Concentrations of PGF and progesterone in utero-ovarian venous plasma and of progesterone in peripheral plasma were studied in 3 sows during the late luteal phase of the oestrous cycle. Blood samples were collected at 3 hourly intervals. At about the time of decreasing progesterone concentration, peaks of PGF of up to 6 ng/ml were evident in the utero-ovarian venous plasma.

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Exogenous prostaglandin F (PGF) has been shown to be luteolytic in the sheep (5) and the cow (6). The changes in concentration of endogenous PGF in the utero-ovarian venous plasma during the oestrous cycle has been described in the sheep (2,3) and, at least for part of the oestrous cycle, in the cow (4). These data indicate that there is an apparent relationship between luteal regression and the presence of PGF in the utero-ovarian plasma. In these species, and also in the sow, the uterus plays a regulatory role in normal ovarian activity (1). No data are available relating the presence of PGF in utero-ovarian plasma to luteal regression in the sow.

The present study was undertaken to determine the presence or otherwise of PGF in the utero-ovarian venous plasma of the cyclic sow at about the time of luteal regression. A brief summary of this study has been reported elsewhere (7).

MATERIALS AND METHODS

General: The animals used in this study were 4 mature Large White Landrace cross sows which were checked daily with a vasectomized boar to determine the occurrence of oestrus. The first day of oestrus, Day 0, was defined as the day on which the sow would first stand for mating. Two consecutive oestrous cycles of normal length, 19 to 22 days, were observed in each sow. Between the eighth and twelfth day of the third cycle, polyvinyl catheters (I.D. 1.0 mm) were inserted into a jugular vein and into the left and right utero-ovarian veins of each sow. Catheter insertion was carried out under general anaesthesia, induced and maintained with halothane. No plasma samples were collected from sow B due to failure to establish catheter patency.

Blood Collection: Commencing immediately after surgery and continuing for periods of up to 8 days, 8 ml blood samples were collected at 3 hourly intervals from the jugular and the left and right utero-ovarian veins of each of 3 sows. Subsequently, a number of blood samples were taken from an ear vein of each of 2 sows. All blood samples were collected into heparinised tubes, placed on ice, centrifuged at 4°C and the plasma stored at -10°C prior to analysis.

Hormone Analysis: The concentration of progesterone in each plasma sample was determined in duplicate using the competitive protein-binding assay of Thorburn and Schneider (8), with the modification that concentrations were corrected for an assay procedural loss of 15 percent. The within assay coefficient of variation of a total of 400 duplicate determinations varied between 9 and 20 percent over the range of concentrations measured. The between assay coefficient of variation of duplicate progesterone determinations of the same plasma sample in 21 assays was 7.0% (Mean ± S.E.M. 25.61 ± 0.38 ng/ml).

Duplicate determinations of prostaglandin F (PGF) were carried out on all utero-ovarian venous plasma samples by the radioimmunoassay technique of Cox, Schneider and Thorburn (9) of which some details have
been reported (3). This technique does not differentiate between PGF$_{1\alpha}$ and PGF$_{2\alpha}$. The assay solvent blank value and its standard deviation was 0.06 ± 0.03 ng (n = 12). Peripheral plasma was collected on Day 9 of the oestrous cycle. The assay value of 0.5 ml aliquots of this plasma was 0.15 ± 0.07 ng (n = 21). Recovery rates of known amounts of PGF$_{2\alpha}$ added to similar 0.5 ml aliquots of this plasma were as follows: 1.25 ng added 0.86 ± 0.08 ng recovered (n = 6) and 2.50 ng added 1.57 ± 0.19 ng recovered (n = 5). All reported concentrations of PGF were corrected for the solvent blank value (0.06 ng) and for the assay recovery rate of 65 percent. Duplicate prostaglandin concentrations were grouped according to the prostaglandin concentration (ng/ml) as follows: > 0.1 < 1.0, > 1.0 < 3.0, > 3.0 < 5.0 and > 5.0. The within assay coefficients of variation and the numbers of duplicates within each of these groups were 45%, n = 54; 15%, n = 11; 21%, n = 7 and 17%, n = 5. The between assay coefficient of variation of duplicate PGF determinations of the same plasma sample in 5 assays was 18 percent. (Mean ± S.E.M. 1.98 ± 0.16 ng/ml).

RESULTS

Data representing concentrations of progesterone and PGF in the utero-ovarian plasma and of progesterone in peripheral plasma of each sow are presented in Figs. 1, 2 and 3.

The concentration of progesterone in the peripheral plasma of sow A (Fig.1) varied between 17 and 47 ng/ml between Days 8 and 13 of the oestrous cycle, the mean value over this period being 26.7 ng/ml. From about Day 13, the progesterone concentration declined in a step-wise fashion reaching approximately 2 ng/ml by the end of Day 15. Although showing large fluctuations, the progesterone concentration in the utero-ovarian venous plasma began to fall on Day 13 from maximum levels of 600-750 ng/ml. Over a two day period, utero-ovarian progesterone concentrations fell to below 50 ng/ml in either left or right utero-ovarian venous plasma. Transient peaks in PGF concentration, ranging from 1 to 6 ng/ml, were evident in plasma collected from the left utero-ovarian vein of sow A from about Day 11 to Day 15.

The progesterone concentrations in the peripheral plasma of sow C (Fig.2) were slightly lower than those in sow A and did not commence to decline until Day 17. Nevertheless, as in sow A, the step-wise decline in progesterone concentrations to below 2 ng/ml proceeded over a 2-3 day period. Utero-ovarian progesterone concentrations were lower and showed greater fluctuations than in sow A. Peaks in PGF concentration were not detected in the left utero-ovarian venous plasma of sow C prior to Day 18. On the right side, a relatively large peak of PGF, exceeding 5 ng/ml, was detected on Day 13. Thereafter peaks were evident until Day 18 when the catheter patency failed.

No peripheral plasma samples were obtained from sow D (Fig. 3). Progesterone concentrations in the utero-ovarian venous plasma were similar to those in the other two sows and, at least on the left side, reached a low level by Day 15 apart from a few brief surges on Days 15 and 16. Small peaks in PGF concentration were evident on Days 15, 16 and 17 in the left utero-ovarian venous plasma and on Days 13, 14 and 15 on the right side.
Fig. 1. Concentrations of prostaglandin F in utero-ovarian venous plasma \( (\Delta - - - \Delta) \) and of progesterone in utero-ovarian plasma \( (O---O) \) and in peripheral plasma \( (\bullet - - - \bullet) \) of sow A during the late luteal phase of the oestrous cycle. First day of oestrus = Day 0. Concentrations of progesterone in utero-ovarian venous plasma do not exceed 800 ng/ml plasma.
Fig. 2. Concentrations of prostaglandin F in utero-ovarian venous plasma (Δ---Δ) and of progesterone in utero-ovarian plasma (0---0) and in peripheral plasma (●●●●) of sow C during the late luteal phase of the oestrous cycle. First day of oestrus = Day 0.
Fig. 3 Concentrations of prostaglandin F in utero-ovarian venous plasma (Δ -- Δ) and of progesterone in utero-ovarian venous plasma (o--o) of sow D during the late luteal phase of the oestrous cycle. First day of oestrous = Day 0.
At the time of catheter insertion there were 8 and 11, 12 and 6, and 7 and 7 corpora lutea on the left and right ovaries of sows A, C and D respectively. Oestrus did not occur in any of the sows for a three week period subsequent to catheter placement. At this time the ovaries were again examined and each sow appeared to be in an anoestrous state.

DISCUSSION

The hormonal assay procedures used in this study were found to be of sufficient accuracy and precision to determine the patterns of plasma progesterone and PGF concentrations during the oestrous cycle in the sow. The possibility of progestins other than progesterone being measured by the competitive protein-binding technique employed in this study has been excluded by the results of previous studies (10, 11).

The peripheral progesterone concentrations obtained in the present study, as well as the time taken for luteal regression, are in close agreement with previous observations (12, 13). These studies indicated that luteal regression is completed in the sow by Day 16 of the oestrous cycle, a situation that was evident in sows A and D. No explanation can be offered for the delay of total luteal regression until Day 19 in sow C. The great variability in progesterone concentration of utero-ovarian venous plasma evident both between sows and between the left and right veins of each sow may have been due to a number of factors as outlined by Thorburn et al. (14). It appears that frequent monitoring of peripheral levels of progesterone provides a more reliable indicator of luteal function than the measurement of either the total weight of luteal tissue, the progesterone concentration of luteal tissue (15) or the progesterone concentration of plasma collected from the utero-ovarian vein. While the progesterone concentrations of luteal tissue have been useful in previous studies, these take no account of changes in luteal tissue blood flow or of changes in the rate of release of progesterone from luteal tissue.

The results obtained from frequent samplings of utero-ovarian venous plasma in three sows show that PGF, of either uterine or ovarian origin, is present in the sow at about the time of luteal regression. Peak concentrations of PGF detected in the sow are of lower magnitude than those reported in the sheep (3) but exhibit a similar pulsatile pattern.

The finding that PGF is luteolytic in several species including the sheep (5) and cow (6) together with the present finding of PGF in the utero-ovarian venous plasma of sows suggest that PGF may also be luteolytic in this species. While, in each of the sows studied, PGF release was associated with luteal regression, there was considerable variation in the onset of PGF secretion in relation to the day of the oestrous cycle.

A comparison of the onset of PGF release with results of previous studies of the control of luteal function in the sow lends further support to the above hypothesis. Subsequent to Day 15-16 of the oestrous cycle a uterine luteolytic effect is either absent or is
ineffective (16, 17). Furthermore, filtered scrapings of uterine mucosa of gilts slaughtered on Days 12-13 of the cycle increased the in vitro synthesis of progesterone by luteal tissue whereas similar material taken on Days 16-18 of the cycle resulted in inhibitory action (18). These findings, together with the fact that either the presence of embryos in the uterus or the absence of the uterus caused increased concentrations of ovarian venous plasma progesterone as early as Day 14 when compared with the same day of the normal oestrous cycle (15), indicate that the uterine luteolytic factor is effective in the sow at about the stage of the cycle that PGF has been detected in utero-ovarian venous plasma.

While PGF has been shown to be present in the utero-ovarian venous plasma of the sow and its presence, at least temporarily, is associated with luteal regression, these observations do not define either the source of this PGF, the factors initiating its release or the possible interrelationships of PGF with hormones other than progesterone. Further experiments will be required to elucidate the pattern and function of PGF secretion during the oestrous cycle of the sow. The present findings require confirmation in sows which continue to exhibit normal ovarian cyclic activity.

REFERENCES


