EFFECT OF BAROMETRIC PRESSURE ON GESTATION LENGTH IN COWS

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SUMMARY

In an effort to determine the effects of barometric pressure on the length of gestation in cattle, two sets of data on calving dates with their corresponding barometric pressure readings were evaluated statistically. The first set of data were from three herds (367 calves), and were collected for two different periods — fall of 1979 and spring of 1980. Chi-square was used to test for significance. Result indicated that there was no significant difference between the rate of parturition in cattle and changes in barometric pressure ($\chi^2 = 7.331$, $df = 2$, $P = 0.05$). The second set of data were on the length of gestation for two herds (94 calves) of different breeds. The cows were artificially inseminated.

Multiple regression was performed between (Y variables) the deviation of each gestation length from 283 days i.e. the average gestation length of cattle and $\times$ variables, the average barometric pressures during four six-hour periods on days of parturition and for three days prepartum (1:00 — 6:00 a.m. day of birth; 6:00 — 12:00 p.m. DB; 12:00 — 6:00 p.m. DB; 6:00 — 12:00 a.m. DB; 6:00 — 12:00 a.m. D₃).

INTRODUCTION

It is widely believed (Dvorak, 1978) that parturition might be influenced in part by prevailing weather conditions. Dvorak (1978) reported that fewer calvings were observed on days when warm front was approaching and barometric pressure was falling.

Parturition induction may result in several advantages (Wagner *et al.* 1974). It allows for more efficient use of labor, since calves born in predetermined groups show more uniform calf sizes and ages at weaning. Calf losses may also be reduced because it is possible to have adequate assistance available during the restricted calving time. Also, the possible reduction of calf birth weight will depend on the timing of parturition (Wagner *et al.* 1974).

The present study was undertaken to determine whether changes in barometric pressure affect the gestation length of cows and, if so, to determine during what periods prepartum, the changes in pressure have their effect.

The result revealed significant dif-

ference for the period 6.00 a.m. on day of birth (DB) and for the periods 6.00 p.m. DI, 6.00 a.m. D₂ prepartum ($P = .01$).

MATERIALS AND METHODS

Two sets of data on parturition dates and barometric pressure readings for the days of parturition and three days prepartum were collected and analyzed statistically. The first set of data was on the parturition dates of three herds (367 calves) of different breeds (Holstein, Angus, Simmental, Charolais and Hereford) for two different periods — fall, 1979 and spring, 1980 which were collected from Kansas State Experiment Station. Barometric pressure readings for the parturition dates were collected from the National Oceanic and Atmospheric Administration, collected at the Russell Weather Station, Russell, Kansas, USA.

The gestation lengths were not considered because the breeding dates were unknown for some cows.

The barometric pressure readings were categorized into rising, steady and falling (Table 1) using arbitrarily set up criteria:-

1. A .01mm/Hg rise in barometric pressure above 30.0 altimeter reading for consecutive six-hour period was considered as a rise.
2. A fall below 29.99 altimeter reading for a consecutive six-hour period was considered as a fall.
3. A steady barometric pressure or a slight fluctuation in barometric pressure reading but not as much as .06mm/Hg at a time was considered as a steady.

These criteria were set up because no work has been done to establish the minimum change in barometric pressure a cow would perceive. The number of calves born at each period of barometric reading (Falling, rising and steady) were

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calculated as percentages of total number of calves. These were the observed frequencies (Table 1). The expected frequencies were obtained by calculating the number of days with rising, falling and steady barometric pressure as a percentage of the total number of days (Table 1). A Chi-square test as described by Dokal and Rohlf (1973) was performed on the data.

The second set of data were on breeding and calving dates of two herds of cattle (94 calves) of different breeds — (Holstein, Angus, Simmental, Charolais and Hereford) collected from Fort Hays State University Farm and from the Kansas State University Experiment Station at Hays, Kansas. All the cows were artificially inseminated so, the breeding and birth dates of the calves were known and their gestation lengths could be calculated. The deviation of each gesta-

tion length from the expected (283 days) gestation length of cattle were calculated as (Y) variable. The (X) variable was calculated by averaging four six-hour periods of barometric pressure readings for the days of parturition and three days prepartum — 1:00 a.m. — 6:00 a.m., DB; 6:00 a.m. — 12:00 noon, DB; 12:00 noon — 6:00 p.m., DB; 6:00 p.m. — 12:00 midnight, DB; — 6:00 p.m. — 12:00 midnight, D₃.

Multiple regression was performed between the variables (X) and (Y) (Table II). With the means obtained by averaging for six-hour periods for the calving day and three days prepartum, a graph (Fig. 1) was plotted to show the barometric pressure pattern relative to the time of parturition.

TABLE 1

Table for the Percentage Observed and Expected Frequencies on the days of Falling, Rising, and Steady Barometric Pressure

Category	Steady	Falling	Rising
Observed %	12.8	50.5	26.7
Expected %	22.9	43.05	34.05

Significant at P .1

$\chi^2 = 5.945$

df = 2

TABLE 2

Anova Table — Devuatuib Vs. Actual Reading

Source	DF	SS	F Value	PRF
6 A.M. DB	1	228.00304981	17.29	0.0001
12 A.M. DB	1	3.58210778	0.27	0.6037
6 P.M. DB	1	17.20006680	1.30	0.2570
12 NOON DB	1	29.09095566	2.21	0.1416
6 A.M. D ₁	1	64.68302067	4.91	0.0298
12 A.M. D ₁	1	23.70846820	1.80	0.1039
6 P.M. D ₁	1	197.45359189	14.28	0.0002
12 P.M. D ₁	1	11.70222332	0.89	0.3491
6 A.M. D ₂	1	142.95222089	10.84	0.0015
12 A.M. D ₂	1	7.51790249	0.57	0.4525
6 P.M. D ₂	1	45.07394951	3.42	0.0684
12 P.M. D ₂	1	44.33050936	3.36	0.0706
6 A.M. D ₃	1	9.42321959	0.71	0.4005
12 A.M. D ₃	1	83.98844423	6.37	0.0137
6 P.M. D ₃	1	20.95231986	1.59	0.2113
12 P.M. D ₃	1	8.80882856	0.67	0.4163

(R²) = .4836

RESULTS

The observed and the expected frequencies of the first data, showing days with falling, rising and steady barometric pressure are shown in (Table 1). Chi-square analysis of the data showed no significant difference between the frequencies of parturition in cattle and change in barometric pressure ($\chi^2 = 7.33$, $df = 2$, $P = .05$) (Table 1).

Application of multiple regression analysis on the second data, to determine the critical periods at which barometric pressure effects are significant pre-partum showed that 6:00 p.m. first day and 6:00 a.m. second day pre-partum were significant ($P = .01$); and also 12:00 a.m. third day pre-partum was significant ($P = .05$). The coefficient of determination (R^2) = 0.484, (Table II).

DISCUSSION

The result of the Chi-square on the first set of data showed no significant difference between the frequencies of parturition in cattle and change in barometric pressure. On analysing the second set of data, using a multiple regression to determine the critical periods at which barometric pressure effects are significant pre-partum (Table II), showed a positive relationship between a change in barometric pressure and deviation from gestation length. This means that as the barometric pressure changes, the chance that a cow will calve before or after the 283 days gestation length increases. This

result agrees with the work by Dvorak (12978) which suggests that a change in barometric pressure may stress a dam sufficiently to stimulate corticoid secretion to a level that triggers the initiation of parturition and also Sommer (1965), observed that fewer calvings were observed on days when a warm front was approaching, and a barometric pressure was rising. Armstrong and Heim (1938) suggested that chronic fatigue of pilots exposed to high altitudes might be due to depletion of adrenal cortex hormones. Van Lier (1942) found that human exposure to low barometric pressure increases urine volume, and it has been shown that certain corticosteroids exhibit diuretic properties. Also Pincus and Hogland (1943) demonstrated that increasing levels of stress elicited elevated levels of diuresis and corticosteroid secretion.

Induced parturition seems to have drawn particular interests in the cattle industry, both dairy and beef. Adams and Wagner (1970) defined a successful induction with corticoids as having occurred within 72 hours post-injection. Parturition induction may result in several advantages (Wagner *et al.* 1974). It allows for more efficient use of labor, since that calves born in predetermined groups show a more uniform calf sizes and ages at weaning. Calf losses may also be reduced because it is possible to have adequate assistance available during the restricted calving time.

It is logical to approach parturition as a

TABLE 3
Anova Table — Deviations Vs. Differences

Source	DF	SS	F. Value	PR F
1 — 6 DB	1	43.35267451	2.43	0.1231
6 — 12 DB	1	16.42413537	0.92	0.3404
12 — 6 DB	1	25.32448065	1.42	0.2372
1 — 6 D ₁	1	129.03979564	7.23	0.0087
6 — 12 D ₁	1	0.35969944	0.02	0.8875
12 — 6 D ₁	1	4.88529108	0.27	0.6024
1 — 6 D ₂	1	244.85840754	13.71	0.0004
6 — 12 D ₂	1	17.69385841	0.99	0.3225
12 — 6 D ₂	1	1.14891941	0.06	0.8004
1 — 6 D ₃	1	22.15574288	1.24	0.2687
6 — 12 D ₃	1	67.09349979	3.76	0.0561
12 — 6 D ₃	1	5.22876741	0.29	0.5899

(R^2) = 0.2853

FIG. 2. BAROMETRIC PRESSURE PATTERN RELATIVE TO THE TIME OF PARTURITION.

phenomenon involving many forces but perhaps, dominated by hormones. The rising level of estrogen during pregnancy causes growth of the myometrium, synthesis of actomyosin and consequently an increase in the contractile capacity of the uterus (McDonald, 1971). According to current views on the subject, (Loss and Dufty, 1980) the onset of parturition is brought about by an increase in glucocorticoid levels; this activates enzymes responsible for the synthesis and release of prostaglandin which promotes luteolysis and decrease in progesterone levels as well as an increase in uterine tone and contractility.

The graph (Fig. 2) on the barometric pressure pattern of parturition from three days pre-partum to the day of parturition is similar to that by Dvorak (1978) and agreed with the work reported by Sommer (1965) in which the greatest proportion of calvings over a 14 — year period occurred after the passage of warm fronts.

Therefore, if the pregnant cows respond to stress in the same way as humans,

exposure to decreasing atmospheric pressure may produce a stress capable of stimulating a delayed response of additional corticoid secretion that mimics the role of fetal corticoids in initiating parturition. This supports the work by Kessler (1979) that a change in weather starts labour in gestating cows.

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