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Uses of PGF in Postpartum Period

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Postpartum Hormonal Treatment of Dairy Cows

There is increased interest among veterinarians and dairy producers in finding effective hormonal therapies for uterine infections in dairy cattle. Tests for detecting antibiotic residues in milk have become increasingly more sensitive and have raised concerns among producers and veterinarians that extra-label use of antibiotics for treatment of uterine infections may lead to violative antibiotic residues in bulk tank milk or in the carcass of cows sent to slaughter following therapy of individual cows.

Use of Luteolytic Prostaglandins in the Postpartum Cow

Luteolytic prostaglandins, either prostaglandin 2-alpha or its analogues (PGF), have been used in many trials to evaluate their potential value for improving the reproductive performance of dairy cows when treated within the first 40 days of the postpartum period. Three types of trials have been used to evaluate the comparative reproductive performance of cows treated in the postpartum period with PGF to untreated herdmates: 1) Whole herd trials in which cows were randomly selected from the whole herd regardless of peripartum disease for comparison of cows treated with PGF in the postpartum period to non-treated herdmates, 2) Trials in which cows which were selected because they were considered to be at high risk for uterine infections resulting from postpartum diseases such as retained fetal membranes or dystocia and were randomly assigned to postpartum PGF therapy or non-treated herdmates, and 3) Trials in which cows that had a normal peripartum were selected to evaluate the comparative benefits of postpartum PGF treatment. In a review of 13 papers, a comparison could be made in days open between 1690 cows treated with PGF in the postpartum period and 1625 untreated herdmates which were randomly selected from whole herd. In the whole herd trails, the average days open for untreated cows was 94.4 compared to 92.9 days for PGF treated cows (Table 1). The 1.5 day reduction in days open for cows treated with PGF seems too small of an economic advantage to routinely recommend treatment all postpartum cows with PGF. Since cows with peripartum disease seem more likely to benefit from PGF therapy, 8 trials were identified in which cows with an abnormal peripartum were selected for comparative study in which a comparison of days open between cows treated with PGF in the postpartum period was made with untreated herdmates with peripartum disease. Average days open for 523 cows treated with PGF was 112.7 days compared to 118.0 days for 450 untreated herdmates, an advantage of 5.3 fewer days for the treated cows (Table 2). A 5.3 day reduction in days open could economically justify the routine identification and treatment of cows with an abnormal peripartum. If additional days open have a cost of $2.50 per day open and the cost of PGF therapy is $2.50 per cow, there would be a 5:1 return on routine therapy of cows with peripartum disease. A $5 cost per treatment with PGF would still allow a 2.6:1 benefit. In contrast to the eight trials whihc compared days open for cows with abnormal peripartums, four papers compared the days open of cows with normal puerperums for 392 cows treated with PGF to 415 untreated herdmates. The average days open for the cows treated with PGF was 89.7 days compared to 87.7 days for the untreated herdmates. The days open for the cow with normal peurperum increased by an additional 2 days for the cows treated with PGF (Table 3). When the differences in average days open were examined by the three categories of cows treated in these trials, only routine treatment of cows with abnormal peripartums seems economically justifiable.

Using average days open to evaluate the benefits of routine treatment of cows with PGF in the postpartum period may not be the most effective method for determining response. When the change in days open for cows treated with PGF in the postpartum period is graphed against the days open for untreated herdmates by trial or herd, there appears to be an increasing advantage for treating cows with PGF as the days open increases for the herd (Figure 1). By plotting the change in days open for studies in which cows were treated with PGF against the days open for untreated herdmates in whole herd trials, the graph shows that herds with long days open appear to benefit the most from routine treatment of postpartum cows with PGF. When a comparison was made of the effect PGF treatment in the studies with days open for control cows was less than 100 days to studies in which days open was greater than 100 days, there is no advantage to postpartum PGF therapy. However, when a comparison was made of PGF treated cows for studies in which days open for untreated control cows was greater than a 100 days, there was a significant reduction of days open in the PGF treated cows (Table 4). Selection of herds for routine postpartum PGF therapy should began by evaluating days open for the herd and selecting potentail herds with days open greater than 100 days.

Days open for herds using artificial insemination is controlled by three factors; days in milk at first breeding, efficiency of heat detection, and herd fertility as measured by conception rate. If days open for the herd is to be reduced, one or more of these control factors must improve. If days open are reduced following PGF treatment of postpartum cows, it seems that an improvement in first service conception is most likely the control factor resulting in a improvement in days open. Twelve papers compare the effects on first service conception rate of PGF treatment in postpartum cows to untreated herdmates in whole herd trials. The average first service conception rate for 2205 cows treated with PGF in the postpartum period is 51.5% compared to 50.8% first service conception rate for 1800 untreated herdmates. The 0.6% advantage is not great enough to justify the routine use of PGF to improve first service conception rate (Table 5). Five papers report on the effect of PGF treatment on first service conception rate for cows which had an abnormal peripartum. The average first conception rate of 460 cows treated with PGF was 40.5% compared to 37.6% for 386 untreated herdmates, an increase in first service conception rate of 2.9% (Table 6). It is interesting to note that in the trials of MacMillan, 1987, the first service conception rate of treated and untreated cows in the whole herd trials was 64% compared to 49% for cows with an abnormal peripartum, but no difference in first service conception rate existed between cows treated with PGF and untreated herdmates (48.5% for PGF vs 48.9% for CTRL). Four papers compare the first service conception rate of cows with normal peripartums. The average first service conception rate of 907 cows treated with PGF was 52.9% compared to 55.2% for 787 untreated herdmates, a disadvantage of 2.3% in conception rate (Table 7). Overall, there was remarkably little difference in average first service conception rate between cows treated with PGF and untreated herdmates whether the comparison is made on a whole herd basis, cows with abnormal peripartums, or cows with normal peripartums. However, when the change in first service conception rate of cows treated with PGF in the postpartum period is graphed against the first service conception rate of untreated herdmates, the primary advantage of postpartum PGF treatment appears to occur in herds with a first service conception rate below the average first service conception rate of all cows in whole herd trials (Figure 2).

A question that frequently arises is the effect of ovarian status at the time of PGF treatment on the response in reproductive performance of cows to PGF treatment. Four papers have examined the effect of ovarian status at the time of treatment through determination of milk or serum progesterone concentration at the time of PGF treatment. Glavill and Dobson, 1991, looked at first service conception rate relative to milk progesterone levels of cows which were selected for peripartum conditions that were likely to adversely affect fertility. The four herds that were selected for the trial had excellent reproductive performance and, as might be expected, progesterone concentration in milk at the time PGF treatment had no effect on first service conception rate in these well managed herds. Etherington, et al., 1988, compared the reproductive performance of cows treated with cloprostenol (CLP) at either 26 days, 40 days, or both 26 and 40 days postpartum with untreated herdmates. Overall, there was a significant reduction in days open for cows treated with CLP at 26 days postpartum and a non-significant reduction when treated at 40 days postpartum. There was a significant improvement in first service conception rate for cows with any CLP treatment. For cows with low milk progesterone at 26 days postpartum, there appears to be a greater advantage to CLP treatment at 26 days than at 40 days but still an advantage at 40 days over no treatment. For cows with elevated milk progesterone, there appears to be an advantage to CLP treatment at 40 days postpartum (Table 8). In the trial by McClary, et al., 1989, there doesn't appear to be any effect of serum progesterone status of the cows at the time PGF treatment on subsequent reproductive performance of the cows (Table 9). In the trails of Young and Anderson, 1986, an advantage of PGF treatment was seen in an improvement in the first service conception rate of cows with low blood progesterone and no advantage in the first service conception rate of cows with elevated progesterone (Table 10). Interpretation of these studies is limited by the limited numbers of cows in these studies, the differences in experimental designs and differences in reporting results. The most pertinent interpretation is that reproductive performance had improved whether progesterone status was low or elevated and of particular interest was that even in cows with low progesterone concentrations at time of treatment, subsequent conception rate had improved. This implies that the mechanism of action for PGF treatment in the postpartum cow is not dependent upon luteolysis to improve subsequent reproductive performance. Bonnett, et al., 1990, evaluated the effects of PGF treatment at day 26 postpartum. PGF treatment at day 26 significantly reduced the number of cows with vaginal discharge and reduced the sized of the previously gravid uterine horn at day 40. PGF treatment at day 26 significanlty decreased the likelihood of isolation of Actinomyces pyogenes from endometrial biopies at day 40.

It is difficult to draw specific conclusions about optimal interval from calving to postpartum PGF therapy. There are few trials in which the interval from calving to PGF treatment was varied within herd and limited numbers of animals for within herd comparison. In the trial by Stevenson and Call, 1988, cows were treated with PGF at either 11-17, 18-25, 25-32, or 33-40 days in milk. The first service conception rate for cows with abnormal peripartum and these intervals was 30, 28, 19, and 15%, respectively, suggesting that there may be an advantage to earlier treatment.

There is limited evidence to suggest that there may be an advantage to treat cows with an abnormal peripartum twice with PGF at a two week interval. In a study of Archbald, et al., 1990 to evaluate the effect of postpartum PGF treatment at 14 days postpartum on cows having dystocia and/or retained fetal membranes, the days open for the PGF group of 115 cows was 137 days and 135 days for untreated herdmates. In a later study by Ricco, et al., 1994, selected by a similar criteria, the first service conception rate for 116 cows treated twice with PGF at 12 and 26 days in milk was 43% compared to 24% for 113 abnormal untreated herdmates. Based on limited evidence, the potential of a relatively high benefit and the low cost of two vs one PGF treatment for cows experiencing an abnormal peurperum, it seems rational to recommend two PGF treatments at a two week interval for those cows at high risk of uterine disease.

Conclusions:

1. There appears to be no advantage to routinely treating postpartum cows with PGF in herds when days open are less than 100 days.

2. There is a potential reduction in days open through the routine treatment of postpartum cows with PGF when the days open for the untreated herd is greater than 100 days.

3. When there is a reduction in days open as a result of routine treatment of cows with PGF in the postpartum period, the reduction in days open is affected through an improvement in first service conception rate. There is no improvement in first service conception rate is greater than 50%. The potential advantage of routine treatment of postpartum cows with PGF is in herds where the normal first service conception rate is less than 50%.

4. Numerous factors affect first service conception rate including accuracy of heat detection, fertility of the semen used, technique of the inseminator, and factors affecting cow fertility including nutritional interactions with reproduction. Any one of these factors can become a limitation to first service conception rate and prevent the potential positive impact routine postpartum PGF therapy may have on first service conception rate.

5. In addition to the potential value that routine postpartum PGF treatment may have on reproductive performance in selected herds, PGF treatment of cows with peripartum health disorders including retained fetal membranes and/or dystocia is likely to benefit the reproductive performance of these cows.

6. One study showed a significant reduction in the isolation of Actinomyces pyogenes from the uterus of cows treated with PGF at 26 days postpartum compared to non-treated herdmates when evaluated at 40 days postpartum.

Suggested guidelines for postpartum treatment with PGF

1. Herds should be initially selected based on excessively high days open. Herds which have average days open of greater than 100 days are more likely to benefit from postpartum PGF therapy. The greater days open for the herd, the greater the potential benefit of routine administration of PGF in the postpartum period.

2. The first service conception rate of herds in which average days open are greater than 100 should be evaluated. To get economical response to routine treatment of postpartum cows with PGF, first service conception must improve by roughly 10 percentage points. This means that the herds that are most likely to get an economical response must have first service conception rates of less than 40%.

3. If a program is implemented to routinely treat postpartum cows with PGF, appropriate methods should be implemented to monitor and evaluate the effect of the program on reproductive performance of the herd.

4. Separate from and in addition to the potential role of routine PGF treatment of postpartum cows, is the use of PGF treatment for cows with peripartum health disorders. Theses cows should be identified and treated twice with PGF at a two week interval with the first treatment at 14 to 28 days in milk.

Table 1. Comparison of Days Open for Untreated and PGF Treated Cows in Whole Herd Trials

	PGF Group		Ctrl Group		Ctrl Minus PGF
	Days Open	No of Cows	Days Open	No of Cows	
Armstrong, 1989	85	84	75	103	-10
Benmrad, 1986	86	44	115	52	29
Etherington, 1984	109.9	76	121.2	79	11.3
Etherington, 1988	120.6	45	149.8	36	29.2
Etherington, 1994	110.4	137	137.2	43	26.8
MacMillan, 1987	87.4	305	89.2	305	1.8
McClary, 1989	98.6	61	118.8	70	20.2
Mortimer, 1984	78.3	263	77.1	253	-1.2
Morton, 1992	88	178	88.5	178	0.5
Stevenson, 1988	112.6	211	102	218	-10.6
White, 1990	79.9	148	81.7	150	1.8
Young, 1984	96	74	103	74	7
Young, 1986	87	64	93	64	6
Weighted Average	**92.9**	1690	**94.4**	1625	**1.5**

Table 2. Comparison of Days Open for Untreated and PGF Treated Cows with Abnormal Peripartum

	PGF Group		Ctrl Group		Ctrl Minus PGF
	Days Open	No of Cows	Days Open	No of Cows	
Archbald, 1990	138	98	136	101	-2
Benmrad, 1986	90	19	133	29	43
Glanvill, 1991	103.4	90	104.8	90	1.4
McClary, 1989	97	6	133	6	36
Ricco, 1994	112	116	120	113	8
Steffan, 1984	123	47	147	21	24
Stevenson, 1988	119	97	112	36	-7
White, 1990	69.6	50	85.3	54	15.7
Weighted Average	**112.7**	523	118.0	450	**5.3**

Table 3. Comparison of Days Open for Untreated and PGF Treated Cows with Normal Peripartum

	PGF Group		Ctrl Group		Ctrl Minus PGF
	Days Open	No of Cows	Days Open	No of Cows	
Lopez-Gatius, 1989	82.4	142	86	140	3.6
MacMillan, 1987	83	25	97	29	14
Stevenson, 1988	102	127	92	150	-10
White, 1990	85.1	98	79.6	96	-5.5
Weighted Average	**89.7**	392	**87.7**	415	**-2.0**

Table 4. Comparison of Effect of PGF Treatment on Days Open for Studies with Days Open Above or Below Mean of 22 Studies

	Ave of Low 50%	Ave of High 50%	Average
Ctrl	85.4	116.7[a]	101.0
PGF	85.6	109.1[b]	97.4
Difference	-0.2	7.6	

ab $P < 0.06$

Table 5. Comparison of First Conception Rate for Untreated and PGF Treated Cows in Whole Herd Trials

	PGF Group		Ctrl Group		PGF Minus Ctrl
	Conc Rate	No of Cows	Conc Rate	No of Cows	
Armstrong, 1989	45.6	101	35	83	10.6
Benmrad, 1986	42	55	29	58	13
Etherington, 1988	43.9	123	18.4	38	25.5
Etherington, 1994	45.3	170	32.7	49	12.6
MacMillan, 1987	63.6	324	64.1	359	-0.5
McClary, 1989	41.3	80	35.7	84	5.6
Morton, 1992	52.6	196	56.1	196	3.55
Stevenson, 1988	35.3	405	42	218	-6.7
White, 1990	62.9	170	62.5	148	0.4
Young & others, 1984	55.4	74	47.3	74	8.1
Young & others, 1986	68.8	64	43.8	64	25
Young, 1989	63.3	185	45.3	184	18
Young, 1989	53.2	109	54.2	92	-1
Young, 1989	55.6	149	64.7	143	-9.1
Weighted Average	**51.5**	2205	**50.8**	1800	**0.6**

Table 6. Comparison of First Service Conception Rate of Untreated and PGF Treated Cows with Abnormal Peripartum

	PGF Group		Ctrl Group		Ctrl Minus PGF
	Conc Rate	No of Cows	Conc Rate	No of Cows	
Glanvill, 1991	41	90	40	36	1
MacMillan, 1987	48.5	165	48.9	141	-0.4
Ricco, 1994	43	73	24	72	19
Stevenson, 1988	23.4	128	15	52	7.8
White, 1990	61.2	31	48.4	31	12.8
Weighted Average	**40.5**	490	37.6	386	**2.9**

Table 7. Comparison of First Service Conception Rate of Untreated and PGF Treated Cows with Normal Peripartum

	PGF Group		Ctrl Group		Ctrl Minus PGF
	Conc Rate	No of Cows	Conc Rate	No of Cows	
Lopez-Gatius, 1989	49.2	124	47.3	131	1.9
MacMillan, 1987	58.7	424	58.1	408	0.6
Stevenson, 1988	40.8	277	45.8	166	-5
White, 1990	69.5	82	72	82	2.5
Weighted Average	**52.9**	907	**55.2**	787	-2.3

Table 8. The Relationship of Milk Progesterone Concentration at Day 26 on Days Open

		Treatment			
	Day 26	Placebo	Clp	Placebo	Clp
	Day 40	Placebo	Placebo	Clp	Clp
Days Open, All Cows		149.8 (n=30)	120.6 (n=35)	123.4 (n=31)	114.2 (n=32)
Days Open, P4 > 1 ng/ml		143 (n=14)	137 (n=13)	119 (n=14)	104 (n=23)
Days Open, P4 < 1 ng/ml		155 (n=16)	113 (n=22)	127 (n=17)	140 (n=9)

Etherington, et al., 1988.

Table 9. The Relationship of Serum Progesterone Concentration at Day 14 to 16 to Reproductive Parameters (PGF Treatment at Day 14 to 16)

	Low Progesterone	High Progesterone
	P4 < 1 ng/ml	P4 > 1 ng/ml
Days to First Service	70.8	78.1
Days Open	98.4	100.3
Services per Pregnancy	1.67	1.50

McClary, et al., 1989.

Table 10. The Relationship between Blood Progesterone Concentration at Days 14 to 28 to First Service Conception (PGF Treatment 14 to 28 DIM)

	P4 < 0.5 ng/ml	P4 > 0.5 ng/ml
PGF Group	64%	56%
Ctrl Group	44%	55%

Young and Anderson, 1986.

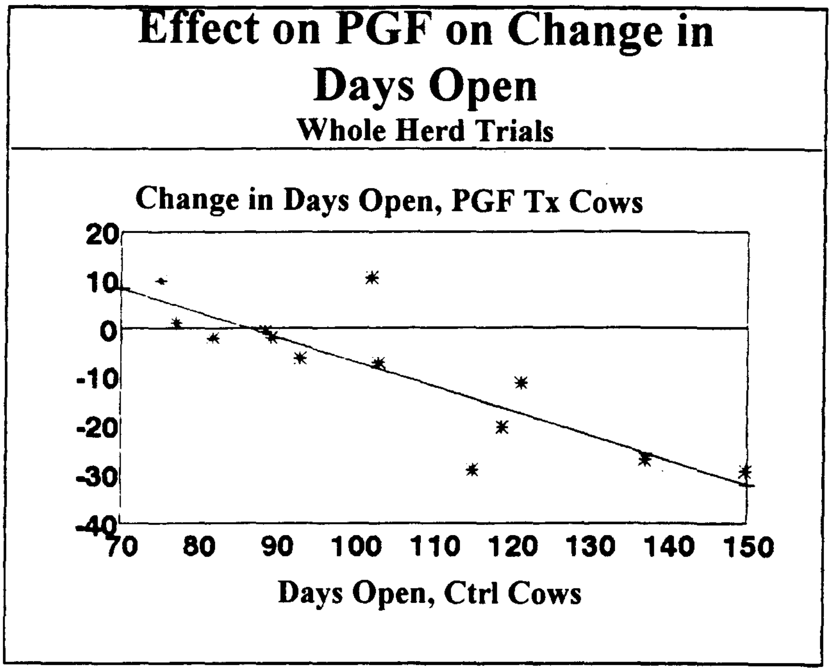

Figure 1

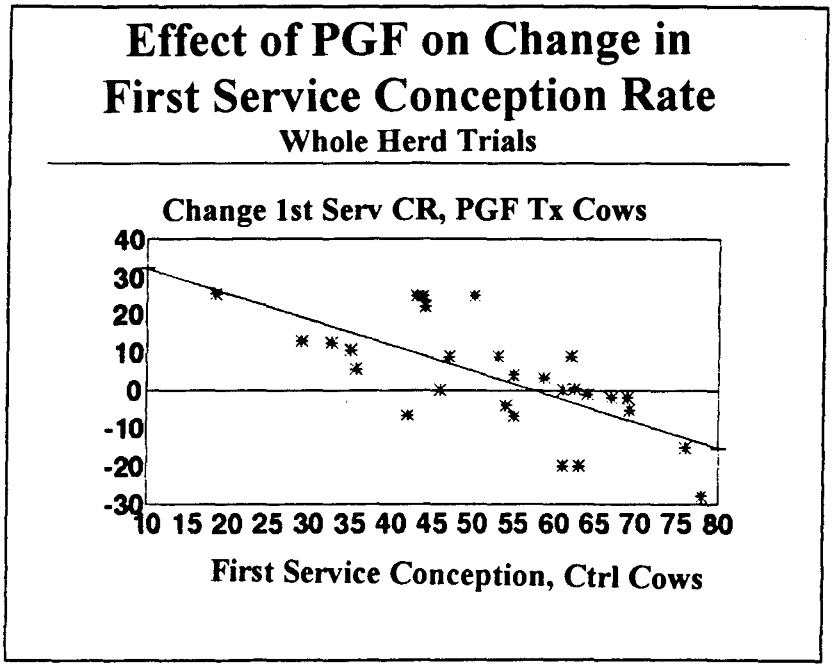

Figure 2

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