OESTROGEN AND PROGESTERONE LEVELS IN THE BLOOD PLASMA OF COWS WITH NORMAL PARTURITION OR WITH A RETAINED PLACENTA

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According to Aehnelt (1960), retention of the placenta may be due to mechanical, infectious, nutritional or hormonal causes. Hormonal factors were found by McDonald, McNutt & Nichols (1954) to play an important rôle in the pathogenesis of retention of the placenta in cattle. Although these authors demonstrated that a relationship existed between progesterone and the incidence of retention, they did not report oestrogen and progesterone levels in the blood of the affected cows. It appeared pertinent, therefore, to determine oestrogen and progesterone levels in cows undergoing a normal parturition and puerperium and to compare these data with those obtained for cows in which the placenta was retained.

Blood samples (20 ml) were taken from the jugular veins of fifteen German black pied cows through a fixed plastic catheter twice daily at 06.00 and 18.00 hours from 3 days before until 1 day after parturition (Day 0 = day of parturition). The blood was collected in centrifuge tubes containing 0.2 ml of a 40% sodium citrate solution and was immediately centrifuged at 700 g. The plasma was stored at -20°C until it was used for oestrogen and progesterone determinations. All animals gave birth normally after physiological gestation periods ranging from 274 to 285 days. In eleven cows, the placenta was expelled within 6 hr of parturition (control group). In the remaining four animals, it was retained for more than 5 days.

Radioimmunoassay was applied for measuring unconjugated oestrogen and progesterone. For the determination of the immunoreactive oestrogens, rabbit antibodies against 17β -oestradiol-4-azo-BSA with equal binding affinity to both oestrone and oestradiol- 17β were used. No cross-reaction with oestradiol- 17α was observed (Agthe & Kolm, 1975). Progesterone determinations were carried out according to the method described by Abraham, Swerdloff, Tulchinsky & Odell (1971), using antibodies against progesterone-11-hemisuccinate-BSA. Celite column chromatography was, however, replaced by selective extraction by petroleum ether (b.p. 40 to 60°C) as suggested by Johansson (1970).

As shown in Text-fig. 1 the mean $\pm$ S.D. progesterone concentrations in the control group and in cows with a retained placenta continually decreased from Day -2 to $+1$ (4.1 ± 1.1 ng/ml to 0.7 ± 0.5 ng/ml and 3.7 ± 0.6 to 1.6 ± 0.3 ng/ml, respectively). Though the difference observed between the cows in the control

group and those with a retained placenta was relatively small, the decrease of progesterone concentration seemed to be more distinct in the control animals. During the last 3 days of pregnancy, the individual oestrogen levels in cows with

TEXT-FIG. 1. Progesterone concentrations in peripheral venous plasma around parturition in eleven control cows (—) and four cows each with a retained placenta (---). The points and vertical lines represent means $\pm$ S.D.

TEXT-FIG. 2. Oestrogen concentrations in peripheral venous plasma around parturition in eleven control cows (—) and four cows each with a retained placenta (---). The points and vertical lines represent means $\pm$ S.D.

normally expelled placentae showed no significant deviation from a plateau level. The plateaus were within the range of 1.2 to 4.8 ng/ml, due to significant variations between individual cows ($P < 0.001$). Oestrogen concentrations decreased significantly within 24 hr of parturition, until they reached approxi-

mately 0.25 ng/ml (Text-fig. 2). Animals with a retained placenta exhibited a marked increase of oestrogen levels within 12 hr before parturition, followed by a slower decrease during the 1st day *post partum*. In one cow, values were found to be about 2.5 ng/ml at 20 hr *post partum*.

The progesterone levels found in control cows were in good agreement with the results obtained by Hoffmann, Schams, Gimenez, Ender, Herrmann & Karg (1973), Smith, Edgerton, Hafs & Convey (1973) and Edqvist, Ekman, Gustafsson & Johansson (1973). These authors also noted a decrease in progesterone concentration about 2 days before parturition. The pattern described for oestrogen levels at the time of normal birth differs, however, from one investigator to another. Robertson (1974) described a continuous increase in the concentrations of oestrone and oestradiol-17 β up to parturition while Robinson, Anastassiadis & Common (1971) found a decrease in total oestrone from 1 to 5 days before parturition. These results agree with those obtained by Smith *et al.* (1973) who recognized a slight but significant decline in the levels of oestrone and oestradiol-17 β , starting about 2 days before parturition. By contrast, Hoffmann *et al.* (1973) and Edqvist *et al.* (1973) described oestrone and oestradiol-17 β concentrations at constant plateau levels during the last 3 days before birth, as in the present study.

For a further understanding of the rôle of hormones at birth, it is essential to differentiate between the effects of oestrogens and progesterone on the occurrence of a retained placenta and, conversely, the influence of retained fetal membranes on oestrogen and progesterone levels in the cow. From the studies of Ainsworth & Ryan (1966) and Pierrepont, Anderson, Griffiths & Turnbull (1969), it is evident that the fetal placenta is a source of oestrogen in cattle. This could explain the high oestrogen concentrations that we found in the cows with a retained placenta after parturition. The increased oestrogen levels before parturition, together with the reduced fall in the progesterone levels may be the cause of placental retention. It is interesting to note that in cows in which premature parturition was induced by injection of glucocorticoids, an increase in the oestrogen level was observed within 24 hr before parturition, accompanied by a high incidence of placental retention (Adams, 1969; Karg, Böhm, Günzler & Müller, 1971; Edqvist, Ekman, Gustafsson, Jacobsson, Johansson & Lindell, 1972; Agthe, Grunert, Fadle & Diez, 1973).

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