206. Marchant, J.N. and Broom, D.M. 1995. Basal heart rate of group-housed sows in relation to stage of gestation. In: *Proc. 29th Int.Cong. Int. Soc.Appl.Ethol.* ed. S.M. Rutter, J. Rushen, H.D. Randle, and J.C. Eddison, 77-78. Potters Bar: Universities Federation for Animal Welfare.

Basal heart rate of group-housed sows in relation to stage of gestation

J.N.Marchant, D.M.Broom

Department of Clinical Veterinary Medicine, University of Cambridge, Madingley Road, Cambridge CB3 0ES, United Kingdom

Introduction

Heart rate has been acknowledged as a useful indicator of an animal's internal physiological state (Fraser and Broom, 1990) and has been widely used in studies on a number of species. Heart rate is affected by posture, locomotion, individual identity and seasonality. In sheep and deer, the seasonal effects on heart rate have been attributed to the seasonal changes seen in food intake (Kay, 1979) and basal metabolic rate (Blaxter and Boyne, 1982). The majority of breeding sows, however, are housed indoors and protected from environmental extremes. Most are fed a restricted diet with changes in food intake dependent on stage of gestation and lactation. The aim of this experiment was to determine the effect of stage of gestation on the basal heart rate of sows.

Animals, materials and methods

The heart rates of 6 LW x Landrace sows, of similar age and parity and housed in a group of 37 sows in a single pen (16.5m x 5.5m), were monitored using a Polar Sport Tester™. The pen was divided into a strawed lying area and a dunging area, part of which was occupied by an Electronic Sow Feeder system. The feeding cycle started daily at 1500hrs and all sows were fed between 2.2kg and 4kg per day, depending on stage of gestation. Water was available *ad libitum*. The housing system was thermostatically ventilated by two fans and was lit both by natural daylight and artificial lighting with lights switched on at 0600hrs and off at 2200hrs, ensuring similar daily temperature and daylength throughout the period of study.

The heart rate monitor consisted of an electrode belt, a clip-on transmitter and a wrist-watch receiver with data memory function. ECG Gel was applied to the electrode surfaces and the belt was placed around the thorax of the sow, caudal to the forelimbs. The signal was tested and the receiver was then fastened around the belt and activated to start recording. After completion of data collection, the receiver was downloaded via a Polar Interface and the data were displayed using Polar Heart Rate Analysis Software - Version 4.00.

Each sow was monitored on five occasions (days i-v) at intervals of approximately 20 days over four consecutive months. Heart rate and behaviour were measured continuously between 0900 hrs and 1140 hrs, the period during which sows were least active. From the behavioural data, the periods of lying with eyes closed, which equated to basal heart rate, were marked on the resulting heart rate graphs. The corresponding numerical data were then analysed to give a daily mean basal heart rate from 3 x 10 minute periods for each sow on each day.

Results

Individually, the sows showed an increasing basal heart rate as gestation progressed towards full term (see Table 1). The rate of increase also became greater as pregnancy progressed but total basal heart rate change over gestation was not correlated with litter size. When stage of gestation and basal heart rate were correlated for individual sows, the best fit was obtained using second order polynomial regression. For three sows, the line of best fit was significant and for the other three, the line of best fit tended towards significance.

Table 1. Basal heart rate (beats per minute) and stage of gestation (days after service) for individual sows on five separate days.

Day	Sow A	Sow B	Sow C	Sow D	Sow E	Sow F
Day (i)	54.3	52.5	44.6	48.7	50.0	48.7
Day (ii)	57.2	53.8	40.3	43.5	55.4	55.1
Day (iii)	72.5	58.2	45.4	50.4	56.4	60.4
Day (iv)	76.6	67.4	50.7	59.9	59.6	66.6
Day (v)	78.0	71.7	54.0	68.7	66.8	70.4

When all data points are included, the line of best fit is again second order polynomial (see Figure 1). From the equation, the average minimum and maximum heart rates are 48.8 bpm and 70.1 bpm respectively. This represents a basal heart rate increase of 21.3 bpm or 43.6% over pregnancy from the start of gestation.

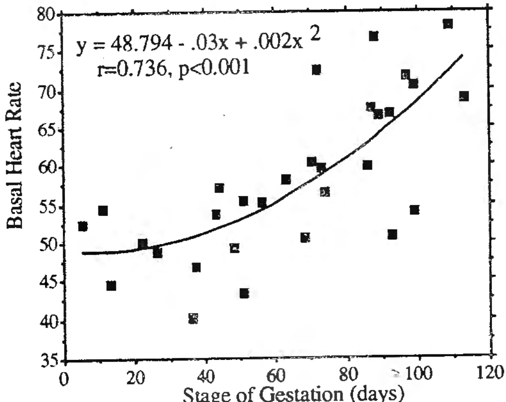

Figure 1. Graph showing correlation between basal heart rate and stage of gestation.

Discussion and Conclusions

The results indicate that basal heart rate increases as gestation progresses for all sows, but the amount of increase depends on the individual identity rather than the potential litter size. The results also demonstrate that the increase is not constant, and that the rate of increase rises towards the last third of gestation. This is expected, because it is during the last third of pregnancy that the fœtal growth rate and oxygen demand are maximal, and hence, uterine blood flow is maximal. It is also possible that basal heart rate of sows continues to rise after parturition, as shown in sheep (Baldock *et al.*, 1988), when metabolic demands of lactation are considerable and feed intake is maximal. This effect of stage of gestation on heart rate is likely to be a major factor in the seasonal variation reported in sheep (Baldock *et al.*, 1988) and red deer (Price *et al.*, 1993). Both these species are seasonally polyoestrus and the results presented here suggest that the effects of stage of gestation, may have been underestimated.

The results demonstrate that the basal heart rate of sows is greatly affected by stage of gestation. It is likely that the basal heart rate of other animals will similarly be affected by stage of gestation and thus, for experiments studying the heart rate of pregnant animals to be valid, it is very important to match experimental treatments for stage of gestation. Any bias towards early or late gestation will have a major influence on results, both in terms of absolute values obtained, and also in their interpretation.

Acknowledgements

This study was funded by the UK Ministry of Agriculture, Fisheries and Food.

References

Baldock, N.M. Sibly, R.M., Penning, P.D., 1988. Behaviour and seasonal variation in heart rate in domestic sheep (Ovis aries). Anim. Behav., 36: 35-43.

Blaxter, K.L., Boyne, A.W., 1982. Fasting and maintenance metabolism in sheep. J. Agric. Sci., Camb., 99: 611-620.

Fraser, A.F., Broom, D.M., 1990. Farm Animal Behaviour and Welfare. Bailiére Tindall: London.

Kay, R.N.B., 1979 Seasonal changes of appetite in deer and sheep. A.R.C. Research Review, 5: 13-15.

Price, S., Sibly, R.M., Davies, M.H., 1993. Effects of behaviour and handling on heart rate of farmed deer. Appl. Anim. Behav. Sci., 37: 111-123.