin. pp. 93-99. 6. O'Shea, J., E. O'Callaghan and W.J. Meany. 1981. Incidence of New Infection in Dairy Cows subjected to Solenoid Induced Airblasts During Milking. Irish J. Agric. Res. 20:163-183. 7. O'Shea, J., E. O'Callaghan, W.J. Meany and C. Crowley. 1976. Effect of Combinations of Large and Small Irregular on Cyclic Vacuum Fluctuations in the Milking Machine on the Rate of New Udder Infection in Dairy Cows. Irish J. Agric. Res. 15:377-399. 8. Stanley, D.E., E.M. Kesler and A.H. Bortree. 1962. Journal Dairy Science 45, 1343. 9. Thiel, C.C., C.L. Cousins, D.R. Westgarth and F.K. Neave. 1972. The Influence of Some Physical Characteristics of the Milking Machine on the Rate of New Mastitis Infections. J. Dairy Res. 40:117. 10. Thiel, C.C., C.L. Thomas, D.R. Westgarth and B. Reiter. 1969. Impact Force as a Possible Cause of Mechanical Transfer of Bacteria to the Interior of the Cow's Teat. J. Dairy Res. 36:279. 11. Thompson, P.D., W.D. Schultze, J.N. Sauls and S.C. Arapis. 1978. Mastitis Infection from Abrupt Loss of Milking Vacuum. J. Dairy Sci. 61:344-351. 12. Whittlestone, W.G. and M.A.S. Jones. 1969. Contamination of the Bovine Streak Canal During Mechanical Milking. N. Z. Vet. J. 17:181. 13. Wilson, C.D. 1958. Vet. Record 70, 159. 14. Woolford, M.W., J.H. Williamson and D.S.M. Phillips. 1980. Aspects of Milking Machine Design Related to Intermammary Infection. Proc. International Workshop Machine Milking and Mastitis. Moorepark Research Centre. Ireland. p. 46.

Questions & Answers:

Question: Do you see as much difference in milk yield between liners in this country as you do in Europe?

Answer: I don't know because I don't have any data. Now you have to recognize also, those were short term trials. And I don"t believe they can be transposed to long term lactation effect. I think that when you see those kinds of differences with milk yield, and with milking time, we had better look pretty carefully at liner design at more than one condition, and that we really better start looking at some of these things because they do apparently have a rather significant impact.

Question: What is the role of the mouthpiece in slippage?

Answer: As I stated in the talk, I think that the mouthpiece construction and rigidity of the mouthpiece, is very important in slip. And that when that mouthpiece is very flabby and gives with vacuum changes, then I'm quite sure it does increase the frequency of slip. I don't know if there's any difference between air vents in short milk tube as reference to slip or not. They didn't make any of those tests in Ireland and that's the only place in the world that I know they're testing for slips. Most of their measurements had to do with, basically, configuration of the mouthpiece and the bore measurements were mostly the dimensions that were made, as opposed to how they were made. They didn't differentiate.

Question: Would you like to comment on flawless milkers?

Answer: I don't know that I can. I would comment in this direction. There are some studies to show that linerless milkers, if we could go back to that one, in fact do increase the infection rate over the conventional machine by about three fold. So we know for example, and other studies have shown, that we can increase the infection rate if there is a collapse, if there is an absence of pulsation. We know that much. Now as opposed to the type of claw, or clawless machines, and so forth, I don't have any idea what that might be. There is some data to show that, let us say, separation of each quarter of the quarter-type milkers, may be of some assistance in preventing cross infection. But I think the data would have to be gathered to see. Theoretically we could reduce cross infection by separating the claw. Whether it does or not, I don't know.

Question: Are there fewer infections with an individual tube?

Answer: I know one piece of research that showed that where there was an individual tube there were fewer infections. But that's only one and I get a little scared of that.

Question: Would you comment on alternating versus simultaneous pulsations?

Answer: The impact potential is the least on simultaneous pulsation because of the configuration of the liners being opened and closed at the same time. The impact effect is the least with simultaneous. If in altering, the alternation is out of sync, that is greater than 50-50, then the impact potential is minimized. In effect, with 50-50, alternating pulsation, you have at the same time the liner is closing on one side, it is opening on the other. You have a direct line back and forth between the two sides where you have energy being introduced in one side in a downer direction toward the claw piece, and upward energy as the liner is opening on the other side in direct opposition to each other. So therefore the impact potential is the very highest on the alternating 50-50. Field has done some considerable work on this in England, and his work shows this pretty clearly. So I don't normally recommend it. Let's take a couple of instances. If you have a 60-40 in the rear and a 50-50 in the front, that negates that. You're getting out of direct opposition to each other. If you have a 55-45, you're not alternating exactly opposite. It's just in the case of an exactly 50-50 alternating.